Technological Intensity, International Technology Transfer and Productivity in the Turkish Automotive Parts Industry

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To my family

Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Mehmet Cemil Simsek
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Abstract

This study investigates whether there are productivity effects through international technology transfer in the Turkish automotive parts industry. Being at sector level, previous studies cannot account for heterogeneities across sectors and within sectors. Before conducting this investigation, this study develops a more accurate measure of technological intensity for individual automotive parts, namely patent counts enabling identification of technological and economic characteristics of the industry. Focusing mainly on the motor vehicle assembly section of the industry, previous case studies have not thoroughly examined the automotive parts supply section. Hence, this study does not only enhance the understanding of both motor vehicle assembly and automotive parts supply sections of the industry, but it also provides insights into technological and economic relations of the global automotive industry with a developing economy.

This study reveals first that the Turkish automotive industry is a motor vehicle assembly hub integrated well with the European automotive value chain. Second, higher the technological intensity of an automotive part, greater the import of that automotive part becomes, whereas smaller the export of that automotive part becomes in Turkey during 2002-2013. On the other hand, there is not clear technological intensity concentration on automotive parts produced in Turkey during 2005-2012, to some extent, reflecting the recent R&D efforts pursued by the industry to build up technological capability. Third, automotive parts supplying enterprises with international linkages in Turkey are more productive, pay more and employ more during 2003-2011. Therefore, this study argues that the government should specifically promote design and R&D activities, and international economic interactions of automotive parts suppliers more that increasingly constitute a larger section of the industry.

Keywords: Technological Intensity Measurement, Patent Counts, Imports, Exports, Production, International Direct Investment, International Technology Transfer, Productivity, Motor Vehicles, Automotive Parts, Motor Vehicle Assembling Enterprises, Automotive Parts Supplying Enterprises, Automotive Manufacturing Industry, Market, Turkey, Global

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List of Abbreviations

ACEA	European Automobile Manufacturers' Association
CIPO	Canadian Intellectual Property Office
Comtrade	International Trade Statistics Database
DWPI	Derwent World Patents Index
ECR	Engineering Cost Rating
EPO	European Patent Office
EU	European Union
FE	Fixed Effects
GDP	Gross Domestic Product
GLS	Generalized Least Squares
HS	Harmonized Commodity Description and Coding System
IPC	International Patent Classification
ISIC	International Standard Industrial Classification of All Economic Activities
JPO	Japan Patent Office
MENA	Middle East and North Africa
N.E.C.	Not Elsewhere Classified
N.E.S.	Not Elsewhere Specified
NACE	Statistical Classification of Economic Activities in the European Community
NUTS	Nomenclature of Territorial Units for Statistics
ODD	Automotive Distributors' Association

OECD	Organisation for Economic Co-operation and Development
OICA	International Organization of Motor Vehicle Manufacturers
OLS	Ordinary Least Squares
OSD	Automotive Manufacturers Association
PCT	Patent Cooperation Treaty
Prodcom	Community Production
R&D	Research and Development
RE	Random Effects
SITC	Standard International Trade Classification
SMEs	Small and Medium-sized Enterprises
TAYSAD	Association of Automotive Parts & Components Manufacturers
TL	Turkish Lira
TurkStat	Turkish Statistical Institute
UNCTAD	United Nations Conference on Trade and Development
UN	United Nations
USPTO	United States Patent and Trademark Office
WCO	World Customs Organization
WIPO	World Intellectual Property Organization

Chapter 1

Introduction

1.1 Motivation

Productivity differentials can explain high income level variations across economies (R. E. Hall and Jones, 1999). In return, productivity is extensively argued to be driven by technological innovations that is, to a large extent, determined by investment in research and development (R&D) (Romer, 1990; Grossman and Helpman, 1991a; Grossman and Helpman, 1991b; Grossman and Helpman, 1991c; Grossman and Helpman, 1994; Jones, 1995; Castellani and Zanfei, 2006; Grossman and Helpman, 2015). Developing economies have scarce resources to devote to R&D investment, and hence they cannot create sufficient innovations and enhance their productivity. Nonetheless, it is widely suggested that developing economies can benefit from productivity effects through international technology transfer. This research regards the Turkish automotive industry, specifically the automotive parts supply section of the industry as a case to study international technology transfer. This approach is to allow for both controlling for more heterogeneities across industries and within the industry, and capturing more insights into the industry that can better inform policy-making.

The automotive industry is highly significant for the Turkish economy. First, automotive imports and exports account for a large part of Turkey's total imports and exports. Second, it is one of the most international investment intensive industries in the Turkish manufacturing sector. Almost all major assemblers in Turkey are joint ventures with European, Asian and American assemblers, while there are local assemblers, as well. Third, it is one of the largest capital oriented manufacturing industries in Turkey. Fourth, the automotive industry is the largest R&D oriented manufacturing industry in Turkey. As a result, the automotive industry constitutes a substantial section of the Turkish manufacturing sector. In addition to this, the industry has also experienced extensive transformations in its ownership and production structures during the last decade especially after Turkey's Customs Union with the European Union (EU). Therefore, it is a significant industry and highly integrated with the world to study as case for investigating international technology transfer.

Former studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) have not extensively explored the automotive parts supply section of the Turkish automotive industry or not made the distinction between motor vehicle assembly and automotive parts supply sections (e.g., Yasar and Morrison Paul, 2007) or relied on small samples (e.g., Ekmekci, 2010). This calls for a thorough investigation into technological and economic characteristics of the automotive parts supply section of the industry that increasingly constitutes a significant section of the Turkish automotive industry. Therefore, this study will not only enhance the understanding of both motor vehicle assembly and automotive parts supply sections of the Turkish automotive industry, but it will also provide insights into technological and economic relations of the global automotive industry with a developing economy, namely Turkey.

Before investigating variations in economic performance characteristics of automotive parts supplying enterprises with different degree of involvement in international economic interactions and the link between international technology transfer channels and productivity in the Turkish automotive parts industry, this study investigates technological stand of the Turkish automotive parts industry by measuring technological intensity of automotive parts that the industry import, export and manufacture to develop a better understanding of the technological characteristics of the industry. As a result, along with economic characteristics of the motor vehicle assembly section of the Turkish automotive industry, this study investigates technological and economic characteristics of the automotive parts supply section of the industry by utilising various publicly available and confidential datasets. Hence, this study looks into issues having significant economic development implications for the Turkish economy.

1.2 Objectives of the Study and Main Research Questions

There are six main objectives of this study. First, this study aims to identify relative place of the Turkish automotive industry in the world and its evolution over the last decade in chapter 2 to have an understanding of the automotive sector structure of Turkey and other major countries and this structure's evolution over the last decade. Second, this study is set to determine automotive import sources and export destinations of Turkey in chapter 3 to further develop an understanding of international automotive trade patterns of Turkey with its individual major partners, in addition to the introduction of general characteristics of the Turkish automotive sector in chapter 2. Third, this study intends to identify significance of the Turkish automotive industry in the Turkish manufacturing sector in chapter 4 to assess relative place of the Turkish automotive industry in the Turkish manufacturing sector with respect to international ownership, R&D, employment, labour expenditure, investment and output characteristics. Fourth, this study is set to reveal economic characteristics of motor vehicle assembling and automotive parts supplying enterprises in Turkey in chapter 4 to add the automotive enterprise dimension to the understanding of the Turkish automotive industry developed in the preceding chapters, while considering ownership characteristics of enterprises. These four objectives are to provide the foundation for the two subsequent objectives of this study. Fifth, this study aims to accurately measure technological intensity of Turkey's automotive parts import, export and production in chapter 5 to determine technological and economic characteristics of the Turkish automotive parts industry before examining the productivity consideration of international technology transfer to automotive parts supplying enterprises in Turkey in chapter 6. Last, after identification of the technological characteristics of the Turkish automotive parts industry, this study intends to determine variations in economic performance characteristics of automotive parts supplying enterprises with different extent of engagement in international economic interactions and investigate the link between international technology transfer channels and productivity in the Turkish automotive parts industry in chapter 6 to establish whether automotive parts supplying enterprises in Turkey benefit from engagement in international economic interactions.

As a result, the following research questions constitute the main theme of the investigation carried out in this study:

- Where does the Turkish automotive sector currently stand in the global automotive trade, motor vehicle assembly and market? How has the Turkish automotive sector evolved over the last decade?
- What are the current international automotive trade patterns of Turkey with its individual major partners?
- What are the economic characteristics of the Turkish automotive industry and how significant is the Turkish automotive industry in the Turkish manufacturing sector in terms of international ownership, R&D, employment, labour expenditure, investment and output?
- What are the distinguishing economic characteristics of international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey?
- What are the technological and economic characteristics of Turkey's automotive parts import, export and production?
- How do economic performance characteristics of automotive parts supplying enterprises in Turkey vary in response to variations in extent of involvement in international economic activities, and what is the link between international technology transfer channels and productivity for automotive parts supplying enterprises in Turkey?

1.3 Methodology and Data

This study analyses the Turkish automotive industry at various levels on descriptive and inferential bases by employing a large number of publicly available and confidential datasets obtained from numerous sources enabling one to consider more technological and economic aspects of the industry.

This study employs descriptive analysis at automotive parts and motor vehicle level in the world, and across regions and all major countries including Turkey in chapter 2, at automotive parts and motor vehicle level for the Turkish automotive industry in chapter 3, and at industry and motor vehicle assembling and automotive parts supplying enterprise levels in chapter 4. This study also employs regression analysis at individual automotive parts level in chapter 5 and at automotive parts supplying enterprise level in chapter 6. These approaches and levels of analyses make findings more robust and provide more insights into technological and economic characteristics of the Turkish automotive industry, especially the automotive parts supply section.

The first main data source is the United Nations' (UN) publicly available International Trade Statistics Database (Comtrade) used in chapter 2 and chapter 3. The second main data source is the International Organization of Motor Vehicle Manufacturers (OICA)'s dataset utilised in chapter 2. The third main data source is the Automotive Manufacturers Association (OSD)'s dataset used in chapter 3. The fourth main data source is the Turkish Statistical Institute (TurkStat)'s publicly available various industry and product level datasets, and confidential enterprise level datasets utilised in chapter 4, chapter 5 and chapter 6. The fifth main data source is the World Intellectual Property Organization, an agency of the UN, (WIPO)'s publicly available PATENTSCOPE database used in chapter 5.

1.4 Contributions of the Study

There are six general contributions of this study to the literature. First, studies in the literature of international technology transfer are generally on developed Organisation for Economic Co-operation and Development (OECD) countries due mainly to availability of relevant data. Therefore, this study extends the literature of international technology transfer to a developing country where unique enterprise level datasets are difficult to find and access. Second, studies in the literature of international technology transfer do not generally distinguish amongst sectors (Keller, 2004). On the other hand, this study focuses on one industry, in particular, on a growing section of an industry, namely the automotive parts supply section of the Turkish automotive industry that entails controlling for more heterogeneities across industries and within an industry. Third, this study separately regards both motor vehicle assembly and automotive parts supply sections of the industry, considers simultaneously motor vehicle and all automotive parts, and analyses all motor vehicle assembling and automotive parts supplying enterprises of the size of more than

20 employees in Turkey in both descriptive and inferential bases. Therefore, this study is different from conventional case studies where only highly specific aspects of the industry are examined with a limited set of variables based on small sample sizes. Hence, this study approaches the industry at various levels, namely sectoral, industrial, motor vehicle and automotive parts, and enterprise levels, and this study also considers almost all aspects of and parties in the industry, thereby not having a representativeness issue. Fourth, this study does not just consider a particular economic indicator of the automotive industry, rather it takes into account all major economic indicators of the industry: technological and economic characteristics of automotive parts imports and exports; motor vehicle imports, exports, assembly, sales and ownership characteristics; international ownership, R&D, employment, labour expenditure, investment and output characteristics of the automotive industry, and various economic characteristics of motor vehicle assembling and automotive parts supplying enterprises in Turkey. Fifth, this study also examines the recent period of the automotive industry where significant developments in the automotive sector have occurred, in addition to providing brief historical context of other periods. Last, this study is to be rigorous in capturing beneficial insights into the automotive industry that can better inform policy-making.

This study also makes additional contributions to knowledge in five specific ways stated by chapter.

First, chapter 2 does not only consider international automotive trade and motor vehicle assembly characteristics of the global automotive sector but it also examines motor vehicle market characteristics of the global automotive sector. In addition to this, chapter 2 does not just consider a specific economy or a group of economies, it takes into account the whole world as well as regions and all major economies along with Turkey regarding the automotive sector. Furthermore, chapter 2 analyses developments in the automotive sector relative to 2003. As a result, chapter 2 determines automotive sector structures of individual major countries and shifts in these structures in relation to 2003.

Second, chapter 3's contributions are, first, despite focusing on the recent structure of the Turkish automotive sector, it explains the Turkish automotive sector within its historical context from its inception associating its development phases with corresponding periods of the Turkish economy. Chapter 3 also points out to major shifts and transformations in the Turkish automotive sector and analyses market related characteristics of the Turkish automotive sector, while stressing significance of the government policies for the sector. Second, chapter 3 simultaneously considers automotive import origins and export destinations of Turkey by the distinction of automotive parts and motor vehicle to identify Turkey's international automotive trade patterns with its individual major partners and shifts in these patterns in comparison with 2003.

Third, contributions of chapter 4 are, first, it identifies relative place of the Turkish automotive industry in the Turkish manufacturing sector. Second, former studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) on the Turkish automotive industry focus mostly on the motor vehicle assembly section of the Turkish automotive industry. Therefore, they do not widely analyse the automotive parts supply section of the automotive industry that is due mainly to lack of data in this field and restrictions on access to relevant data. Hence, such studies cannot accurately analyse the automotive parts supply section of the Turkish automotive industry that increasingly constitutes a larger section of the automotive industry. Therefore, chapter 4 examines separately both assembly and supply sections of the Turkish automotive industry at enterprise level based on key economic indicators, while considering ownership characteristics of enterprises. As a result, chapter 4 determines significance of the Turkish automotive industry in the Turkish manufacturing sector and provides major economic characteristics of international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey.

Fourth, chapter 5's contributions are, first, it develops a more accurate measure of technological intensity of automotive parts to precisely identify variations in technological intensity amongst automotive parts enabling thorough investigation of technological characteristics of substantially increasing cross-border trade in intermediate goods or automotive parts (Feenstra, 1998). Development of patent counts for a particular automotive part as a measure of technological intensity of that automotive part is due to the fact that previous technological intensity measures are at industry level unable to capture technological variations within industries. Second, chapter 5 applies this patent measure of technological intensity in the Turkish automotive parts industry to have a better understanding of the technological characteristics of the Turkish automotive parts industry. Third, chapter 5 compares technological intensity of automotive parts findings with suggestions of the institutional development literature allowing for identification of the extent of quality of institutions as a determinant of technological specialisation fields for the Turkish automotive parts industry (Acemoglu, S. Johnson, and Robinson, 2001). This exercise also enables more effective investigation of international technology transfer in the Turkish automotive parts industry in chapter 6.

Last, contributions of chapter 6 are, first, previous studies on the international technology transfer generally focus on developed OECD countries by investigating specific channels of international technology transfer, one channel at a time across sectors (Keller, 2004). Therefore, such studies cannot fully account for simultaneously major channels of international technology transfer in the context of major developing countries and specific sectors, thereby failing to consider simultaneously major channels, and address developing country and sector specific factors. Second, as stated earlier that previous studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) on the Turkish automotive industry concentrate mainly on the motor vehicle assembly section of the Turkish automotive industry. Hence, they do not widely analyse the automotive parts supply section of the automotive industry that is due mainly to lack of data in this field and restrictions on access to relevant data. Therefore, such studies cannot accurately analyse the automotive parts supply section of the Turkish automotive industry that increasingly generates a larger section of the automotive industry. Such studies are also mostly qualitative and based on small samples with a limited set of variables leading to questions on representativeness of their findings. On the other hand, Sonmez (2013) focuses mainly on automotive parts supplying enterprises in Turkey and has a relatively larger sample of around 150 compared to similar studies' (e.g., Ekmekci, 2010). Nevertheless, when the number of automotive parts supplying enterprises of around one thousand of the size of more than 20 employees is considered in Turkey, Sonmez (2013) cannot reach fairly representative and conclusive findings due to its research methodology adopted. On the other hand, this study employs TurkStat's enterprise level datasets covering all automotive parts supplying enterprises of the size of more than 20 workers representing more than 90% of the automotive parts supply section of the industry. Third, chapter 6 also differs from previous automotive industry studies in the sense that in contrast to previous studies (e.g., Yasar and Morrison Paul, 2007), this study does not consider motor vehicle assembling enterprises in regression analysis to control for more heterogeneities between motor vehicle assembling and automotive parts supplying enterprises. This study also considers a relatively long period of time and concentrates on the recent period (Yasar and Morrison Paul, 2007). Furthermore, Sonmez (2013) looks particularly at knowledge and technology transfer from motor vehicle assemblers to automotive parts suppliers in Turkey, while considering variations in absorptive capacity between international and local automotive parts suppliers by surveying automotive enterprises in Turkey. On the other hand, this study investigates international technology transfer and its subsequent productivity impacts, due to involvement of automotive parts supplying enterprises in Turkey in international ownership, import and export activities. Fourth, this study in chapter 6 investigates major channels of international technology transfer in a large developing country's one of the most internationally involved industries, namely the Turkish automotive parts industry during the recent period. Therefore, in addition to technological characteristics of the Turkish automotive parts industry at automotive parts level investigated in chapter 5, this study in chapter 6 captures complementary and confirming insights into international technology transfer characteristics of the Turkish automotive parts industry at automotive parts supplying enterprise level.

1.5 Overview of the Study

This study is organised into five complementary chapters each of which develops the study further and enables in-depth examination at sectoral, industrial, automotive parts and motor vehicle, and enterprise levels. Chapter 2 initiates the introduction and descriptive economic analysis of the global automotive sector with reference to cross-border automotive trade, motor vehicle assembly and market characteristics of the world, regions and all major economies enabling identification of automotive sector structures of individual major countries including Turkey. Chapter 3 introduces the Turkish automotive sector within its historical context and analyses international automotive trade patterns of Turkey with its individual major partners advancing the understanding of the Turkish automotive sector introduced in the previous chapter. Chapter 4 enables identification of significance of the Turkish automotive industry in the Turkish manufacturing sector and examination of major economic characteristics of international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey. These three chapters of descriptive economic analysis are to pave the way for a better development of the two subsequent chapters of inferential analysis focusing on technological and economic characteristics of the Turkish automotive parts industry at automotive parts and automotive parts supplying enterprise levels, respectively. Chapter 5 focuses on where the automotive parts supply section of the Turkish automotive industry stands in technological terms and how production, export and import of automotive parts are related with one another in Turkey. Chapter 6 moves from analysis of technological and economic characteristics of automotive parts imported, exported and produced in Turkey in chapter 5 to analysis of channels of international technology transfer to automotive parts supplying enterprises in Turkey. This is to specifically provide insights into economic performance characteristics of automotive parts supplying enterprises in Turkey and establish the link between involvement in international economic activities and productivity in the Turkish automotive parts industry. Chapter 7 concludes this study by first providing an overview of main findings, second stating recommendations and policy implications, and last underlining limitations and recommendations for future research.

Chapter 2

Descriptive Analysis of the Global Automotive Sector

2.1 Introduction

The automotive sector is one of the largest sectors in terms of cross-border trade in the world. In this respect, it, to a large extent, reflects the current economic situation of the world. This chapter first reports the world and regions' automotive imports, exports, and motor vehicle assembly and market characteristics. Second, this chapter considers how the global automotive industry is evolved in relation to 2003. Third, this chapter identifies automotive sector structures of individual major countries that all constitute more than 84% of economic activities of the world. Therefore, this chapter does not only analyse supply and demand related economic characteristics of the global automotive sector but it also examines cross-border economic relations of the sector. In addition to this, this chapter does not just consider one economy or a group of economies, it takes into account the whole world as well as regions and all major economies. Furthermore, this chapter examines developments in the global automotive sector in comparison with 2003. As a result, this chapter aims to provide insights into the global automotive sector and automotive sectors of regions and major countries by considering key economic indicators.

There are fifteen highly large motor vehicle groups in the world accounting for about 82% of the world motor vehicle assembly. There are also around one hundred global mega suppliers in the world. These largest motor vehicle groups and global mega suppliers are head-quartered in Japan, Germany, the USA, Korea, France, Italy, China and Canada. Furthermore, there are growing trends in clustering, follow source and regionalisation in the automotive sector. On the other hand, despite implementation of widespread liberal economic policies around the world, governments still highly influence decision-making in the automotive sector via regulations, investment incentives and supports, monetary and fiscal policies.

Despite a lower share in the global automotive sector compare to the last decade, Europe is still the largest automotive importer and exporter, and the second largest motor vehicle assembly region after Asia-Pacific in the world. Europe is also the third largest motor vehicle market after Asia-Pacific and the Americas. Furthermore, Europe has the second largest motor vehicle fleet after the Americas and the highest motor vehicle ownership rate amongst regions in the world.

On the other hand, Asia-Pacific has obtained a larger share in the world automotive imports and exports, motor vehicle assembly and market compared to the last decade. Asia-Pacific is the third largest automotive importer after Europe and the Americas, and the second largest automotive exporter after Europe in the world. Asia-Pacific is the largest motor vehicle assembly region and market in the world. Along with Europe, Asia-Pacific is the only region that assembles more motor vehicles than its internal demand. Given Asia-Pacific's first place in the world motor vehicle assembly and market but its second place in the world automotive exports and its third place in the world automotive imports, Asia-Pacific is less engaged in the international automotive trade than Europe and the Americas. On the other hand, despite its recent high performance in the global automotive sector, Asia-Pacific still has the third largest motor vehicle fleet and the third highest motor vehicle ownership rate amongst regions in the world.

The Americas have also had a lower share in the global automotive sector as in the case of Europe compared to the last decade. The Americas are the second largest automotive importer after Europe and the third largest automotive exporter after Europe and Asia-Pacific in the world. The Americas are also the third largest motor vehicle assembly region after Asia-Pacific and Europe in the world. On the other hand, the Americas are the second largest motor vehicle market after Asia in the world leading the Americas to assemble much fewer motor vehicles than their internal demand. Despite their relatively weaker performance in the global automotive sector during the last decade, the Americas still have the largest motor vehicle fleet and the second highest motor vehicle ownership rate after Europe in the world.

Given trends and rankings of the largest regions in the global automotive sector, variations in extent of intra-regional and inter-regional automotive trade across regions should be emphasised. Around two thirds of Europe and Americas' cross-border automotive trade are internal, whilst about one fifth of Asia-Pacific's cross-border automotive trade are internal (Dicken, 2011). Therefore, a higher share of cross-border automotive trade interactions of Europe and the Americas stated earlier tend to be within their own regions.

Turkey constitutes more than 1% of the world automotive imports, exports, motor vehicle assembly and market. The Turkish automotive sector has also displayed performance in automotive imports, exports, and motor vehicle assembly and market similar to or better than comparable countries' during the last decade. Automotive imports and exports constitute more than 10% of Turkey's total imports and exports. Import of automotive parts constitutes the majority of Turkey's automotive imports, whilst export of motor vehicles constitutes the majority of Turkey's automotive exports. More than 70% of Turkey's motor vehicle assembly are also exported. Imported motor vehicles constitute more than 70% of Turkey's motor vehicle sales. Furthermore, motor vehicle assembly of Turkey is larger than its sales by one third. Therefore, the Turkish automotive sector is highly open and well integrated with the global automotive industry as a motor vehicle assembly hub. On the other hand, Turkey has a lower motor vehicle ownership rate than comparable countries' resulting in potentials for the automotive industry. As result, the Turkish automotive sector is a major regional motor vehicle assembly hub and market that possesses significant opportunities for the automotive industry.[1]

A close examination of the recent characteristics of the global and Turkish automotive sectors reveals four major points. First, being in the neighbourhood of Europe, receiving a large amount of automotive investment from Europe and having a Customs Union with the EU, Turkey carries out around 80% of its cross-border automotive trade with Europe as reported in section 3.3. Therefore, intra-regional trade is highly prominent in the Turkish automotive sector. Second, most growth in the global automotive sector comes from Asia-Pacific. Nevertheless, the Turkish automotive sector is highly focused on the European automotive sector and its cross-border trade relations with Asia-Pacific are weak. Therefore, the Turkish automotive sector should also develop more cross-border trade relations with Asia-Pacific to diversify its cross-border relations as well as benefit from the recent substantial expansion of the Asia-Pacific automotive sector. Third, being in close geographic proximity to the Middle East and North Africa (MENA), Turkey has developed substantial cross-border trade relations with the MENA. Nevertheless, the Turkish automotive industry, in particular, has not developed extensive economic relations with the MENA whose automotive sector has experienced substantial expansion during the last decade. Therefore, the Turkish automotive industry should forge more economic relations with this growing market, as well. Last, cross-border trade of automotive parts gains more prominence in the world automotive trade creating more opportunities for the automotive industry. Hence, automotive enterprises should pay more attention to the automotive parts supply section of the industry to benefit more from this growing trend.

This study determines five different structures of automotive sectors of individual major countries derived from thorough examination of intensities and compositions of automotive imports and exports, and characteristics of motor vehicle assembly and sales. The first pattern is characterised with specialisation in assembly of motor vehicles. Such countries, e.g., Turkey, in particular, source more than 50% of their automotive imports in the form of automotive parts, while dispatching more than 50% of their automotive exports in the form of motor vehicles. Such countries are also highly engaged with the global automotive industry in terms of motor vehicle market.

The second pattern is that despite being major motor vehicle assembly locations, specific countries offshore their motor vehicle assembly activity. Such countries, e.g., Italy

[1] Further descriptive analysis of the Turkish automotive sector is made in chapter 3.

source more than 50% of their automotive imports in the form of motor vehicles, whilst dispatching more than 50% of their automotive exports in the form of automotive parts. Therefore, such countries dispatch a larger portion of their automotive exports in the form of automotive parts to overseas motor vehicle assembly plants and source a larger portion of their automotive imports in the form of motor vehicles.

The third pattern is that particular countries specialise in the automotive industry by producing and exporting automotive parts, importing automotive parts and also assembling motor vehicles. Such countries, e.g., Czechia[2] source more than 50% of their automotive imports in the form of automotive parts and they also dispatch more than 50% of their automotive exports in the form of automotive parts. Existence of this pattern is due mainly to the practice that such countries provide automotive parts for overseas motor vehicle assembly plants of major international motor vehicle groups. Therefore, such countries are highly engaged with the global automotive industry in terms of both motor vehicle assembly and market.

The fourth pattern is that particular countries are identified with motor vehicle assembly for their relatively large internal markets and less involvement in international automotive trade. Such countries, e.g., China source more than 50% of their automotive imports in the form of automotive parts and they also dispatch more than 50% of their automotive exports in the form of automotive parts. Such countries also have limited engagement with the global automotive industry in terms of both motor vehicle assembly and market.

The fifth pattern is that particular countries are internal market oriented and have small motor vehicle assembly capacities if they are engaged with assembling motor vehicles, source motor vehicles abroad, and have low engagement with automotive exports. Such countries, e.g., Switzerland source more than 50% of their automotive imports in the form of motor vehicles, while dispatching more than 50% of their automotive exports in the form of automotive parts.

This chapter also assesses each automotive sector structure of individual major countries with respect to theories of comparative advantage and competitive advantage (Porter, 1990; Porter, 1998a; Porter, 1998b; Samuelson, 2004; Baldone et al., 2007; Helpman, 2011; Grossman and Rossi-Hansberg, 2012; Hanson, 2012; R. Baldwin and Robert-Nicoud, 2014; Timmer et al., 2014).

A particular note should be made on China that has gained a greater share in the global automotive industry relative to the last decade. China has become the largest motor vehicle assembling country and market in the world overtaking the place of the USA during the last decade. Nevertheless, the USA still has the largest motor vehicle fleet and China has the second largest motor vehicle fleet in the world. China's motor vehicle ownership rate is one eight of USA's and its motor vehicle ownership rate is also 40% lower than the world average resulting in more opportunities for the global automotive industry. Despite having

[2] In 2016, the Czech Republic changed its short-name to Czechia that is adopted throughout this study for convenience.

one of the largest increases in automotive imports across countries during the last decade, China is the fourth largest automotive importer after the USA, Germany and the UK in the world. Automotive exports of China have also demonstrated a similar pattern that of its automotive imports. In spite of having one of the largest rises in automotive exports across countries during the last decade, China is the fifth largest automotive exporter after Germany, the USA, Japan and Mexico in the world. As a result, despite being the largest motor vehicle assembling country and market in the world, China is relatively less involved in automotive imports and exports and does not have a major international motor vehicle brand as other major motor vehicle assembling countries have. Therefore, China possesses substantial opportunities for the global automotive industry.

Section 2.2 explains structure of the global automotive sector. Section 2.3 reports general economic characteristics of the global automotive industry. Section 2.4 presents the global automotive market. Section 2.5 puts forward findings on international automotive trade, and motor vehicle assembly and market structures of individual major countries. Section 2.6 summarises main findings on the global automotive sector.

2.2 Structure of the Global Automotive Sector

This section first briefly explains the historical development of the global automotive industry and then the global automotive sector. This section also explains the value chain of the automotive sector, major motor vehicle assembling groups and global mega automotive parts suppliers, and trends in the automotive industry. Furthermore, it briefly describes government policies implemented in the industry.

Motor vehicles originated from Europe, specifically from Germany and France with the development of gasoline engine in the late 19th century. Nevertheless, the USA dominated the world automotive industry due to its application of mass production techniques until the second half of the 20th century. After this period, European countries and Japan also gained prominence in assembly and exports of motor vehicles (Flink, 1990; Laux, 1992; Foreman-Peck, 1995).[3]

The global automotive sector consists of a large number of diverse parties. It embodies automotive parts suppliers, motor vehicle assemblers and consumers (buyers), dealers and distributors, after-market services, engineering firms, test centres, and interest groups including trade unions, business associations and lobbies. This sector also has extensive backward and forward linkages with other manufacturing industries e.g., steel and rubber, and service sectors, such as financial institutions and insurance companies. Therefore, the sector accounts for a substantial part of the economy.

The automotive industry includes passenger car and commercial vehicle assemblers; these enterprises assemble motor vehicles and produce particular automotive parts such as

[3] Please see Casson (1986), Foreman-Peck (1986), and Clark and Fujimoto (1991) for transformations that this industry experienced throughout the second half of the 20th century.

engines and transmissions. Motor vehicle assemblers are also involved in design, R&D, test and marketing activities. In addition to assemblers, this industry incorporates automotive parts suppliers, which are segmented as 0.5 (global mega suppliers), 1^{st}, 2^{nd}, and 3^{rd} tier suppliers. Each supplier in upstream serves one another, 3^{rd} tier suppliers serve 2^{nd} tier suppliers, in return 2^{nd} tier suppliers serve 1^{st} and 0.5 tier suppliers. Consequently, 0.5 and 1^{st} tier suppliers provide assemblers with systems or modules, subsystems, automotive parts of motor vehicles (Veloso, 2000; Humphrey and Memedovic, 2003).

The reason why 0.5 automotive parts suppliers are called global mega suppliers is that they are larger in in terms of employment and turnover than particular motor vehicle assemblers and they are closer to assemblers than 1^{st} tier automotive parts suppliers (Dicken, 2011). Global mega suppliers or 0.5 tier suppliers are also called system suppliers. These suppliers widely engage in assembling parts provided by other automotive parts suppliers to form systems or modules and subsystems, such as compact full doors, brake systems, power trains for shipping them to motor vehicle assemblers. This trend on global mega suppliers, and hence reduction in number of automotive parts suppliers with which motor vehicle assemblers work is partly driven by the demand from motor vehicle assemblers to reduce their inventory and coordination costs and difficulties (Andrea and Smith, 2002).[4]

Along with production of automotive parts and assembly of modules, global mega and 1^{st} tier suppliers also widely engage in design and R&D activities in close cooperation with motor vehicle assemblers called co-design. On the other hand, 2^{nd} and 3^{rd} automotive parts suppliers engage mostly in production activities based on specifications provided by global mega and 1^{st} tier suppliers, and motor vehicle assemblers.[5] This close cooperation is mainly the result of efficiency seeking strategies of motor vehicle assemblers; therefore, motor vehicle assemblers have left engagement in low value added processes and production of low value added automotive parts to suppliers. Thus, motor vehicle assemblers are the leaders in organising the automotive supply chain. Main elements of this organisation are depicted in Figure 2.1.[6]

There are fifteen highly large motor vehicle groups in the world. They vary in their share of the world motor vehicle assembly from about 2% to around 11%. They all constitute about 82% of the world motor vehicle assembly.[7] There are five large groups head-quartered in Japan comprising 27.1% of the world motor vehicle assembly in 2015. There are three large groups head-quartered in Germany making up 15.9% of the world motor vehicle assembly, while there are two large groups head-quartered in the USA constituting 15.4% of the world motor vehicle assembly in 2015. There is one large group head-quartered in Korea making up 8.9% of the world motor vehicle assembly in 2015. There are two large groups head-quartered in France comprising 6.7% of the

[4] It should also be noted that particular mega suppliers are former subsidiaries of motor vehicle assemblers occurred due to restructuring in the industry resulting in vertical disintegration of assemblers.

[5] Please note that after-market sales are also highly significant for automotive parts suppliers especially those are based in developing countries.

[6] Please note that Figure 2.1 does not include global mega suppliers.

[7] Data is compiled by the OICA. Please see section 2.3 for detail.

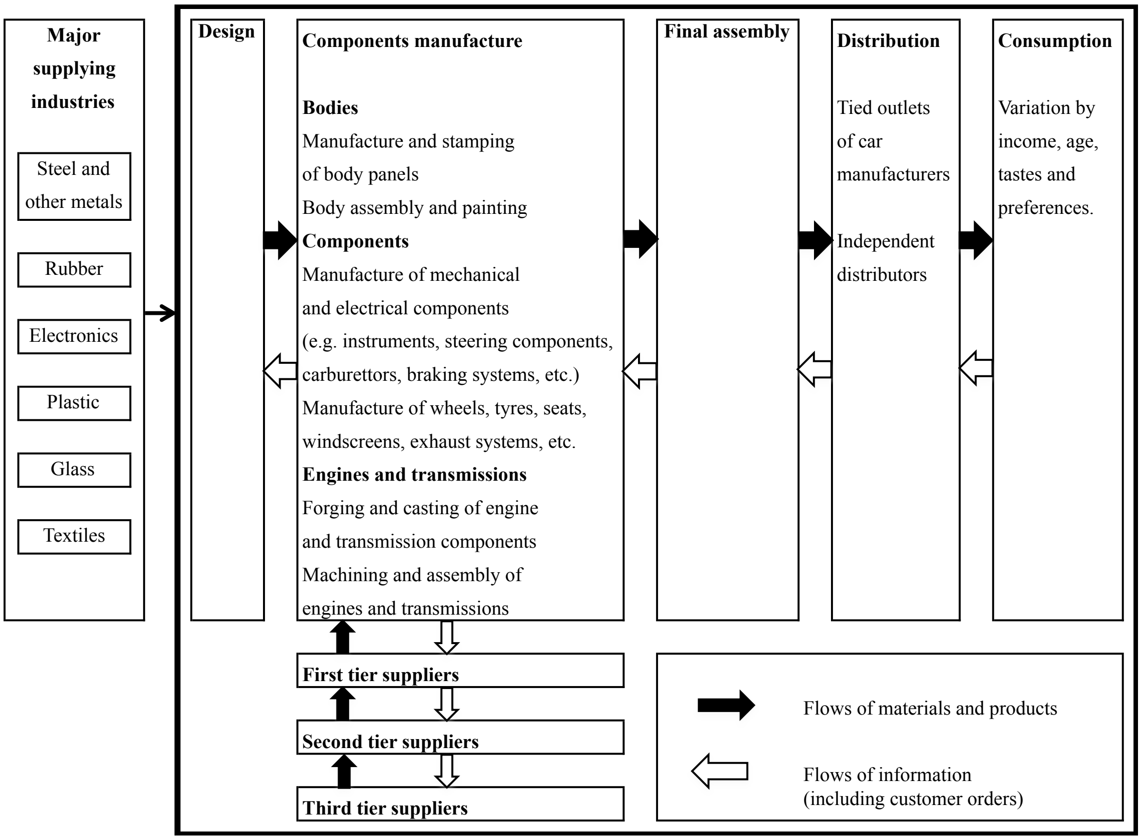

Figure 2.1 The Value Chain of Automotive Sector

Source: (Dicken, 2011, Figure 11.1)

world motor vehicle assembly in 2015. There is one large group controlled by Italy and another large group head-quartered in China constituting 5.4% and 2.5% of the world motor vehicle assembly, respectively in 2015. There are also around one hundred global mega suppliers in the world. In 2015, the largest fifteen global mega suppliers in terms of turnover are Robert Bosch head-quartered in Germany, Denso head-quartered in Japan, Magna International head-quartered in Canada, Continental head-quartered in Germany, ZF Friedrichshafen head-quartered in Germany, Hyundai Mobis head-quartered in Korea, Aisin Seiki head-quartered in Japan, Faurecia head-quartered in France, Johnson Controls head-quartered in the USA, Lear head-quartered in the USA, Valeo head-quartered in France, Delphi Automotive head-quartered in the USA, Yazaki head-quartered in Japan, Sumitomo Electric Industries head-quartered in Japan and JTEKT head-quartered in Japan, respectively (Automotive News, 2016). As a result, locations of the headquarters of the largest fifteen motor vehicle assemblers are, to a large extent, in line with locations of the headquarters of the largest fifteenth global mega automotive parts suppliers.

There are three main trends worth pointing out here. First, there is an increasing trend towards clustering within a country or a region having two dimensions. The first dimension is that automotive parts suppliers producing heavy, bulky and model specific parts are located close to motor vehicle assembly plants for precise time delivery and reduction of transportation costs.[8] The second dimension is that design centres are likely to cluster in large or well-established markets to satisfy local needs and tastes (Sturgeon et al., 2008). Second, when motor vehicle assemblers invest in or move to any location, they tend to take their supply base with themselves, which is called "follow source" (Humphrey, 2003; Ivarsson and Alvstam, 2004).[9] Ivarsson and Alvstam (2004) argue that follow source trend is mostly driven by quality standards requirements and just in time delivery schemes of motor vehicle assemblers. This follow source might be in the form of green-field investments, joint ventures with local enterprises, or acquisition of local enterprises. This trend of follow source has resulted in governments and local governments generously providing investment incentives to motor vehicle assemblers to attract investments of automotive parts suppliers, as well. The last trend is regionalisation (Dicken, 2011). International automotive trade tends to be bounded by geography. This is due mainly to prevalence of trade areas and agreements between geographically close countries. Around two thirds of Europe and Americas' cross-border automotive trade are internal, whereas about one fifth of Asia-Pacific's cross-border automotive trade are internal (Dicken, 2011). Being in the neighbourhood of Europe, receiving a large volume of automotive investment from Europe and having a Customs Union with the EU, Turkey also carries out around 80% of its cross-border automotive trade with Europe as reported in section 3.3.

Due to its scale and significance in the economy and its large backward and forward linkages with other sectors, governments pay special attention to the automotive sector. Therefore, this industry has been subject to heavy government interventions and regulations, and highly protectionist policies from voluntary export restrictions (Melo and Tarr, 1996), quotas, high customs tariff, local content requirements (Pursell, 2001), to obligations to form joint ventures with local enterprises (Liu and Dicken, 2006). The Turkish automotive industry also faced similar economic policies: mainly local content requirements, high tariff barriers, and foreign exchange allocations.[10] However, mainly after 1990s especially in developed countries and to some extend in developing countries, this industry has been liberalized. Nevertheless, governments are still prominent in affecting decision-making processes in the automotive sector via regulations, investment incentives and supports, monetary and fiscal policies.

2.3 General Economic Characteristics of the Global Automotive Industry

This section carries out a descriptive analysis of imports, exports and assembly characteristics of the global automotive industry and automotive industries of major economies. International trade data presented in this section is retrieved from publicly available UN

[8]Please see subsubsection 4.3.2.1 for clustering in the Turkish automotive industry.

[9]Please see subsubsection 4.3.2.1 for follow source in the Turkish automotive industry.

[10]Structure of the Turkish automotive sector is analysed within its historical context in detail in section 3.2.

Comtrade based on 6-digit HS[11] codes associated with the automotive industry.[12] The UN constructs this dataset by compiling international trade data reports of each individual country. On the other hand, motor vehicle assembly data reported in this section is obtained from OICA's dataset.[13] Motor vehicles broadly consist of passenger cars and commercial vehicles. The OICA defines passenger cars as "road motor vehicles, other than a motor cycle, intended for the carriage of passengers and designed to seat no more than nine persons (including the driver). The term "passenger cars" therefore covers taxis and hired passenger cars, provided that they have fewer than ten seats." The OICA also identifies commercial vehicles to "include light commercial vehicles, heavy trucks, coaches and buses." The following subsections explain automotive imports and exports, and motor vehicle assembly across regions and major countries, respectively.

2.3.1 Total, Automotive and Motor Vehicle Imports across Regions and Major Countries

This subsection reports total imports, automotive imports and motor vehicle imports across regions and major countries in 2003 and 2015, and changes between these periods.

2.3.1.1 Total Imports across Regions and Major Countries

Table 2.1 reports value of total imports of regions and major countries in current billion US dollars, regions and major countries' share in the world imports in 2003 and 2015, percent change in total imports and world imports share between 2003 and 2015, and share of Turkey in regions and major countries' total imports in 2003 and 2015, and percent change in this share between 2003 and 2015.

Table 2.1 presents first that in 2015, the world imports were about $15.7 trillion just more than doubled compared to 2003. In 2003, Europe constituted 45.3% of the world imports being the largest importer in the world. Nevertheless, Europe's share in the world imports decreased by 14.3% to 38.8% but it was still the largest importer in the world in 2015. On the other hand, Asia-Pacific increased its share of the world imports by 28.5% to 33.4% in 2015 in comparison with 2003 but it was still the second largest importer in the world after Europe in 2015. In 2015, Africa and the MENA increased their shares in the world imports by 10.1% and 26.3% to 1.4% and 3.2%, respectively, whilst Americas' share in the world imports decreased by 6.8% but the Americas were still the third largest importer in the world. Second, the MENA sourced a larger share of its all imports from

[11] The Harmonized Commodity Description and Coding System, abbreviated as HS, "is a multipurpose international product nomenclature developed by the World Customs Organization (WCO). HS is, at most, 6-digit level and for customs tariffs and collection of international trade statistics."

[12] Please see https://comtrade.un.org/data/ to access this database. Please also see Appendix D: Table D.4 for the list of 6-digit automotive parts and motor vehicle HS codes along with their descriptions.

[13] Please see http://www.oica.net to access this dataset. The OICA compiles this dataset from reports of national trade organisations, OICA members or correspondents, National Offices of Statistics or Ministries of Transport.

Turkey in both 2003 and 2015 compared to other regions, while Europe sourced around 1% and 1.5% of its all imports from Turkey in 2003 and 2015, respectively having the second largest share. On the other hand, Asia-Pacific sourced a smaller share of its all imports from Turkey compared to Africa and the Americas. In 2015, Turkey met around 0.8% of the world imports by an increase of 37% in comparison with 2003. Last, in 2003, Turkey imported just over $69 billion making up 0.9% of the world imports. On the other hand, in 2015 Turkey imported just over $207 billion constituting 1.3% of the world imports translating into an increase of 198.8% in imports value and 44.2% in the world imports share. During the period of 2003 and 2015, this relative increase in total imports of Turkey was larger than comparable countries of Thailand and Poland's.

Table 2.1 Total Imports across Regions and Major Countries (in current billion US dollars)

	2003		2015		Change 03/15		Share of Turkey		
	Value	PCT	Value	PCT	Value	PCT	2003	2015	Change
Africa	93.3	1.2	213	1.4	128.2	10.1	0.4	1	146.4
Remaining	58.9	0.8	133.4	0.8	126.5	9.3	0.4	1.3	190.3
South Africa	34.4	0.5	79.6	0.5	131.3	11.6	0.4	0.6	63.1
Americas	1892.6	25	3654.8	23.3	93.1	-6.8	0.2	0.3	30.9
Argentina	13.9	0.2	59.8	0.4	331.4	108.2	0.1	0.3	305.8
Brazil	48.3	0.6	171.4	1.1	254.8	71.2	0.1	0.3	175.2
Canada	240.4	3.2	419.2	2.7	74.4	-15.9	0.1	0.2	74
Chile	19.3	0.3	63	0.4	227.2	57.9	0.1	0.4	228.3
Colombia	13.9	0.2	54	0.3	289.3	87.9	0.1	0.4	416.5
Mexico	170.5	2.3	395.2	2.5	131.7	11.8	0.1	0.2	195.9
Remaining	81.3	1.1	185.3	1.2	128	10	0.1	0.3	203.9
USA	1305.1	17.2	2306.8	14.7	76.8	-14.7	0.3	0.4	15.6
Asia-Pacific	1968.3	26	5240.6	33.4	166.2	28.5	0.1	0.2	101.3
Australia	89.1	1.2	200.1	1.3	124.7	8.4	0.2	0.3	66.9
China	412.8	5.4	1681.7	10.7	307.4	96.6	0.1	0.2	36.4
India	72.4	1	390.7	2.5	439.5	160.3	0.1	0.3	176
Indonesia	32.6	0.4	178.2	1.1	447.4	164.2	0.1	0.6	301.9
Japan	383.5	5.1	625.6	4	63.1	-21.3	0.1	0.1	82.2
Korea	178.8	2.4	436.5	2.8	144.1	17.8	0	0.2	313.9
Malaysia	82.4	1.1	176.2	1.1	113.7	3.1	0	0.3	438.7
Pakistan	13	0.2	44	0.3	237.1	62.7	0.5	0.5	-7.2
Philippines	42.6	0.6	70.2	0.4	64.8	-20.5	0.1	0.1	151
Remaining	585.3	7.7	1235.4	7.9	111.1	1.9	0.2	0.4	113.4
Thailand	75.8	1	202	1.3	166.4	28.6	0.1	0.1	-7.3
Europe	3431.2	45.3	6092	38.8	77.5	-14.3	1	1.5	44.1

Continued on the next page

Total Imports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	Value	PCT	Value	PCT	Value	PCT	2003	2015	Change
EU (28)	3080.1	40.7	5192.5	33.1	68.6	-18.6	1	1.4	33.4
Austria	91.6	1.2	147.9	0.9	61.5	-22.1	0.9	1.1	26.5
Belgium	234.9	3.1	371	2.4	57.9	-23.8	0.6	1	78.5
Czechia	51.2	0.7	140.7	0.9	174.6	32.5	0.6	0.9	41.2
France	362.5	4.8	651.5	4.2	79.7	-13.3	0.9	1.2	38.9
Germany	601.8	7.9	1056.3	6.7	75.5	-15.3	1.4	1.5	11.8
Hungary	47.7	0.6	90.4	0.6	89.6	-8.5	0.8	0.8	7.2
Italy	297.4	3.9	409	2.6	37.5	-33.6	1.3	1.8	41.8
Netherlands	234	3.1	419.1	2.7	79.1	-13.6	0.6	0.7	6.4
Poland	67.1	0.9	189.7	1.2	182.5	36.3	1.3	1.5	18.5
Remaining	313.2	4.1	474.6	3	51.5	-26.9	1	1.3	28.9
Romania	24	0.3	69.9	0.4	191	40.4	3.8	3.6	-5.7
Slovakia	22.6	0.3	73	0.5	222.8	55.8	0.5	0.7	51.2
Slovenia	13.9	0.2	25.9	0.2	86.8	-9.9	1.1	1.7	60.4
Spain	208.5	2.8	305.3	1.9	46.4	-29.4	1	1.8	80.2
Sweden	84.2	1.1	138.1	0.9	64	-20.9	0.6	0.9	41.6
UK	425.4	5.6	630.3	4	48.2	-28.5	1.1	1.8	58.2
Other Europe	351.1	4.6	899.5	5.7	156.1	23.6	1.1	2.4	115.5
Israel	34.2	0.5	62.1	0.4	81.4	-12.4	2.8	3.9	41.7
Remaining	89.9	1.2	194.2	1.2	116.1	4.3	1.1	2.1	99.8
Russia	57.3	0.8	182.8	1.2	218.7	53.8	1.6	2.2	37.6
Switzerland	100.4	1.3	253.2	1.6	152.3	21.7	0.3	2.4	636.1
Turkey	69.3	0.9	207.2	1.3	198.8	44.2			
MENA	190.4	2.5	498.3	3.2	161.7	26.3	1.7	2.9	64.1
Algeria	13.5	0.2	51.8	0.3	282.4	84.6	3.2	3.9	22
Egypt	10.9	0.1	74.4	0.5	582.7	229.4	1.6	4.4	183.4
Iran									
Morocco	14.2	0.2	37.5	0.2	163.8	27.3	1.5	4.2	186.4
Remaining	101.3	1.3	150.6	1	48.7	-28.2	1.7	2.4	37.8
Saudi Arabia	39.6	0.5	163.8	1	314	99.8	1.4	1.8	27.4
Tunisia	11	0.1	20.2	0.1	84.7	-10.9	1.8	3.9	114.4
World	7575.9	100	15698.6	100	107.2		0.6	0.8	37

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. International trade data on Iran is unavailable for the specified years.

Source: Calculations are based on UN Comtrade.

2.3.1.2 Automotive Imports across Regions and Major Countries

Table 2.2 presents value of automotive imports of regions and major countries in current billion US dollars, motor vehicles' share in automotive imports, regions and major countries' share in the world automotive imports in 2003 and 2015, percent change in automotive imports, motor vehicles' share in automotive imports and world automotive imports share between 2003 and 2015, share of automotive imports in the total imports in 2003 and 2015 and change in this share between 2003 and 2015, and share of Turkey in regions and major countries' automotive imports, motor vehicles' share in automotive imports from Turkey in 2003 and 2015 and percent change in these shares between 2003 and 2015.

Table 2.2 reports that in 2015, the world automotive imports were more than \$1.7 trillion increased by around 86% compared to 2003. This increase in the world automotive imports was smaller than the increase in the total world imports. In 2015, 48.9% of these imports were in the form of motor vehicles decreased by 8.2% in comparison with 2003, while the remaining world automotive imports were in the form of automotive parts. In 2015, automotive imports constituted around 11% of world's total imports contracted by 10.2% in relation to 2003. In 2003, Europe constituted 51.3% of the world automotive imports being the largest automotive importer in the world as in the case of the total imports but its share in the world automotive imports decreased by 13.6% to 44.3% but it was still the largest automotive importer in the world in 2015. On the other hand, in 2015 the Americas made up 34.5% of the world automotive imports decreased by 2.6% in relation to 2003 but they were still the second largest automotive importer in the world after Europe in 2015. When the automotive imports share ranking is compared with the total imports share ranking, the Americas overtook Asia-Pacific's second place in the world imports. Therefore, in 2015 Asia-Pacific constituted 16.1% of the world automotive imports increased by 53.2% from 10.5% in 2003 giving rise Asia-Pacific to occupy the third place in the world automotive importer ranking as just mentioned losing its second place in the world imports to the Americas. In 2015, the MENA and Africa increased their shares in the automotive imports by 121.2% and 20.4% to 3.9% and 1.2%, being placed the fourth and fifth largest automotive importers in the world, respectively. This order of rankings in world automotive imports is consistent with the order of rankings in the total world imports.

Table 2.2 also reveals that in 2015 72.4% of MENA's automotive imports were in the form of motor vehicles up by 6.2% compared to 2003 placing the MENA at the top of the list in this particular ranking in the world. The MENA was followed by Africa, the Americas, Europe and Asia-Pacific, respectively and this order of ranking was identical in 2003, as well despite positive and negative changes in this particular share for regions between 2003 and 2015. In spite of having the largest increase in motor vehicles' share in automotive imports in comparison with 2003, Asia-Pacific was the region with the lowest share in 2015 as stated earlier. Europe and the Americas were only regions that imported a larger share of their automotive imports in the form of automotive parts in 2015 compared with 2003.

Furthermore, Table 2.2 indicates share of automotive imports in the total imports for regions and major countries. In 2015, 16.3% of total imports of the Americas were in the automotive industry down by 6.2% in comparison with 2003 still placing the Americas at the top of the list in this particular area in the world. The Americas were followed by the MENA, Europe, Africa and Asia-Pacific, respectively in 2015. Asia-Pacific had the lowest automotive imports share in the total imports almost half of the closest region. All countries' automotive imports shares in their total imports decreased in 2015 compared to 2003 except the MENA and Asia-Pacific that increased their automotive imports shares in total imports by 57.3% and 7%, respectively. As a result, the Americas and Europe were only regions whose automotive imports shares in total imports were larger than 10% in both 2003 and 2015. Nevertheless, due to larger relative increase in automotive imports, the MENA was also one of the regions in addition to the Americas and Europe with a share of automotive imports in the total imports exceeding 10%.

Next, Table 2.2 reports first that Europe sourced 2.8% of its total automotive imports from Turkey in 2015 more than doubled compared to 2003, having the largest share amongst regions. In spite of being the first region that sourced a larger share of its automotive imports from Turkey amongst regions in 2003 in line with its corresponding figure in Table 2.1, the MENA followed Europe by sourcing 2.2% of its automotive imports from Turkey in 2015. On the other hand, Africa had the third largest share followed by the Americas and Asia-Pacific in 2015. This order of rankings was also the case for corresponding figures in Table 2.1. Asia-Pacific and Europe sourced a larger share of their automotive imports from Turkey than their acquirement of total imports from Turkey, while the Americas sourced a smaller share of their automotive imports from Turkey than their acquirement of total imports from Turkey in both 2003 and 2015. Africa and the MENA sourced a larger share of their automotive imports from Turkey than their acquirement of total imports from Turkey in 2003, while Africa and the MENA sourced a smaller share of their automotive imports from Turkey than their acquirement of total imports from Turkey in 2015. As a result, in 2015 around 1.4% of the world automotive imports sourced from Turkey an increase of 92.6% from around 0.8% in 2003 and in comparison with the world imports from Turkey, the world automotive imports from Turkey were 1.75 times larger in 2015. Second, over half of Europe and MENA's automotive imports sourced from Turkey were in the form of motor vehicles, while over half of Africa, Americas and Asia-Pacific's automotive imports sourced from Turkey were in the form of automotive parts in both 2003 and 2015. Regions' shares of motor vehicles in the automotive imports sourced from Turkey except Europe were smaller than corresponding regions' shares of motor vehicles in their overall automotive imports in both 2003 and 2015. This means that regions except Europe tend to incline to import more automotive parts than motor vehicles from Turkey in comparison with their overall automotive parts imports. On the other hand, overall, in 2015

55.5% of the world automotive imports sourced from Turkey were in the form of motor vehicles down by 4.4% from 58.1% in 2003. Therefore, when Europe was considered it was more likely to import motor vehicles than automotive parts from Turkey. As a result, variations in the extent of shares of automotive imports sourced from Turkey across regions and regional variations in shares of motor vehicles in automotive imports sourced from Turkey and corresponding overall shares reported in Table 2.2 indicate that the Turkish automotive industry is a motor vehicle assembly hub in its region, namely Europe and the MENA.

Last, Table 2.2 presents that in 2003, Turkey obtained automotive imports of around $7.9 billion making up 0.8% of the world automotive imports. On the other hand, in 2015 Turkey acquired automotive imports of around $25.8 billion constituting 1.5% of the world automotive imports translating into an increase of almost 228% in value and 76.3% in the world automotive imports share. These increases of automotive imports exceeded their corresponding total imports increases but were still not highly different from their corresponding total imports reported in Table 2.1. During the period of 2003 and 2015, these relative increases of automotive imports of Turkey were larger than comparable countries of Czechia, Poland and Hungary's. In 2015, Turkey also sourced 46.3% of its automotive imports in the form of motor vehicles being just below average of Europe increased by 4.3% from 44.4% in 2003. Furthermore, in 2015 12.4% of Turkey's imports were in the automotive industry increased by 9.7% from 11.3% in 2003 being below averages of Europe but they became highly close in 2015.

Table 2.2 Automotive Imports across Regions and Major Countries (in current billion US dollars)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey					
													2003		2015		Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Africa	9.1	63	1	20.4	63.3	1.2	123.9	0.5	20.4	9.7	9.6	-1.9	0.5	34.8	1	48.4	110.1	39.1
Remaining	5.4	69.5	0.6	11.6	67.6	0.7	114.7	-2.7	15.4	9.2	8.7	-5.2	0.4	37.9	0.2	52.5	-53.4	38.6
South Africa	3.7	53.5	0.4	8.7	57.6	0.5	137.5	7.8	27.7	10.7	11	2.7	0.6	31.8	1.1	43.6	78.9	37
Americas	328.3	55.1	35.5	594.7	49.8	34.5	81.2	-9.6	-2.6	17.3	16.3	-6.2	0.1	35	0.3	46.3	432.3	32.4
Argentina	2.3	39.9	0.3	11.6	43.2	0.7	399.4	8.2	168.5	16.7	19.4	15.7	0.1	0	0.6	31.3	641	
Brazil	4.8	18.7	0.5	20.3	36.2	1.2	323.6	94.2	127.7	9.9	11.9	19.4	0.4	0	0.6	0	48.8	
Canada	62	42.8	6.7	88.7	48.7	5.1	43.1	13.7	-23.1	25.8	21.2	-18	0	37.6	0.1	57.8	915.7	53.6
Chile	2.4	59	0.3	9.1	63.3	0.5	272.4	7.3	100.2	12.7	14.5	13.8	0.1	0.3	0.8	78.1	732.6	
Colombia	1.4	59.7	0.2	5.6	59.4	0.3	291.6	-0.5	110.5	10.3	10.4	0.6	0.2	2.2	0.2	11.4	17.9	427.8
Mexico	27.8	27.6	3	65.7	18.8	3.8	136.1	-31.9	26.9	16.3	16.6	1.9	0.1	26.5	0.3	28.5	227.6	7.6
Remaining	7.4	63.8	0.8	19.1	65.6	1.1	157	2.8	38.2	9.1	10.3	12.7	0.1	11.1	0.3	52.9	309.1	375.8
USA	220.1	62.6	23.8	374.7	55.1	21.8	70.2	-11.9	-8.5	16.9	16.2	-3.7	0.1	45.8	0.3	52.6	456.1	14.9
Asia-Pacific	97.3	39.9	10.5	277.2	43.4	16.1	184.9	8.8	53.2	4.9	5.3	7	0.2	34.4	0.3	26	35.9	-24.4
Australia	14.9	67.5	1.6	30.3	70.3	1.8	102.6	4.2	9	16.8	15.1	-9.8	0.2	27.7	0.3	64.3	28.8	132.2
China	20.8	25.6	2.2	95.5	47.3	5.5	360.2	85	147.4	5	5.7	12.9	0.3	26.8	0.1	1.4	-53.2	-94.9
India	1.3	7.8	0.1	10.4	3.6	0.6	691.4	-53.8	325.5	1.8	2.7	46.7	0.3	0	0.4	0.5	56.5	
Indonesia	2.8	21.1	0.3	10.9	22.5	0.6	294.5	6.6	112.1	8.5	6.1	-27.9	0	0	0.1	37.3	311.9	
Japan	17.1	42.7	1.8	33.7	28.2	2	97.5	-33.9	6.2	4.5	5.4	21	0.1	3.5	0.2	24	228.2	588.9
Korea	6.5	18.1	0.7	23.5	45.4	1.4	263.1	150.4	95.2	3.6	5.4	48.8	0.1	26	0.5	3.3	579.3	-87.4
Malaysia	3	45.8	0.3	9.1	34.8	0.5	204.7	-24.1	63.8	3.6	5.1	42.6	0.1	43.5	0.1	38.7	35.1	-11.1
Pakistan	0.8	52.3	0.1	2.6	53.4	0.1	238.1	2.1	81.8	5.8	5.8	0.3	1.8	4.4	0.5	1.1	-69.4	-75.4

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Automotive Imports across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey					
													2003		2015		Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Philippines	1.4	43.8	0.2	5	72.4	0.3	246.5	65.2	86.3	3.4	7.1	110.3	0	33.2	0	53	26	59.8
Remaining	23.2	47.4	2.5	41.8	50.3	2.4	79.8	6.2	-3.3	4	3.4	-14.8	0.3	59.5	0.6	41.1	123.7	-31
Thailand	5.6	16	0.6	14.5	12	0.8	161	-24.6	40.3	7.3	7.2	-2	0	19	0.1	7.5	186.9	-60.8
Europe	475.2	54.1	51.3	763.4	47.8	44.3	60.7	-11.7	-13.6	13.8	12.5	-9.5	1.3	59.5	2.8	57.7	109.7	-3
EU (28)	442.7	53.5	47.8	675.6	47	39.2	52.6	-12.2	-17.9	14.4	13	-9.5	1.3	57.9	2.8	58	116.6	0.1
Austria	15.1	46.4	1.6	21.6	47.3	1.3	43.4	2.1	-22.9	16.4	14.6	-11.2	0.9	44.5	1.6	66.7	74.4	49.8
Belgium	38	53.9	4.1	51.3	64.8	3	35.1	20.3	-27.4	16.2	13.8	-14.5	0.9	65.3	3	77.7	223.2	18.9
Czechia	7.2	30.1	0.8	23.3	21.6	1.4	225.8	-28.3	75.2	14	16.6	18.6	1.3	75.2	1.5	46.5	14.3	-38.2
France	52.6	53.5	5.7	75.2	55.2	4.4	43	3	-23.1	14.5	11.5	-20.4	1.6	61.2	3.8	67.4	131.2	10.3
Germany	83.7	45.7	9	146.4	37.1	8.5	74.8	-18.8	-6	13.9	13.9	-0.4	1.4	27.2	2.7	26.4	92.4	-3
Hungary	8.1	32.3	0.9	17.5	19.1	1	116.6	-40.8	16.4	17	19.4	14.3	1.6	90.9	1.2	40.8	-26	-55.1
Italy	43.2	70.1	4.7	46.6	56.7	2.7	7.8	-19.1	-42	14.5	11.4	-21.6	2.4	64.2	5.1	70.4	107.4	9.7
Netherlands	18	53.2	1.9	28.8	44.9	1.7	60	-15.7	-14	7.7	6.9	-10.7	0.2	31.4	0.9	52.8	308.1	67.8
Poland	9.9	48.2	1.1	24.2	36	1.4	144.2	-25.4	31.3	14.7	12.7	-13.6	3.1	68.5	2.9	56.9	-8.3	-16.9
Remaining	32.9	64	3.6	42.9	60	2.5	30.3	-6.3	-30	10.5	9	-14	1.5	83	2.5	76.1	74.4	-8.2
Romania	1.8	48.6	0.2	9.3	28.5	0.5	421.6	-41.4	180.4	7.4	13.3	79.2	6.6	61.9	6.3	18.6	-3.9	-70
Slovakia	4.8	22.2	0.5	15.8	18.4	0.9	227.4	-17.3	76	21.4	21.7	1.4	0.7	91	0.8	70.4	12.4	-22.6
Slovenia	2.2	48.2	0.2	4.2	53.4	0.2	93	10.7	3.7	15.6	16.1	3.3	2.1	56.8	4.1	73.6	97.8	29.4
Spain	42.9	46.9	4.6	51.8	38.5	3	20.8	-17.8	-35.1	20.6	17	-17.5	0.8	75.6	2.2	58.6	175.7	-22.4
Sweden	13.1	35.8	1.4	20.7	45.5	1.2	58.4	26.9	-14.9	15.6	15	-3.4	0.6	69.4	1.4	40.9	121.4	-41
UK	69.3	64.6	7.5	96	61.3	5.6	38.5	-5.2	-25.5	16.3	15.2	-6.5	0.7	52	3.1	74.7	362.5	43.8
Other Europe	32.5	62.5	3.5	87.9	54.1	5.1	170.2	-13.4	45.3	9.3	9.8	5.5	1.8	80.3	2.4	54.2	33.7	-32.5
Israel	2.3	69.3	0.2	5.5	75.9	0.3	143.5	9.6	30.9	6.6	8.9	34.2	7.2	85.2	8.8	74.5	21.6	-12.6

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Automotive Imports across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey					
													2003		2015		Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Remaining	8.5	62.7	0.9	17.9	59.4	1	109.7	-5.3	12.7	9.5	9.2	-3	1.1	82.8	2.1	52.9	98.2	-36.1
Russia	4.9	65.9	0.5	22.2	36.7	1.3	349.1	-44.4	141.4	8.6	12.2	40.9	3.2	75.1	1.9	17.8	-41	-76.3
Switzerland	8.9	74.4	1	16.4	76.5	1	84.6	2.8	-0.8	8.9	6.5	-26.8	0.3	72.6	1.2	83.7	298.6	15.2
Turkey	7.9	44.4	0.8	25.8	46.3	1.5	228	4.3	76.3	11.3	12.4	9.7						
MENA	16.2	68.2	1.8	66.8	72.4	3.9	311.5	6.2	121.2	8.5	13.4	57.3	1.9	59.7	2.2	50.8	12.7	-14.9
Algeria	1.5	61.9	0.2	6.2	69.7	0.4	326.6	12.6	129.4	10.8	12	11.6	4	53	4.4	58.1	10.8	9.6
Egypt	0.6	29.1	0.1	7.6	63.3	0.4	1278.9	117.1	641.4	5	10.2	102	3.5	19.5	4.2	60.4	18.9	210.3
Iran																		
Morocco	0.9	61.6	0.1	4.3	51.2	0.2	363.5	-16.9	149.2	6.5	11.4	75.7	4.1	47	7.2	67.8	73.6	44.4
Remaining	4.1	67.2	0.4	17.5	76.7	1	329	14.1	130.6	4	11.6	188.4	1.2	43.9	1.3	18.2	5.1	-58.5
Saudi Arabia	8.2	75.2	0.9	29.2	76.6	1.7	257.8	1.9	92.4	20.6	17.8	-13.6	1.4	80.3	0.8	33.8	-40.2	-57.8
Tunisia	1.1	52.9	0.1	2.1	62.5	0.1	92.8	18.1	3.7	9.8	10.2	4.4	3.4	64.1	4.3	63.8	29.3	-0.5
World	926.1	53.3	100	1722.5	48.9	100	86	-8.2		12.2	11	-10.2	0.8	58.1	1.4	55.5	92.6	-4.4

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. MV stands for motor vehicle. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. International trade data on Iran is unavailable for the specified years. Appendix D: Table D.4 lists 6-digit automotive parts and motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

2.3.1.3 Motor Vehicle Imports across Regions and Major Countries

Table 2.3 indicates motor vehicle[14] imports of regions and major countries in thousand units, regions and major countries' share in the world motor vehicle imports in 2003 and 2015, percent change in motor vehicle imports and world motor vehicle imports share between 2003 and 2015, and share of Turkey in regions and major countries' motor vehicle imports in 2003 and 2015, and percent change in this share between 2003 and 2015.

Table 2.3 presents that in 2015, around 41.9 million units of motor vehicles were imported worldwide increased by just more than a quarter from around 33.3 million units in 2003.[15] Europe, in 2003 constituted 57.6% of the world motor vehicle imports being the largest motor vehicle importer in the world in line with Table 2.1 and Table 2.2 but Europe gained more prominence in the case of the motor vehicle imports compared to the total and automotive imports.[16] On the other hand, Europe's share in world motor vehicle imports decreased by 16.7% to 47.9% but it was still the largest motor vehicle importer in the world in 2015. The Americas were the second largest motor vehicle importer in the world in 2015, which is parallel to automotive imports ranking by making up 33% of the world motor vehicle imports up by 7.4% from 30.7% in 2003. Asia-Pacific, in 2003 constituted 8.6% of the world motor vehicle imports but it made up 12.5% of the world motor vehicle imports up by 45.1% in 2015 leading Asia-Pacific to be the third largest motor vehicle importer in the world consistent with its place in the world automotive imports. Nevertheless, Asia-Pacific's share in the world motor vehicle imports was lower than its share in the world automotive imports since Asia-Pacific relatively imported a larger share of its automotive imports in the form of automotive parts rather than motor vehicles and other regions comparatively imported more of their automotive products in the form of motor vehicles despite tendency of Asia-Pacific towards importing more automotive products as motor vehicles in 2015. The MENA, in 2015 more than doubled its share in the world motor vehicle imports to 5.7% from 2.4% in 2003 having the largest increase in motor vehicle imports amongst regions. MENA's share in the world motor vehicle imports exceeded its share in the world automotive imports as the MENA made the majority of its automotive imports in the form of motor vehicles as reported in Table 2.2. Africa as seen in Table 2.3 only consists of South Africa data had the lowest share in the world motor vehicle imports in both 2003 and 2015 by making up 0.7% and 0.9% of the world motor vehicle imports, respectively that meant an increase of 39.3% in its share in the world motor vehicle imports between 2003 and 2015.

[14] Import data on motor vehicles includes passenger cars, commercial vehicles and farm tractors.

[15] Please note that import data does not include motor vehicle imports of category of Africa remaining and please see notes of Table 2.3 for detail.

[16] One of the reasons for these high units of motor vehicle imports by Europe was the practice of importing motor vehicles to export.

Table 2.3 also reveals share of Turkey in regions and major countries' motor vehicle imports.[17] In 2015, Europe sourced 4.5% of its motor vehicle imports from Turkey increased by 170.6% from 1.7% in 2003, being the largest amongst regions. Compared to share of Turkey in Europe's automotive imports, share of Turkey in Europe's motor vehicle imports was larger in both 2003 and 2015. In spite of being the first region that sourced a larger share of its automotive and motor vehicle imports from Turkey amongst regions in 2003, the MENA followed Europe by sourcing 2% of its motor vehicle imports from Turkey in 2015. On the other hand, Africa had the third largest share followed by the Americas and Asia-Pacific in 2015. This order of rankings was also consistent with corresponding rankings in Table 2.1. As a result, in 2015 around 2.3% of the world motor vehicle imports were sourced from Turkey by an increase of 128.1% in comparison with 2003. This increase was larger than the increase in the share of the world automotive imports sourced from Turkey. It was also the case that share of the world motor vehicle imports sourced from Turkey was larger than share of the world automotive imports sourced from Turkey in both 2003 and 2015. These overall and regional findings of the motor vehicle imports sourced from Turkey confirms the earlier finding in Table 2.2 that Turkey is a motor vehicle assembly hub for Europe and the MENA.

Last, Table 2.3 presents that in 2003, Turkey imported around 234.5 thousand units of motor vehicles making up 0.7% of the world motor vehicle imports. On the other hand, in 2015 Turkey imported about 722.5 thousand units of motor vehicles constituting 1.7% of the world motor vehicle imports translating into an increase of almost 208% in units and 144.9% in the world motor vehicle imports share. Turkey had the largest motor vehicle imports increase in Europe in 2015 compared to 2003.

Table 2.3 Motor Vehicle Imports across Regions and Major Countries (in thousand units)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Africa	224	0.7	392.4	0.9	75.2	39.3	0.2	0.8	333.5
Remaining South Africa	224	0.7	392.4	0.9	75.2	39.3	0.2	0.8	333.5
Americas	10250.2	30.7	13839.4	33	35	7.4	0.1	0.3	356.7
Argentina	103.7	0.3	355.9	0.8	243.3	173	0	0.4	1257.4
Brazil	96.9	0.3	401.3	1	314.1	229.3	0.3	0.1	-77.4
Canada	1529	4.6	1883	4.5	23.2	-2.1	0	0.2	1315.3
Chile	134.2	0.4	306.4	0.7	128.4	81.6	0.3	1.4	366.8

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[17] Please note that share of Turkey in regions and major countries' motor vehicle imports in Table 2.3 differed from share of Turkey in regions and major countries' automotive imports in Table 2.2 because share of motor vehicles in the automotive imports and "unit value" of motor vehicle imports varied across regions and countries.

Motor Vehicle Imports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Colombia	128	0.4	286.4	0.7	123.8	78	0.1	0	-63.8
Mexico	717.8	2.2	1013.5	2.4	41.2	12.3	0.1	0.3	211.5
Remaining	319.1	1	777.1	1.9	143.5	93.6	0	0.2	2122.3
USA	7221.5	21.7	8815.7	21	22.1	-2.9	0.1	0.3	349.9
Asia-Pacific	2869.5	8.6	5234.4	12.5	82.4	45.1	0.2	0.2	-19.2
Australia	677.7	2	1175	2.8	73.4	37.9	0.4	0.3	-16.1
China	174.5	0.5	1106.7	2.6	534.2	404.3	0.7	0	-99.5
India	9.1	0	18.2	0	100.8	59.7	0	0.1	173.9
Indonesia	38.4	0.1	113.8	0.3	196.5	135.8	0.1	0.1	-23.2
Japan	289.2	0.9	342.3	0.8	18.4	-5.9	0	0.3	4668.1
Korea	56.2	0.2	353.4	0.8	529	400.1	0.2	0	-70.6
Malaysia	257.3	0.8	332.7	0.8	29.3	2.8	0	0.1	180.4
Pakistan	101.4	0.3	251.1	0.6	147.7	96.9	0.2	0	-90.1
Philippines	41.5	0.1	101.7	0.2	144.9	94.7	0	0	-13.8
Remaining	1123.2	3.4	1334.7	3.2	18.8	-5.5	0.2	0.3	54.8
Thailand	100.9	0.3	104.8	0.2	3.8	-17.5	0.1	0	-46.8
Europe	19192	57.6	20101.5	47.9	4.7	-16.7	1.7	4.5	170.6
EU (28)	17826.6	53.5	17596.2	42	-1.3	-21.5	1.6	4.6	193
Austria	479.5	1.4	455.2	1.1	-5.1	-24.5	0.9	2.9	232.3
Belgium	1569.8	4.7	1769.1	4.2	12.7	-10.4	1.3	4.9	287.8
Czechia	186.7	0.6	290.6	0.7	55.7	23.8	3.2	3.9	21.6
France	1888.3	5.7	2364.3	5.6	25.2	-0.4	2.1	6.8	223.7
Germany	2964.6	8.9	2635.5	6.3	-11.1	-29.3	0.7	1.9	168.6
Hungary	232.8	0.7	182.9	0.4	-21.4	-37.5	5.2	0.9	-82.9
Italy	2130.1	6.4	1643.5	3.9	-22.8	-38.6	2.9	8.4	188.4
Netherlands	656.8	2	726.4	1.7	10.6	-12.1	0.1	1.8	1501.4
Poland	391.6	1.2	454.3	1.1	16	-7.7	5.7	6.9	21.5
Remaining	2110	6.3	2049.5	4.9	-2.9	-22.8	1.5	2.9	89.6
Romania	46.8	0.1	117.2	0.3	150.7	99.3	11.8	7.2	-38.9
Slovakia	156.8	0.5	125.9	0.3	-19.7	-36.2	1.9	5.3	175.4
Slovenia	93.2	0.3	146	0.3	56.7	24.6	1.7	7.3	336.5
Spain	1401.2	4.2	966	2.3	-31.1	-45.2	1.6	4	150.9
Sweden	288.4	0.9	482.1	1.1	67.2	32.9	1.5	1.5	2.4
UK	3230.3	9.7	3187.6	7.6	-1.3	-21.5	0.7	5.3	671.8
Other Europe	1365.4	4.1	2505.3	6	83.5	45.9	3	3.3	10.3
Israel	128.2	0.4	258.1	0.6	101.4	60.1	10.6	12	13.7
Remaining	398.2	1.2	710.6	1.7	78.4	41.9	1.6	1.6	4.5

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Motor Vehicle Imports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Russia	284.4	0.9	395.1	0.9	38.9	10.5	4.6	1.8	-61
Switzerland	320.1	1	419.1	1	30.9	4.1	0.5	2.4	388.4
Turkey	234.5	0.7	722.5	1.7	208	144.9			
MENA	812.6	2.4	2371.6	5.7	191.9	132.1	1.7	2	18.4
Algeria	74.6	0.2	295.4	0.7	296.2	215	2.4	4.1	69.8
Egypt	22.6	0.1	232.9	0.6	930.4	719.3	2.9	4.1	45
Iran									
Morocco	62	0.2	99.6	0.2	60.5	27.6	2.2	13.2	492.6
Remaining	222.4	0.7	683	1.6	207.2	144.3	0.8	0.6	-19.2
Saudi Arabia	384.2	1.2	967.6	2.3	151.8	100.2	1.3	0.3	-80.9
Tunisia	46.8	0.1	93	0.2	98.9	58.2	6.6	6.2	-5.8
World	33348.2	100	41939.3	100	25.8		1	2.3	128

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. QTY stands for quantity. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. In case of missing or erroneous data, closest year's data with consistent entry is used. Category of Africa remaining does not have reliable data on quantity of motor vehicles traded. This is mainly because of the fact that volume unit of trade is mixed with weight unit of trade. As a result, category of Africa remaining is not considered. International trade data on Iran is unavailable for the specified years. Appendix D: Table D.4 lists 6-digit motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

2.3.2 Total, Automotive and Motor Vehicle Exports across Regions and Major Countries

This subsection reports total exports, automotive exports and motor vehicle exports across regions and major countries in 2003 and 2015, and changes between these periods.

2.3.2.1 Total Exports across Regions and Major Countries

Table 2.4 reports value of total exports of regions and major countries in current billion US dollars, regions and major countries' share in the world exports in 2003 and 2015, percent change in total exports and world exports share between 2003 and 2015, and share of Turkey in regions and major countries' total exports in 2003 and 2015, and percent change in this share between 2003 and 2015.

Table 2.4 present that in 2015, the world exports were about $15.7 trillion just more than doubled compared to 2003. In 2003, Europe constituted 47.5% of the world exports being the largest exporter in the world. Nonetheless, Europe's share in the world exports decreased by 14.2% to 40.8% but it was still the largest exporter in the world in 2015. On the other hand, Asia-Pacific increased its share of the world exports by 28.1% to 37.1% in 2015 in comparison with 2003 but it was still the second largest exporter in the world after Europe in 2015. Africa, MENA and Americas' shares in the world exports decreased by 14.2%, 7.3% and 5.3% to 1%, 3.4% and 17.6%, respectively in 2015. Therefore, this order of the rankings of regions in the world exports was in line with their counterparts of the rankings of regions in the world imports in both 2003 and 2015.

Table 2.4 also reveals that in 2015, 1.7% of Europe's total exports were destined for Turkey increased by 41.3% from 1.2% in 2003 the largest share amongst regions overtaking MENA's place in imports as reported in Table 2.1. The MENA dispatched 0.8% and 1.3% of its total exports to Turkey in 2003 and 2015, respectively having the second largest share after Europe. While Asia-Pacific sourced a smaller share of its total imports from Turkey (0.1% in 2003 and 0.2% in 2015) compared to Africa and the Americas, Asia-Pacific dispatched a larger proportion of its total exports to Turkey (0.4% in 2003 and 0.7% in 2015) in comparison with Africa and the Americas. In a similar sense, Africa's place in rankings of shares of Turkey in exports also overtaken by the Americas valid for in both 2003 and 2015. As a result, in 2015 Turkey was destined around 1.1% of the world exports by an increase of 43% from 0.8% in 2003. Therefore, the share of the world imports sourced from Turkey was outstripped by the share of the world exports destined for Turkey in both 2003 and 2015. This gap also widened in 2015 indicated by a lower increase rate of 37% in the share of the world imports sourced from Turkey.

Last, Table 2.4 reports that in 2003, Turkey exported just over $47 billion making up 0.6% of the world exports. On the other hand, in 2015 Turkey exported about $144 billion constituting 0.9% of the world exports translating into an increase of 204.4% in exports value and 43.4% in the world exports share. This relative increase in total exports of Turkey was larger than comparable countries of Hungary and Argentina's but smaller than that of Poland and Czechia. As a result, in comparison with share of Turkey in the world imports, Turkey constituted relatively a smaller share of the world exports in both 2003 and 2015 confirming the finding stated earlier on the world level.

Table 2.4 Total Exports across Regions and Major Countries (in current billion US dollars)

	2003		2015		Change 03/15		Share of Turkey		
	Value	PCT	Value	PCT	Value	PCT	2003	2015	Change
Africa	87.7	1.2	159.7	1	82.2	-14.2	0.3	0.4	69.1
Remaining	56	0.8	90.1	0.6	60.8	-24.2	0.1	0.4	202.6

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Total Exports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	Value	PCT	Value	PCT	Value	PCT	2003	2015	Change
South Africa	31.6	0.4	69.6	0.4	120.1	3.7	0.5	0.5	-0.4
Americas	1374	18.6	2760.4	17.6	100.9	-5.3	0.3	0.5	78.7
Argentina	29.9	0.4	56.8	0.4	89.7	-10.6	0.6	0.6	5.3
Brazil	73.2	1	191.1	1.2	161.1	23	0.5	0.7	51.7
Canada	272.2	3.7	408.8	2.6	50.2	-29.2	0.1	0.2	200.7
Chile	21.7	0.3	63.4	0.4	192.6	37.9	0.6	0.5	-12.1
Colombia	13.1	0.2	35.7	0.2	172.6	28.4	0.4	2.1	391.3
Mexico	164.9	2.2	380.6	2.4	130.8	8.7	0	0.1	85.4
Remaining	75.3	1	120.2	0.8	59.5	-24.8	0.1	0.5	598.8
USA	723.6	9.8	1503.9	9.6	107.8	-2.1	0.4	0.6	58.3
Asia-Pacific	2139.6	29	5819	37.1	172	28.1	0.4	0.7	89.2
Australia	70.3	1	187.8	1.2	167.2	25.9	0.2	0.2	-23.9
China	438.2	5.9	2281.9	14.6	420.7	145.3	0.5	0.8	73.3
India	59.4	0.8	264.4	1.7	345.4	109.8	0.8	1.7	119.3
Indonesia	61.1	0.8	176	1.1	188.3	35.8	0.4	0.8	90.2
Japan	472	6.4	624.9	4	32.4	-37.6	0.3	0.3	17
Korea	193.8	2.6	526.9	3.4	171.9	28.1	0.7	1.2	67.2
Malaysia	104.7	1.4	200.2	1.3	91.2	-9.9	0.3	0.5	60.2
Pakistan	11.9	0.2	22.1	0.1	85.2	-12.8	1.7	1.1	-36.5
Philippines	36.2	0.5	58.6	0.4	61.9	-23.7	0	0.1	60.1
Remaining	611.7	8.3	1265.3	8.1	106.9	-2.5	0.3	0.5	81.7
Thailand	80.3	1.1	210.9	1.3	162.5	23.7	0.3	0.5	76.6
Europe	3507.1	47.5	6390.1	40.8	82.2	-14.2	1.2	1.7	41.3
EU (28)	3081.4	41.7	5344.8	34.1	73.5	-18.3	1.1	1.6	47.2
Austria	89.3	1.2	145.3	0.9	62.8	-23.3	0.9	1	14.9
Belgium	255.6	3.5	397.7	2.5	55.6	-26.7	0.9	1.3	48
Czechia	48.7	0.7	157.2	1	222.6	52	0.7	1.2	80.2
France	358.1	4.9	573.1	3.7	60	-24.6	1	1.5	50.3
Germany	748.5	10.1	1331.2	8.5	77.8	-16.2	1.3	1.9	39.6
Hungary	43	0.6	100.2	0.6	132.9	9.7	0.7	2	193.8
Italy	299.5	4.1	458.8	2.9	53.2	-27.8	1.7	2.4	38.6
Netherlands	264.8	3.6	472	3	78.2	-16	0.8	1.3	52.2
Poland	52.8	0.7	194.5	1.2	268.6	73.7	0.7	1.6	139.3
Remaining	298.4	4	468.2	3	56.9	-26.1	0.9	1.6	81.5
Romania	17.6	0.2	60.6	0.4	244	62.1	5.1	3.9	-22.9
Slovakia	21.9	0.3	75.1	0.5	242.4	61.3	0.7	1.2	68.9
Slovenia	12.8	0.2	26.6	0.2	108.2	-1.9	0.6	1.1	70.9

Continued on the next page

Total Exports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	Value	PCT	Value	PCT	Value	PCT	2003	2015	Change
Spain	156	2.1	278.1	1.8	78.3	-16	1.3	2	61.2
Sweden	102.4	1.4	140.1	0.9	36.8	-35.5	0.7	1.1	44.6
UK	312.1	4.2	466.3	3	49.4	-29.6	0.9	1.2	25.9
Other Europe	425.7	5.8	1045.3	6.7	145.6	15.7	2.1	2.2	6.8
Israel	31.8	0.4	64.1	0.4	101.6	-5	1.5	2.7	79.5
Remaining	108	1.5	201.5	1.3	86.6	-12.1	1.3	2	60.8
Russia	133.7	1.8	343.9	2.2	157.3	21.2	3.6	3.4	-5.4
Switzerland	105	1.4	292	1.9	178.1	31	1.2	0.9	-25.6
Turkey	47.3	0.6	143.9	0.9	204.4	43.4			
MENA	273.2	3.7	537.6	3.4	96.8	-7.3	0.8	1.3	74.2
Algeria	24.7	0.3	34.8	0.2	41.1	-33.5	4.3	5.2	20.1
Egypt	6.2	0.1	22	0.1	256.7	68	2.3	5.8	150.6
Iran									
Morocco	8.8	0.1	22	0.1	151.1	18.3	0.6	3.1	453.5
Remaining	132.8	1.8	243.2	1.6	83.1	-13.7	0.5	0.6	33.3
Saudi Arabia	92.8	1.3	201.5	1.3	117.2	2.3	0.1	0.9	595
Tunisia	8	0.1	14.1	0.1	75.3	-17.4	1	0.7	-24.5
World	7381.5	100	15666.8	100	112.2		0.8	1.1	43

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. International trade data on Iran is unavailable for the specified years.

Source: Calculations are based on UN Comtrade.

2.3.2.2 Automotive Exports across Regions and Major Countries

Table 2.5 reports value of automotive exports of regions and major countries in current billion US dollars, motor vehicles' share in automotive exports, regions and major countries' share in the world automotive exports in 2003 and 2015, percent change in automotive exports, motor vehicles' share in automotive exports and world automotive exports share between 2003 and 2015, share of automotive exports in the total exports in 2003 and 2015 and change in this share between 2003 and 2015, and share of Turkey in regions and major countries' automotive exports, motor vehicles' share in automotive exports to Turkey in 2003 and 2015 and percent change in these shares between 2003 and 2015.

Table 2.5 presents that in 2015, the world automotive exports were more than $1.7 trillion increased by 90.1% compared to 2003. This rise in the world automotive exports was smaller than the rise in the world exports. In 2015, 49.3% of these exports were in the form of motor vehicles decreased by 7.7% in comparison with 2003, while the remaining automotive exports were in the form of automotive parts. In 2015, automotive exports constituted around 11.2% of the world exports contracted by 10.4% in relation to 2003.[18] In 2003, Europe constituted 54.8% of the world automotive exports being the largest automotive exporter in the world as in the case of the total exports but its share in the world automotive exports decreased by 9.2% to 49.8% in 2015 still a larger share compared to Europe's share in the world exports. In 2015, Europe's share in the world automotive exports was 5.5 percentage points larger than its share in the world automotive imports. In 2015, Asia-Pacific made up 26.8% of the world automotive exports up by 23.2% from 21.7% in 2003 being the second largest automotive exporter in the world overtaking the place of the Americas. On the other hand, Asia-Pacific's share in the world exports was larger than its share in the world automotive exports in both 2003 and 2015. Asia-Pacific's share in the world automotive exports was more than 10 percentage points larger than its share in the world automotive imports in both 2003 and 2015. On the other hand, in 2015 the Americas constituted 22.3% of the world automotive exports down by 1.8% from 22.7% in 2003 losing their second place in the ranking of the share in the world automotive exports in 2003 to Asia-Pacific and occupying the third place in 2015. Americas' share in the world exports were more than 4 percentage points smaller than their share in the world automotive exports in both 2003 and 2015. On the other hand, Americas' share in the world automotive exports were more than 12 percentage points smaller than their share in the world automotive imports in both 2003 and 2015. Despite constituting more than 3% of the world exports and being the fourth largest exporter in the world in both 2003 and 2015, the MENA was overtaken by Africa when MENA's share in the world automotive exports was considered in 2003 and 2015. The MENA made up 0.5% of the world automotive exports increased by 356.1% from 0.1% in 2003 occupying the last place in the share of the world automotive exports in 2015. This was the largest increase amongst regions' but it was still short of Africa's share in the world automotive exports. MENA's share in the world automotive imports outstripped its share in the world automotive exports by a large margin in both 2003 and 2015. Africa constituted around 0.6% of the world automotive exports with a positive change of 0.3% between 2003 and 2015 being in the fourth place in the ranking of the share in the world automotive exports in both 2003 and 2015. Africa's share in the world exports was well above its share in the world automotive exports in both 2003 and 2015. Africa's share in the world automotive imports also exceeded its share in the world automotive exports in both 2003 and 2015.

Table 2.5 also indicates that in 2015, regions conducted more than half of their automotive exports in the form of motor vehicles except Asia-Pacific. In 2015, 68.6% of Africa's automotive exports were in the form of motor vehicles being the first region in this particular ranking followed by the MENA, Europe, the Americas and Asia-Pacific,

[18] Please see footnote 23 for explanation of the discrepancy between the total values of automotive exports and imports.

respectively. Asia-Pacific and Europe were only regions whose shares of motor vehicles in the automotive exports decreased by 21.4% and 5.9%, respectively. This decrease only led Asia-Pacific to dispatch less than 50% of its automotive exports in the form of motor vehicles in 2015. In addition to this, Asia-Pacific also conducted less than 50% of its automotive imports in the form of motor vehicles as reported in Table 2.2. Asia-Pacific and the MENA were only regions whose shares of motor vehicles in the automotive imports exceeded their corresponding shares of motor vehicles in the automotive exports in 2015.

Furthermore, Table 2.5 reveals share of automotive exports in the total exports for regions and major countries. In 2015, 14.2% of total exports of the Americas were in the automotive industry down by 7.1% in comparison with 2003 still placing the Americas at the top of the list in this particular area in the world. The Americas were followed by Europe, Asia-Pacific, Africa and the MENA, respectively in both 2003 and 2015. Compared with the order of rankings of shares of automotive imports in the total imports, the order of rankings of shares of automotive exports in the total exports changed in 2003 and 2015. The MENA had the second largest automotive imports share in the total imports as reported in Table 2.2 but it had the lowest automotive exports share in the total exports in 2015. Asia-Pacific had the lowest automotive imports share in the total imports, while it had the third largest automotive exports share in the total exports in both 2003 and 2015. All countries' automotive exports shares in the total exports decreased in 2015 compared to 2003 except the MENA and Africa that increased their automotive exports shares in the total exports by 340.6% and 4.6%, respectively. As a result, the Americas and Europe were only regions whose automotive exports shares in the total exports were larger than 10% in both 2003 and 2015. This was also valid for corresponding automotive imports share for both 2003 and 2015.[19] Table 2.5 and Table 2.2 also indicate that in both 2003 and 2015, shares of automotive exports in the total exports of Asia-Pacific and Europe exceeded their corresponding automotive imports shares in the total imports, while shares of automotive imports in the total imports of Africa, the Americas and MENA outstripped their corresponding automotive imports shares in the total imports.

Next, Table 2.5 presents share of Turkey in regions' automotive exports and motor vehicles' share in such exports. First, in 2015 2.9% of MENA's automotive exports were destined for Turkey increased from 0.2% in 2003 having the largest share and increase amongst regions, and it also overtook Europe's first place. The MENA was followed by Europe that in 2015 dispatched 2.4% of its automotive exports to Turkey up by 84.3% from 1.3% in 2003. Europe was followed by Asia-Pacific, Africa and the Americas, respectively. All regions dispatched a larger share of their automotive exports to Turkey in 2015 in comparison with 2003.

Second, the MENA dispatched a larger share of its automotive exports than its total exports to Turkey in 2015 but the reverse held for 2003. On the other hand, in both 2003

[19]Please note that the MENA increased its share of automotive imports in the total imports to 13.4% in 2015.

and 2015 Europe and Asia-Pacific dispatched larger shares of their automotive exports than their total exports to Turkey, while the Americas and Africa sent smaller shares of their automotive exports than their total exports to Turkey. Therefore, orders of rankings of shares of total and automotive exports of regions destined for Turkey were different from each other in both 2003 and 2015. In comparison with the world exports share to Turkey, the world automotive exports share to Turkey were about 1.28 times larger in 2015, while these shares were highly close to each other in 2003.

Third, Europe, Africa and the Americas sourced a larger share of their automotive imports from Turkey than their shipment of automotive exports to Turkey, while Asia-Pacific dispatched a larger share of its automotive exports to Turkey than its acquirement of automotive imports from Turkey in both 2003 and 2015. On the other hand, in 2003 the MENA sourced a larger share of its automotive imports from Turkey than its shipment of automotive exports to Turkey, while in 2015 the MENA dispatched a larger share of its automotive exports to Turkey than its acquirement of automotive imports from Turkey. As a result, in 2015 around 1.4% of the world automotive exports destined for Turkey by an increase of 73.6% from around 0.8% in 2003. These figures were highly close to their corresponding world automotive imports sourced from Turkey valid for both 2003 and 2015 but the world automotive imports sourced from Turkey increased by 92.6% in 2015 in comparison with 2003.

Fourth, over half of Africa's automotive exports destined for Turkey were in the form of automotive parts in both 2003 and 2015 but share of motor vehicles in the automotive exports from Africa to Turkey increased in 2015. This pattern is consistent with its corresponding figure in Table 2.2 but a larger portion of Africa's automotive imports sourced from Turkey were in the form of motor vehicles in both 2003 and 2015. The Americas also displayed a similar pattern that over half of Americas' automotive exports destined for Turkey were in the form of automotive parts in both 2003 and 2015 but share of motor vehicles in the automotive exports from the Americas to Turkey increased in 2015. This pattern is consistent with its corresponding figure in Table 2.2 but a larger portion of Americas' automotive imports sourced from Turkey were in the form of motor vehicles in both 2003 and 2015. On the other hand, 34.4% of Asia-Pacific's automotive imports sourced from Turkey reported in Table 2.2 were in the form of motor vehicles, while 53.3% of Asia-Pacific's automotive exports destined for Turkey reported in Table 2.5 were in the form of motor vehicles in 2003. Both of these shares dropped to 26% and 22.5%, respectively in 2015. Therefore, more than 50% of Asia's automotive exports destined for Turkey were in the form of automotive parts as in the case of Asia-Pacific's automotive imports sourced from Turkey in 2015. In 2003, 59.5% of Europe's automotive imports sourced from Turkey reported in Table 2.2 were in the form of motor vehicles, while 48.2% of Europe's automotive exports destined for Turkey reported in Table 2.5 were in the form of motor vehicles that corresponds to a difference of more than 11 percentage points. While the first share dropped to 57.7%, the second share increased to 52% in 2015 that meant a difference of more than 5 percentage points a smaller difference compared to 2003. Therefore, in contrast to 2003 in 2015 more than 50% of Europe's automotive exports destined for Turkey were in the form of motor vehicles rather than automotive parts but this share was still smaller than its corresponding share of motor vehicles in Europe's automotive imports sourced from Turkey by 5 percentage points. In 2003, 59.7% of MENA's automotive imports sourced from Turkey were in the form of motor vehicles, while 13.2% of MENA's automotive exports destined for Turkey were in the form of motor vehicles. While the first share dropped to 50.8%, the second share increased to 87.8% in 2015. Therefore, in contrast to 2003 in 2015 more than 50% of MENA's automotive exports destined for Turkey were in the form of motor vehicles exceeding its corresponding share of motor vehicles in MENA's automotive imports sourced from Turkey. Therefore, in 2003 58.1% of the world automotive imports sourced from Turkey reported in Table 2.2 were in the form of motor vehicles, while 48.4% of the world automotive exports destined for Turkey reported in Table 2.5 were in the form of motor vehicles corresponding to a difference of less than 10 percentage points. Both shares dropped to 55.5% and 47.6% in 2015 meaning a difference of less than 8 percentage points a smaller difference compared to 2003.

Fifth, regions' shares of motor vehicles in the automotive imports sourced from Turkey except Europe were smaller than corresponding regions' shares of motor vehicles in their overall automotive imports in both 2003 and 2015 as reported in Table 2.2. This means that regions excluding Europe tend to incline to import more automotive parts than motor vehicles from Turkey in comparison with their overall automotive parts imports. On the other hand, regions' shares of motor vehicles in the automotive exports destined for Turkey were smaller than corresponding regions' shares of motor vehicles in their overall automotive exports in both 2003 and 2015 excluding Asia-Pacific in 2003 and the MENA in 2015 as reported in Table 2.5. This means that regions tend to incline to export more automotive parts than motor vehicles to Turkey in comparison with their overall automotive parts exports. As a result, over half of Europe and MENA's automotive imports sourced from Turkey were in the form of motor vehicles, while over half of Africa, Americas and Asia-Pacific's automotive imports sourced from Turkey were in the form of automotive parts in both 2003 and 2015. On the other hand, over half of Europe and MENA's automotive exports destined for Turkey were in the form of motor vehicles, while over half of Africa, Americas and Asia-Pacific's automotive exports destined for Turkey were in the form of automotive parts in 2015. All in all, variations in the extent of shares of automotive imports sourced from and exports destined for Turkey across regions and regional variations in shares of motor vehicles in the automotive imports sourced from and exports destined for Turkey and corresponding overall shares reported in Table 2.2 and Table 2.5 indicate that the Turkish automotive industry is a motor vehicle assembly hub as well as a large motor vehicle market in its region, namely Europe and the MENA.

Last, Table 2.5 reports that in 2003, Turkey dispatched automotive exports of around \$6.6 billion making up 0.7% of the world automotive exports. On the other hand, in 2015 Turkey dispatched automotive exports of around \$22.5 billion constituting 1.3% of the world automotive exports translating into an increase of around 243.4% in value and 80.7% in the world automotive exports share. These increases of automotive exports exceeded their corresponding total exports increases reported in Table 2.4. In 2003, Turkey's share in the world automotive exports was larger than Turkey's share in the world exports and this difference increased further in 2015. During the period of 2003 and 2015, these relative increases of automotive exports of Turkey were larger than comparable country of Brazil's and close to comparable countries of Slovakia, Poland and Hungary's[20] but smaller than that of Thailand. In 2015, Turkey also dispatched 57.4% of its automotive exports in the form of motor vehicles being above the average of Europe decreased by 7.1% from 61.7% in 2003. In 2015, 15.7% of Turkey's exports were in the automotive industry up by 12.8% from 13.9% in 2003. Share of automotive exports in Turkey's total exports was smaller than Europe's corresponding average share in 2003, but it was larger than Europe's corresponding average share in 2015. In both 2003 and 2015, share of automotive exports in Turkey's total exports was larger than share of automotive imports in Turkey's total imports.

[20] Please note that these countries' shares in the world automotive exports were larger than that of Turkey in both 2003 and 2015.

Table 2.5 Automotive Exports across Regions and Major Countries (in current billion US dollars)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey 2003		Share of Turkey 2015		Share of Turkey Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Africa	5.8	52.1	0.6	11	68.6	0.6	90.6	31.7	0.3	6.6	6.9	4.6	0.2	0.4	0.4	8.7	61.9	1851
Remaining	0.7	78.3	0.1	0.7	54.1	0	-11.1	-30.9	-53.2	1.3	0.7	-44.7	0	100	0	85.7	12.5	-14.3
South Africa	5	48.2	0.5	10.4	69.5	0.6	105.6	44.2	8.2	15.9	14.9	-6.6	0.3	0.2	0.4	7.6	48.3	3904.4
Americas	209.7	48.5	22.7	391.5	51.1	22.3	86.7	5.2	-1.8	15.3	14.2	-7.1	0.1	28.2	0.1	42.6	111.7	50.7
Argentina	1.8	50.3	0.2	6.6	77.3	0.4	257	53.7	87.8	6.1	11.6	88.2	0	0	0.9	98.9	1983.5	
Brazil	9.7	43.3	1	14.6	46.3	0.8	51.4	7.1	-20.4	13.2	7.7	-42	0.6	0.3	0.2	0	-72.2	-100
Canada	63.4	66.3	6.9	69.3	69.3	3.9	9.2	4.4	-42.6	23.3	16.9	-27.3	0	85.7	0	72.8	243.4	-15.1
Chile	0.4	43.2	0	1.2	39	0.1	213.7	-9.7	65	1.8	1.9	7.2	0	0	0	0	104.2	
Colombia	0.2	36.9	0	0.7	57.7	0	192.8	56.2	54.1	1.8	1.9	7.4	0		0	0		
Mexico	41.8	47.7	4.5	122.5	52	7	192.9	9	54.1	25.4	32.2	26.9	0	98.4	0	62.4	108.9	-36.5
Remaining	0.8	34.6	0.1	1.9	17	0.1	143.2	-50.9	27.9	1.1	1.6	52.4	0		0	0		
USA	91.5	37.3	9.9	174.7	43.1	9.9	90.9	15.4	0.4	12.7	11.6	-8.2	0.1	49.8	0.2	34.5	243.6	-30.6
Asia-Pacific	201	52.6	21.7	470.8	41.3	26.8	134.2	-21.4	23.2	9.4	8.1	-13.9	0.5	53.3	0.8	22.5	65.6	-57.7
Australia	3.1	62.7	0.3	3.1	58.7	0.2	0.5	-6.4	-47.1	4.4	1.6	-62.4	0	0	0.1	50.5	462.2	
China	15.8	3.2	1.7	117.4	11.5	6.7	644.2	254.6	291.5	3.6	5.1	42.9	0.6	3	0.9	3.9	41.1	31.5
India	2	34.3	0.2	16.6	47.2	0.9	731.2	37.8	337.3	3.4	6.3	86.6	0.8	29.1	4.7	17.8	471.7	-39
Indonesia	1.9	2.8	0.2	8.8	33.2	0.5	373.9	1104.8	149.3	3	5	64.4	0.2	0	0.2	0	58.6	
Japan	127	61.5	13.7	165.9	60.9	9.4	30.6	-0.9	-31.3	26.9	26.5	-1.3	0.3	57.2	0.4	39.8	7.6	-30.3
Korea	27.5	69.6	3	88.9	51.5	5.1	223.5	-25.9	70.2	14.2	16.9	19	1.3	69.2	1.2	27.6	-7.3	-60.2
Malaysia	1.4	5.8	0.2	4.1	9.9	0.2	187.4	72.2	51.2	1.4	2.1	50.3	0.3	0	0.3	0	-6.5	
Pakistan	0	45.7	0	0.1	33.3	0	131.4	-27.1	21.7	0.2	0.3	25	0.5	0	2	2.7	263.3	

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Automotive Exports across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey					
													2003		2015		Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Philippines	1.9	8.8	0.2	4.2	1	0.2	123.4	-88.5	17.5	5.2	7.2	38	0	0	0	1	16	
Remaining	14	17.6	1.5	24.2	13.5	1.4	72.6	-23.3	-9.2	2.3	1.9	-16.6	0.3	1.7	0.4	7.9	24.2	376.3
Thailand	6.4	41.5	0.7	37.5	47.9	2.1	484.9	15.6	207.7	8	17.8	122.8	0.5	72	0.5	67.5	9.9	-6.3
Europe	507.3	55.8	54.8	875.3	52.5	49.8	72.5	-5.9	-9.2	14.5	13.7	-5.3	1.3	48.2	2.4	52	84.3	7.9
EU (28)	493.8	56	53.4	835.6	52.7	47.5	69.2	-5.9	-11	16	15.6	-2.4	1.3	48.1	2.4	52.1	85.8	8.3
Austria	14.1	39.4	1.5	22.1	34	1.3	57.3	-13.7	-17.3	15.8	15.2	-3.4	0.5	81.1	0.5	43.1	14.2	-46.9
Belgium	40.3	72.7	4.4	48.1	70.5	2.7	19.3	-3.1	-37.2	15.8	12.1	-23.3	0.8	50.4	1	52.1	21.4	3.2
Czechia	11.8	32.5	1.3	44.8	40.6	2.6	280.1	24.8	100	24.2	28.5	17.8	0.4	32.1	1.9	62	351.7	93
France	67.2	54.1	7.3	62.7	44.8	3.6	-6.7	-17.3	-50.9	18.8	10.9	-41.7	1.6	46.1	2.5	38.3	55.1	-16.8
Germany	171.1	62.8	18.5	304.1	58.1	17.3	77.7	-7.4	-6.5	22.9	22.8	-0.1	1.4	52.9	2.8	53.9	102.1	2
Hungary	9.3	17.7	1	30.7	37.3	1.7	228.7	111.3	72.9	21.7	30.7	41.1	0.2	1.7	3	33.7	1318.8	1875.4
Italy	32.2	40.4	3.5	50	43.3	2.8	55.3	7.2	-18.3	10.8	10.9	1.4	2.6	15.8	3.5	31.3	33.1	97.9
Netherlands	12.8	56	1.4	23.1	47.8	1.3	80.1	-14.6	-5.3	4.9	4.9	1	1.7	90.4	2.3	71.4	34.2	-20.9
Poland	10.3	26.8	1.1	34.7	29.1	2	238.5	8.6	78.1	19.4	17.9	-8.2	0.3	0.2	3.4	49.5	956.8	
Remaining	15.8	44.7	1.7	24.6	39.4	1.4	55.4	-11.9	-18.2	5.3	5.3	-0.9	0.5	42.1	1.7	22.4	208.6	-46.7
Romania	1.5	5.8	0.2	15.9	21.2	0.9	988.3	268.1	472.5	8.3	26.3	216.4	1.6	70.5	4.1	48.7	153.3	-31
Slovakia	8	50.7	0.9	27.5	51.6	1.6	243.7	1.7	80.8	36.6	36.7	0.4	0.3	84.7	1.3	52.6	424.7	-37.9
Slovenia	2.2	44.6	0.2	5.2	49.1	0.3	133.6	10.1	22.9	17.5	19.6	12.2	1.7	26	0.7	18.5	-59.9	-28.9
Spain	42.8	63.4	4.6	60.9	64.5	3.5	42.5	1.6	-25	27.4	21.9	-20.1	1.6	71.1	3	76.9	83.4	8.1
Sweden	15.4	51.6	1.7	19.7	51.5	1.1	28.2	-0.2	-32.5	15	14.1	-6.3	0.4	78.8	0.4	46.1	-7.9	-41.5
UK	39	57	4.2	61.3	69.4	3.5	56.9	21.7	-17.4	12.5	13.1	5	1.4	32.1	1.8	67.1	33.5	108.7
Other Europe	13.5	48.2	1.5	39.6	48.4	2.3	194.3	0.3	54.8	3.2	3.8	19.8	0.5	59.1	0.5	13.4	-12.7	-77.3
Israel	0.2	5.7	0	0.4	10.5	0	159.4	83.6	36.4	0.5	0.7	28.7	2.5	0	1	2.2	-61.7	

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Automotive Exports across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive			Share of Turkey					
													2003		2015		Change 03/15	
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change	PCT	MV	PCT	MV	PCT	MV
Remaining	2.9	37	0.3	8.6	36.6	0.5	199.9	-1.2	57.8	2.7	4.3	60.8	0.1	21	0.5	18.5	425.7	-12.1
Russia	1.9	49.1	0.2	4.5	50.1	0.3	137.7	2.1	25	1.4	1.3	-7.6	1.2	79.8	0.4	5.8	-67.1	-92.8
Switzerland	2	22.3	0.2	3.5	22.2	0.2	79.5	-0.5	-5.5	1.9	1.2	-35.4	0.4	40.9	0.3	9.3	-5.4	-77.3
Turkey	6.6	61.7	0.7	22.5	57.4	1.3	243.4	-7.1	80.7	13.9	15.7	12.8						
MENA	1.1	38.4	0.1	9.5	59.2	0.5	767	54.1	356.1	0.4	1.8	340.6	0.2	13.2	2.9	87.8	1672.2	566.7
Algeria	0	58.8	0	0	7.8	0	-75.5	-86.7	-87.1	0	0	-82.7	0		0	0		
Egypt	0	17.6	0	0.3	23.4	0	1263.9	32.6	617.5	0.4	1.4	282.4	0.2	0	8	0	4614.1	
Iran																		
Morocco	0.1	10.3	0	4.1	60.9	0.2	4093.7	489.3	2106.1	1.1	18.4	1570.3	1	0	5.8	99.3	485.1	
Remaining	0.3	62.4	0	2.7	75.6	0.2	682.9	21.2	311.9	0.3	1.1	327.5	0.1	32.2	0.1	72.8	-31.9	126.3
Saudi Arabia	0.3	62.2	0	1.4	71.2	0.1	412.1	14.5	169.4	0.3	0.7	135.8	0	100	0.2	88.9	1129.7	-11.1
Tunisia	0.4	5.3	0	1	2.6	0.1	188.9	-51.2	52	4.4	7.3	64.7	0.1	10.9	0.6	0	781.8	-100
World	924.8	53.4	100	1758	49.3	100	90.1	-7.7		12.5	11.2	-10.4	0.8	48.4	1.4	47.6	73.6	-1.7

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. MV stands for motor vehicle. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. International trade data on Iran is unavailable for the specified years. Appendix D: Table D.4 lists 6-digit automotive parts and motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

2.3.2.3 Motor Vehicle Exports across Regions and Major Countries

Table 2.6 reveals motor vehicle[21] exports of regions and major countries in thousand units, regions and major countries' share in the world motor vehicle exports in 2003 and 2015, percent change in motor vehicle exports and world motor vehicle exports share between 2003 and 2015, and share of Turkey in regions and major countries' motor vehicle exports in 2003 and 2015, and percent change in this share between 2003 and 2015.

Table 2.6 reports that in 2015, about 47.9 million units of motor vehicles were exported worldwide increased by about 30% from around 36.9 million units in 2003.[22,23] Europe, in 2003 constituted 59.2% of the world motor vehicle exports being the largest motor vehicle exporter in the world in line with Table 2.4 and Table 2.5 but Europe had more significance in the case of the motor vehicle exports compared to the total exports and automotive exports.[24] On the other hand, Europe's share in the world motor vehicle exports decreased by 12.6% to 51.7% but it was still the largest motor vehicle exporter in the world in 2015. Europe's share in the world motor vehicle exports was also about 4 percentage points larger than its share in the world motor vehicle imports in 2015. Asia-Pacific, in 2015 made up 28% of the world motor vehicle exports increased by 22.6% from 22.8% in 2003 leading Asia-Pacific to be the second largest motor vehicle exporter in the world consistent with its place in the world automotive exports but with a higher share in the world motor vehicle exports. Asia-Pacific's share in the world motor vehicle exports was also around 15 percentage points larger than its share in the world motor vehicle imports in both 2003 and 2015. This positive differential was the largest amongst regions in both 2003 and 2015. The Americas, in 2015 constituted 19% of the world motor vehicle exports increased by 11.2% from 17.1% in 2003 resulting in the Americas being the third largest motor vehicle exporter in the world consistent with their place in the world automotive exports. On the other hand, share of automotive exports of the Americas in the world automotive exports were well larger than share of motor vehicle exports of the Americas in the world motor vehicle exports in both 2003 and 2015. This was due mainly to the fact that unit value of motor vehicles exported by countries in the Americas was much larger than Asia-Pacific's in both 2003 and 2015. Americas' share in the world motor vehicle exports were also about 14 percentage points smaller than their share in the world motor vehicle imports in both

[21] Export data on motor vehicles includes passenger cars, commercial vehicles and farm tractors as in the case of import data.

[22] Please note that export data does not include motor vehicle exports of category of Africa remaining and please see notes of Table 2.6 for detail.

[23] Please note that total number of motor vehicles exported in the world in Table 2.6 are larger than total number of motor vehicles imported in the world in Table 2.3. The main reason for this discrepancy is that in particular instances unfinished motor vehicles are usually declared by exporters as finished motor vehicles to origin countries, while they are declared by importers to destination countries as importation of other items to be assembled. This practice enables importers to avoid bearing high customs tariffs of motor vehicles and pay low customs tariffs of other items. This is also reflected in the total values of automotive exports in Table 2.5 and imports in Table 2.2.

[24] One of the reasons for these high units of motor vehicle exports by Europe was the practice of exporting initially imported motor vehicles as underlined in subsubsection 2.3.1.3.

2003 and 2015. This negative differential was the largest amongst regions in both 2003 and 2015. Africa as seen in Table 2.6 only consists of South Africa data, in 2015 made up 0.7% of the world motor vehicle exports down by 12.3% from 0.8% in 2003 leading Africa to be the fourth largest motor vehicle exporter in the world consistent with its place in the world automotive exports. Despite changes of various magnitudes, Africa's share in the world motor vehicle exports was not highly different from its share in the world motor vehicle imports in both 2003 and 2015. The MENA, in 2015 constituted 0.5% of the world motor vehicle exports increased by more than 5.5 times from 0.1% in 2003 still placing the MENA to the last spot amongst the world motor vehicle exporters in line with its place in the world automotive exports. MENA's share in the world motor vehicle exports was smaller than its share in the world motor vehicle imports in both 2003 and 2015 and even the gap widened in 2015, despite having the largest increase in the world motor vehicle exports share.

Table 2.6 also reveals share of Turkey in regions and major countries' motor vehicle exports.[25] In 2015, the MENA dispatched 5.1% of its motor vehicle exports to Turkey increased by a highly large margin from 0.1% in 2003. Therefore, the MENA had the largest share amongst regions in 2015 overtaking the place of Europe in 2003. Share of Turkey in MENA's motor vehicle exports was smaller than share of Turkey in MENA's automotive exports in 2003 but it became larger in 2015. Share of Turkey in MENA's motor vehicle exports was smaller than share of Turkey in MENA's motor vehicle imports in 2003 by a large margin. On the other hand, share of Turkey in MENA's motor vehicle exports was much larger than share of Turkey in MENA's motor vehicle imports in 2015. 2.7% of Europe's motor vehicle exports, in 2015 were destined for Turkey increased by 92.8% from 1.4% in 2003, being the second largest share amongst regions. Share of Turkey in Europe's automotive exports was smaller than share of Turkey in Europe's motor vehicle exports by a smaller margin in both 2003 and 2015. On the other hand, share of Turkey in Europe's motor vehicle exports was smaller than share of Turkey in Europe's motor vehicle imports in both 2003 and 2015 and even by a larger margin in 2015. 0.6% of Asia-Pacific's motor vehicle exports, in 2015 were destined for Turkey decreased by 1.7% the smallest change and only decrease amongst regions from 0.6% in 2003, being the third largest share amongst regions. Share of Turkey in Asia-Pacific's automotive exports was smaller than share of Turkey in Asia-Pacific's motor vehicle exports by a smaller margin in 2003, while it was larger in 2015. On the other hand, share of Turkey in Asia-Pacific's motor vehicle exports was larger than share of Turkey in Asia-Pacific's motor vehicle imports in both 2003 and 2015. Despite large increases, share of Turkey in Americas and Africa's motor vehicle exports was around 0.1% leading the Americas and Africa to have the fourth and fifth largest shares amongst regions, respectively in 2015. Share of

[25]Please note that share of Turkey in regions and major countries' motor vehicle exports in Table 2.6 differed from share of Turkey in regions and major countries' automotive exports in Table 2.5 because share of motor vehicles in the automotive exports and "unit value" of motor vehicle exports varied across regions and countries.

Turkey in Americas and Africa's automotive exports was larger than share of Turkey in Americas and Africa's motor vehicle exports in both 2003 and 2015. On the other hand, share of Turkey in Americas and Africa's motor vehicle exports was much smaller than share of Turkey in Americas and Africa's motor vehicle imports in both 2003 and 2015. As a result, in 2015 around 1.6% of world's motor vehicle exports destined for Turkey by an increase of 63.2% from around 1% 2003. This increase was smaller than the increase in world's automotive exports destined for Turkey but it was still the case that share of the world motor vehicle exports destined for Turkey was larger than share of the world automotive exports destined for Turkey in both 2003 and 2015. On the other hand, share of the world motor vehicle imports sourced from Turkey was larger than share of the world motor vehicle exports destined for Turkey in both 2003 and 2015 and even the differential was larger in 2015. As a result, variations in share of Turkey in regions' motor vehicle exports indicate that Turkey is a significant motor vehicle destination, and hence market in its region, Europe and the MENA.

Last, Table 2.6 presents that in 2003, Turkey dispatched around 370 thousand units of motor vehicles making up 1% of the world motor vehicle exports. On the other hand, in 2015 Turkey dispatched more than 1 million units of motor vehicles constituting 2.2% of the world motor vehicle exports translating into an increase of 180.5% in units and 116.3% in the world motor vehicle exports share. During the period of 2003 and 2015, these relative increases of motor vehicle exports of Turkey were larger than comparable countries of Poland and Brazil's and smaller than comparable countries of Thailand, Czechia and Slovakia's. Share of Turkey in the world motor vehicle exports was also larger than share of Turkey in the world automotive exports in both 2003 and 2015 and even the differential was larger in 2015. Furthermore, Turkey's share in the world motor vehicle exports was larger than Turkey's share in the world motor vehicle imports in both 2003 and 2015, despite a larger increase in Turkey's share in the world motor vehicle imports in 2015.

Table 2.6 Motor Vehicle Exports across Regions and Major Countries (in thousand units)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Africa	292.9	0.8	332.9	0.7	13.7	-12.3	0	0.1	7377.5
Remaining									
South Africa	292.9	0.8	332.9	0.7	13.7	-12.3	0	0.1	7377.5
Americas	6319.2	17.1	9116.6	19	44.3	11.2	0	0.1	83.9
Argentina	84.9	0.2	248.5	0.5	192.9	125.8	0.3	0.9	190.6
Brazil	511.2	1.4	428.6	0.9	-16.2	-35.4	0.2	0	-99.5
Canada	2366.7	6.4	2191	4.6	-7.4	-28.6	0	0	304.4
Chile	3.8	0	4.1	0	8.7	-16.2	0	0	-8

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Motor Vehicle Exports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Colombia	8	0	31.6	0.1	294.7	204.3	0	0	
Mexico	1461.3	4	3128.1	6.5	114.1	65.1	0	0	45.8
Remaining	12.6	0	22.1	0	76	35.7	0	0	70.5
USA	1870.8	5.1	3062.6	6.4	63.7	26.2	0.1	0.1	86.7
Asia-Pacific	8429	22.8	13402.3	28	59	22.6	0.6	0.6	-1.7
Australia	177.1	0.5	107.5	0.2	-39.3	-53.2	0	0	92.9
China	202.1	0.5	1416.4	3	600.9	440.4	0.2	0.7	240.1
India	175.5	0.5	1309.1	2.7	645.8	475.1	0.4	1.1	195.6
Indonesia	3.8	0	189.5	0.4	4844.2	3712.5	0	0	
Japan	5704.8	15.5	5843.2	12.2	2.4	-21	0.4	0.3	-28
Korea	1602.9	4.3	2871.1	6	79.1	38.1	1.6	1	-35.1
Malaysia	15.9	0	26.9	0.1	69.5	30.7	0	0	32.7
Pakistan	1.5	0	3.6	0	134.9	81.1	0.5	0.1	-81.8
Philippines	12.9	0	8.4	0	-34.9	-49.8	0.1	0.1	53.5
Remaining	159.3	0.4	342.6	0.7	115	65.8	0	0.1	1394.5
Thailand	373	1	1283.9	2.7	244.2	165.4	0.6	0.6	11.1
Europe	21834.3	59.2	24750.1	51.7	13.4	-12.6	1.4	2.7	92.8
EU (28)	21101.6	57.2	23249.9	48.6	10.2	-15	1.4	2.7	98.5
Austria	315.3	0.9	281.4	0.6	-10.8	-31.2	0.8	0.5	-40.7
Belgium	2473.4	6.7	1923.1	4	-22.2	-40	0.6	0.6	5.9
Czechia	391.3	1.1	1263.8	2.6	223	149	0.4	2.9	615.8
France	3070.2	8.3	1897.1	4	-38.2	-52.4	1.6	1.9	21.6
Germany	7586	20.6	8509.1	17.8	12.2	-13.5	1.2	2.9	144.2
Hungary	144.5	0.4	611.2	1.3	322.9	226.1	0	2.4	6015.6
Italy	981.6	2.7	1035.1	2.2	5.5	-18.7	1	2.8	183.5
Netherlands	374.2	1	350.6	0.7	-6.3	-27.8	1.3	1.5	17.2
Poland	313.1	0.8	718.6	1.5	129.5	77	0	5.7	
Remaining	647.4	1.8	628.9	1.3	-2.9	-25.1	0.6	0.3	-49.6
Romania	13.4	0	380.8	0.8	2738.2	2088.6	17.3	11.3	-34.7
Slovakia	247.8	0.7	799.5	1.7	222.6	148.8	0.5	1.4	200.6
Slovenia	121.4	0.3	246.7	0.5	103.3	56.8	1.1	0	-97.9
Spain	2635.2	7.1	2433.9	5.1	-7.6	-28.8	2.1	3.9	85.1
Sweden	315.4	0.9	298.1	0.6	-5.5	-27.1	0.5	0.3	-34.8
UK	1471.4	4	1872.2	3.9	27.2	-1.9	3.4	2.8	-16.9
Other Europe	732.7	2	1500.2	3.1	104.8	57.9	2.3	0.2	-93.3
Israel	0.5	0	1.4	0	180.4	116.2	4.3	0.2	-95.1
Remaining	79.7	0.2	195.4	0.4	145.2	89.1	0.2	0.3	38

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Motor Vehicle Exports across Regions and Major Countries (Continued)

	2003		2015		Change 03/15		Share of Turkey		
	QTY	PCT	QTY	PCT	QTY	PCT	2003	2015	Change
Russia	168.5	0.5	127	0.3	-24.6	-41.9	3.7	0	-99.5
Switzerland	114	0.3	138.3	0.3	21.4	-6.4	1.5	0	-98.5
Turkey	370	1	1038	2.2	180.5	116.3			
MENA	30.6	0.1	259.2	0.5	746.3	552.6	0.1	5.1	5495.5
Algeria	0.1	0	0	0	-93.1	-94.7	0	0	
Egypt	0.3	0	3.8	0	1187.8	893	0.3	0	-100
Iran									
Morocco	0.7	0	166.1	0.3	22153.9	17060.1	0.4	7.8	1842.6
Remaining	11.5	0	20.9	0	82.8	41	0.1	0.8	585.8
Saudi Arabia	17.5	0	67.7	0.1	286.3	197.9	0.1	0.2	262.4
Tunisia	0.4	0	0.5	0	9.1	-15.9	0.5	0.2	-54.2
World	36906	100	47861	100	29.7		1	1.6	63.2

Notes: Data is based on reporting of each individual country. Shares are rounded, so they may not add up to 100%. QTY stands for quantity. PCT means percent. 2015 data on Indonesia is unavailable, instead 2014 data is used for Indonesia. In case of missing or erroneous data, closest year's data with consistent entry is used. Category of Africa remaining does not have reliable data on quantity of motor vehicles traded. This is mainly because of the fact that volume unit of trade is mixed with weight unit of trade. As a result, category of Africa remaining is not considered. International trade data on Iran is unavailable for the specified years. Appendix D: Table D.4 lists 6-digit motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

2.3.3 Motor Vehicle Assembly across Regions and Major Countries

Table 2.7 reports motor vehicle assembly of regions and major countries in thousand units, passenger cars' share in motor vehicle assembly, regions and major countries' share in the world motor vehicle assembly in 2003 and 2015, percent change in motor vehicle assembly units, passenger cars' share in motor vehicle assembly and world motor vehicle assembly share between 2003 and 2015, and share of motor vehicle assembly exported in 2003 and 2015 and percent change in this share between 2003 and 2015.[26,27,28]

[26] Please note that while import and export data include farm tractors, assembly data does not include farm tractors, so assembly data on motor vehicles consists of data on assembly of passenger cars and commercial vehicles. Please see section 2.3 for definitions of passenger cars and commercial vehicles and the dataset used in this subsection.

[27] Please note that there can be double counting in the assembly data as indicated by the OICA.

[28] Please note that share of motor vehicle assembly exported for specific countries and, in particular, almost all European countries was larger than 100% in both 2003 and 2015. There are several reasons for this

Table 2.7 presents that in 2015, about 91.5 million units of motor vehicles were assembled worldwide increased by 49.2% from around 61.3 million units in 2003. In 2015, 75.5% of motor vehicles assembled worldwide were passenger cars up by 8.7% from 69.5% in 2003, while the remaining were commercial vehicles. In 2015, 51.6% of the world motor vehicle assembly were carried out by Asia-Pacific increased by 47.5% the largest increase amongst regions from 35% in 2003 leading Asia-Pacific to be the largest motor vehicle assembling region in the world in both 2003 and 2015. 83.8% of motor vehicle assembly of Asia-Pacific, in 2015 were passenger cars up by 14.3% the largest increase amongst regions from 73.3% in 2003 a larger share than Africa and Americas'. In 2015, Europe made up 23.3% of the world motor vehicle assembly decreased by 30.3% the largest fall amongst regions from 33.4% in 2003. Europe's share was still larger than Americas' by a small margin leading Europe to be the second largest motor vehicle assembling region in the world in both 2003 and 2015. 87.1% of motor vehicle assembly of Europe, in 2015 were passenger cars up by 0.7% a smaller increase from 86.5% in 2003 leading Europe to lose its first place in 2003 to the MENA. The Americas, in 2015 constituted 23% of the world motor vehicle assembly decreased by 23% the second largest fall after Europe's amongst regions from 29.8% in 2003 still leading the Americas to be the third largest motor vehicle assembling region in the world in both 2003 and 2015. The Americas were the only region with more than 50% of their motor vehicle assembly were in the form of commercial vehicles due to high demands for commercial vehicles in the Americas, especially by the USA and Canada. Therefore, the Americas were the region with the lowest passenger car assembly share amongst regions in both 2003 and 2015. The MENA, in 2015 made up 1.5% of the world motor vehicle assembly up by 36.4% the second largest increase after Asia-Pacific's amongst regions from 1.1% in 2003 still leading the MENA to be the fourth largest motor vehicle assembling region in the world in both 2003 and 2015. 88.7% of motor vehicle assembly of the MENA, in 2015 were passenger cars up by 3% the second largest increase after Asia-Pacific's amongst regions from 86.1% in 2003 leading the MENA to gain the first place of Europe in 2003. Africa, in 2015 constituted around 0.7% of the world motor vehicle assembly decreased by 4.2% the smallest decrease amongst regions from about 0.7% in 2003 placing Africa in the last spot in the world in both 2003 and 2015. 55.4% of motor vehicle assembly of Africa in

discrepancy. First, international trade data includes cross-border trade of farm tractors, while assembly data reported in Table 2.7 does not embody manufacture of farm tractors. Second, motor vehicles assembled in Europe and destined for export markets can be reported by more than one country i.e. both home-country of motor vehicle assembler and the country where motor vehicles are assembled, so there can be double counting of motor vehicle exports. Third, motor vehicles in inventory can be exported in a successive year, which creates lags, and hence discrepancies between timings of the assembly and exports of motor vehicles. Fourth, particular countries, especially European ones import high units of motor vehicles for export even if they do not add any value to imported motor vehicles, which deflates both import and export values as well as quantities. This practice was underlined in Table 2.3 and Table 2.6. Fifth, export data of motor vehicles includes both newly assembled motor vehicles and second-hand motor vehicles that results in discrepancies between current assembly and export data of motor vehicles. Second-hand motor vehicle trades are very large amongst European countries as well as between European countries and other countries, so the discrepancy between current assembly and export data of motor vehicles is much larger for European countries.

2015 were passenger cars decreased by 20% the largest fall amongst regions from 69.3% in 2003 still leading Africa to occupy the fourth spot before the Americas. Therefore, more than 50% of motor vehicle assembly of Africa were in the form of passenger cars in 2015.

Table 2.7 also reports share of motor vehicle exports in motor vehicle assembly across regions and major countries in 2003 and 2015 and percent change in this share between 2003 and 2015. 52.3% of the world motor vehicles assembled were exported, in 2015 decreased by 13.1% from 60.2% in 2003. Europe was the most motor vehicle export intensive region in the world in both 2003 and 2015 but these shares should be interpreted with caution as its motor vehicle exports was larger than its motor vehicle assembly in both 2003 and 2015.[29] Africa, in 2015 exported 54.1% of its assembled motor vehicles decreased by 20.5% the second largest fall after Asia-Pacific's amongst regions from 68% in 2003 still leading Africa to be the second largest motor vehicle export intensive region in the world in both 2003 and 2015. 43.4% of Americas' motor vehicle assembly were exported in 2015 increased by 25.5% the second largest increase after MENA's amongst regions from 34.6% in 2003 leading the Americas to be the third largest motor vehicle export intensive region in the world in 2015 by resulting in the Americas overtaking the third place of Asia-Pacific in 2003. In 2015, Asia-Pacific exported 28.4% of its assembled motor vehicles decreased by 27.8% the largest fall amongst regions from 39.3% in 2003 leading Asia-Pacific to be the fourth largest motor vehicle export intensive region in the world in 2015, resulting in Asia-Pacific losing its third place to the Americas in 2003. 19.5% of motor vehicle assembly of the MENA were exported in 2015 increased by more than threefold the largest increase amongst regions from 4.7% in 2003 but still leading the MENA to occupy the last sport in the world in 2015.

Last, Table 2.7 indicates that in 2003, Turkey assembled around 533 thousand units of motor vehicles, 55.1% of which were passenger cars, making up 0.9% of the world motor vehicle assembly. On the other hand, in 2015 Turkey assembled more than 1.3 million units of motor vehicles, 58.2% of which were passenger cars, constituting 1.5% of the world motor vehicle assembly translating into an increase of 154.8% in units, 5.6% in share of passenger cars, and 70.7% in the world motor vehicle assembly share. During the period of 2003 and 2015, these relative increases of motor vehicle assembly of Turkey were larger than comparable country of Poland's, close to comparable country of Thailand's and smaller than comparable country of Czechia's. Compared with passenger cars' average share in motor vehicle assembly in Europe, passenger cars' share in motor vehicle assembly in Turkey indicated that Turkey specialised in the assembly of commercial vehicles but still more than half of motor vehicles assembled in Turkey were in the form of passenger cars in both 2003 and 2015. 76.4% of motor vehicle assembly of Turkey were also exported in 2015 increased by 10.1% from 69.4% in 2003. Motor vehicle export intensity of Turkey was larger than comparable country of Thailand but it was still well below its European counterparts' in both 2003 and 2015.

[29] Please see footnote 28 for reasons for this excessive motor vehicle exports.

Table 2.7 Motor Vehicle Assembly across Regions and Major Countries (in thousand units)

	2003			2015			Change 03/15			Share of Export		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2003	2015	Change
Africa	430.7	69.3	0.7	615.7	55.4	0.7	42.9	-20	-4.2	68	54.1	-20.5
Remaining	9.4	75.9	0	0		0	-100		-100			
South Africa	421.3	69.1	0.7	615.7	55.4	0.7	46.1	-19.9	-2.1	69.5	54.1	-22.2
Americas	18280.3	45.2	29.8	21013.4	44.9	23	15	-0.7	-23	34.6	43.4	25.5
Argentina	169.2	64.6	0.3	533.7	57.9	0.6	215.5	-10.5	111.4	50.2	46.6	-7.2
Brazil	1827.8	82.3	3	2429.5	83.1	2.7	32.9	0.9	-10.9	28	17.6	-36.9
Canada	2552.9	52.5	4.2	2283.5	38.9	2.5	-10.6	-25.9	-40.1	92.7	95.9	3.5
Chile	6	30.2	0	0		0	-100		-100	62.6		
Colombia	20	89.7	0	78.1	98.6	0.1	290.6	10	161.8	40	40.5	1
Mexico	1575.4	49.1	2.6	3565.5	55.2	3.9	126.3	12.3	51.7	92.8	87.7	-5.4
Remaining	14.1	57.6	0	23.1	42.2	0	64.3	-26.8	10.1	89.5	95.8	7.1
USA	12115	37.2	19.8	12100.1	34.4	13.2	-0.1	-7.6	-33.1	15.4	25.3	63.9
Asia-Pacific	21451.1	73.3	35	47209.2	83.8	51.6	120.1	14.3	47.5	39.3	28.4	-27.8
Australia	413.3	88.5	0.7	173	92.4	0.2	-58.1	4.5	-71.9	42.9	62.1	45
China	4443.7	45.4	7.2	24503.3	86	26.8	451.4	89.4	269.5	4.5	5.8	27.1
India	1161.5	78.2	1.9	4125.7	81.9	4.5	255.2	4.7	138	15.1	31.7	110
Indonesia	322	63.1	0.5	1098.8	75	1.2	241.2	18.9	128.6	1.2	17.2	1349.1
Japan	10286.2	82.4	16.8	9278.2	84.4	10.1	-9.8	2.4	-39.6	55.5	63	13.6
Korea	3177.9	87.1	5.2	4556	90.8	5	43.4	4.2	-3.9	50.4	63	24.9
Malaysia	344.3	94.4	0.6	614.7	90.8	0.7	78.5	-3.8	19.6	4.6	4.4	-5.1
Pakistan	51.7	81.6	0.1	229.7	79.5	0.3	344.3	-2.6	197.8	2.9	1.6	-47.1
Philippines	53.8	71.9	0.1	112.5	68.9	0.1	109.2	-4.1	40.2	24.1	7.5	-68.9
Remaining	68	82.4	0.1	250.8	97.2	0.3	269.1	18	147.3	234.5	136.6	-41.7

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Motor Vehicle Assembly across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Export		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2003	2015	Change
Taiwan	386.7	68.5	0.6	351.1	85	0.4	-9.2	24.1	-39.2			
Thailand	742.1	33.9	1.2	1915.4	40.3	2.1	158.1	18.9	73	50.3	67	33.3
Europe	20501.9	86.5	33.4	21331.5	87.1	23.3	4	0.7	-30.3	106.5	116	8.9
EU (28)	18550.6	88	30.3	18481.4	89.2	20.2	-0.4	1.4	-33.2	113.8	125.8	10.6
Austria	139.7	85	0.2	125.5	86.9	0.1	-10.1	2.2	-39.8	225.8	224.2	-0.7
Belgium	904.4	87.5	1.5	409.3	90.2	0.4	-54.7	3	-69.7	273.5	469.8	71.8
Czechia	441.7	98.8	0.7	1303.6	99.6	1.4	195.1	0.8	97.8	88.6	96.9	9.4
France	3620.1	89	5.9	1970	78.9	2.2	-45.6	-11.3	-63.5	84.8	96.3	13.5
Germany	5506.6	93.4	9	6033.2	94.6	6.6	9.6	1.3	-26.6	137.8	141	2.4
Hungary	126.1	97	0.2	495.4	99.3	0.5	292.8	2.3	163.2	114.6	123.4	7.7
Italy	1321.6	77.7	2.2	1014.2	65.4	1.1	-23.3	-15.8	-48.6	74.3	102.1	37.4
Netherlands	215.3	75.8	0.4	119.3	47.6	0.1	-44.6	-37.2	-62.9	173.8	294	69.1
Poland	322.1	95.3	0.5	660.6	80.9	0.7	105.1	-15	37.5	97.2	108.8	11.9
Remaining	259	71.3	0.4	225.7	81.7	0.2	-12.9	14.6	-41.6	249.9	278.7	11.5
Romania	95.2	79.5	0.2	387.2	100	0.4	306.5	25.8	172.4	14.1	98.3	598.2
Slovakia	281.3	99.9	0.5	1000	100	1.1	255.4	0.1	138.2	88.1	80	-9.2
Slovenia	118.2	93.6	0.2	133.1	100	0.1	12.6	6.9	-24.5	102.7	185.4	80.6
Spain	3029.8	79.2	4.9	2733.2	81.2	3	-9.8	2.5	-39.5	87	89	2.4
Sweden	323	86.8	0.5	189	100	0.2	-41.5	15.2	-60.8	97.6	157.7	61.6
UK	1846.4	89.8	3	1682.2	94.4	1.8	-8.9	5.1	-38.9	79.7	111.3	39.7
Other Europe	1951.3	72.8	3.2	2850.1	73.8	3.1	46.1	1.3	-2.1	37.5	52.6	40.2
Israel												
Remaining	139.1	83.4	0.2	106.9	90.3	0.1	-23.2	8.3	-48.5	57.3	182.8	219.1
Russia	1278.8	79	2.1	1384.4	87.8	1.5	8.3	11.1	-27.5	13.2	9.2	-30.4

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Motor Vehicle Assembly across Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Export		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2003	2015	Change
Switzerland												
Turkey	533.4	55.1	0.9	1358.8	58.2	1.5	154.8	5.6	70.7	69.4	76.4	10.1
MENA	651.9	86.1	1.1	1327.2	88.7	1.5	103.6	3	36.4	4.7	19.5	315.7
Algeria	0		0	20	100	0					0.1	
Egypt	50	65.1	0.1	36	33.3	0	-28	-48.8	-51.8	0.6	10.7	1689.1
Iran	582.1	88.8	0.9	982.3	90.1	1.1	68.8	1.4	13.1			
Morocco	18.5	58.1	0	288.3	90.2	0.3	1454.7	55.2	941.8	4	57.6	1331.4
Remaining												
Saudi Arabia												
Tunisia	0		0	0.5	0	0					89.5	
World	61315.9	69.5	100	91496.9	75.5	100	49.2	8.7		60.2	52.3	-13.1

Notes: Data is based on reporting of each national motor vehicle assemblers association and estimates of the OICA. Data does not include farm tractors. 2015 Data on the Netherlands is obtained from the European Automobile Manufacturers' Association (ACEA). Shares are rounded, so they may not add up to 100%. QTY means quantity. PC stands for passenger car. PCT means percent.

Source: Calculations are based on OICA and ACEA's datasets, and UN Comtrade.

2.4 The Global Automotive Market

This section carries out a descriptive analysis of motor vehicle sales in 2005 and 2015 and changes between 2005 and 2015, motor vehicle fleet in 2005 and 2014 and changes between 2005 and 2014, and motorisation rate per 1000 inhabitants in 2014 in the world and across regions and major countries. Data reported in this section is compiled by the OICA.[30] The following subsections explain motor vehicle sales and in use across regions and major countries, respectively.

2.4.1 Motor Vehicle Sales across Regions and Major Countries

Table 2.8 reports motor vehicle sales of regions and major countries in thousand units, passenger cars' share in motor vehicle sales, regions and major countries' share in the world motor vehicle sales in 2005 and 2015, percent change in motor vehicle sales, passenger cars' share in motor vehicle sales and world motor vehicle sales share between 2005 and 2015, share of motor vehicle sales imported in 2005 and 2015 and percent change in this share between 2005 and 2015, and motor vehicle sales in relation to motor vehicle assembly in 2005 and 2015 and percent change in this share between 2005 and 2015.[31,32,33]

Table 2.8 presents that in 2015, motor vehicle sales worldwide were about 89.2 million units increased by 35.2% from around 65.9 million units in 2005. 73.8% of motor vehicle sales worldwide, in 2015 were passenger cars up by 7.5% from 68.6% in 2005, while the remaining were commercial vehicles. In 2015, 45% of the world motor vehicle sales were carried out by Asia-Pacific increased by 63.4% the largest increase amongst regions from 27.6% in 2005 leading Asia-Pacific to be the largest motor vehicle market in the world, resulting in Asia-Pacific overtaking the first place of the Americas in 2005 and moving up by two places. 82% of motor vehicle sales of Asia-Pacific, in 2015 were passenger cars up by 13.1% the largest increase amongst regions from 72.5% in 2005 still the second largest share leading Asia-Pacific to overtake the second place of the MENA in 2005 but still highly close to MENA's share in 2015. The Americas, in 2015 constituted 28.3% of the world motor vehicle market decreased by 20.1% the third largest fall after Europe and Africa's amongst regions from 35.4% in 2005 still leading the Americas to be the second largest motor vehicle market in the world in 2015 losing their first place to Asia-Pacific in 2005. The Americas were the only region with around 50% of their motor vehicle sales were in the form of commercial vehicles due to high demands for such vehicles in the

[30] Please see section 2.3 for detail.

[31] Please note that 2003 motor vehicle sales data is unavailable, instead 2005 motor vehicle sales data is used in this subsection.

[32] Please note that while import and export data include farm tractors, sales data does not include farm tractors, so sales data on motor vehicles consists of data on sales of passenger cars and commercial vehicles. Please see section 2.3 for definitions of passenger cars and commercial vehicles.

[33] Please note that share of motor vehicle sales imported for specific countries and, in particular, almost all European countries was larger than 100% in both 2005 and 2015. Please see footnote 28 for explanation for this discrepancy.

Americas, especially by the USA and Canada. Therefore, the Americas were the region with the lowest passenger car sales share amongst regions in both 2005 and 2015. In 2015, Europe made up 21.6% of the world motor vehicle market decreased by 32.7% the largest fall amongst regions from 32.2% in 2005 leading Europe to be the third largest motor vehicle market in the world in 2015 losing its second place to the Americas in 2005. 86.4% of motor vehicle sales of Europe, in 2015 were passenger cars increased by 1.6% a small increase from 85% in 2005 still leading Europe to have the largest share in both 2005 and 2015. The MENA, in 2015 made up 4.2% of the world motor vehicle market up by 11.1% the second largest increase after Asia-Pacific's amongst regions from 3.7% in 2005 still leading the MENA to be the fourth largest motor vehicle market in the world in both 2005 and 2015. 81.9% of motor vehicle sales of the MENA, in 2015 were passenger cars up by 5.7% the second largest increase after Asia-Pacific's amongst regions from 77.4% in 2005 having the third largest share but losing its second place to Asia-Pacific in 2005. On the other hand, it was still highly close to Asia-Pacific's share in 2015. Africa, in 2015 constituted around 0.9% of the world motor vehicle market decreased by 22.3% the second largest fall after Europe's from about 1.2% in 2005 resulting in Africa being the smallest motor vehicle market in the world in both 2005 and 2015. 67% of motor vehicle sales of Africa, in 2015 were passenger cars decreased by 0.5% a small and only fall amongst regions from 67.4% in 2005 still leading Africa to occupy the fourth spot before the Americas.

Table 2.8 also reports share of motor vehicle imports in motor vehicle sales across regions and major countries in 2005 and 2015 and change in this share between 2005 and 2015. 47% of the motor vehicle sales worldwide were imported in 2015 decreased by 19.5% from 58.4% in 2005. Europe was the most motor vehicle import intensive region in the world in both 2005 and 2015 but these shares should be interpreted with caution as Europe's motor vehicle imports was larger than its motor vehicle sales in both 2005 and 2015.[34] 63.9% of motor vehicle sales of the MENA were imported in 2015 decreased by 5.4% the second largest fall after Asia-Pacific's amongst regions from 67.5% in 2005 but still resulting in the MENA being the second largest motor vehicle import intensive region in the world in both 2005 and 2015. 54.8% of Americas' motor vehicle sales were imported in 2015 increased by 8.9% the largest increase amongst regions from 50.4% in 2005 still leading the Americas to be the third largest motor vehicle import intensive region in the world in both 2005 and 2015. 49.1% of motor vehicle sales of Africa were imported in 2015 increased by 8.2% the second largest increase after Americas' amongst regions from 45.4% in 2005 leading Africa to be the fourth largest motor vehicle import intensive region in the world in both 2005 and 2015. 13% of motor vehicle sales of Asia-Pacific were imported in 2015 decreased by 31.1% the largest fall amongst regions from 18.9% in 2005 resulting in Asia-Pacific being the least motor vehicle import intensive region in the world in both 2005 and 2015.

[34] Please see footnote 28 for reasons for this excessive motor vehicle imports.

Furthermore, Table 2.8 presents that in 2015 the world motor vehicle sales were 2.5% smaller than the world motor vehicle assembly, whereas they were 2% smaller in 2005. MENA's motor vehicle sales, in 2015 was about 1.8 times larger than its motor vehicle assembly also valid for 2005 that was the largest positive difference amongst regions. Africa's motor vehicle sales, in 2015 was 29.7% larger than its motor vehicle assembly, whilst it was 42.3% larger in 2005. Americas' motor vehicle sales, in 2015 were around 20% larger than their motor vehicle assembly also valid for 2005. Europe's motor vehicle sales, in 2015 was 9.5% smaller than its motor vehicle assembly, whereas it was 0.4% smaller in 2005. Asia-Pacific's motor vehicle sales, in 2015 was 15% smaller than its motor vehicle assembly, whilst it was 27.9% smaller in 2005 that was the largest negative difference amongst regions. As a result, Asia-Pacific and Europe were only regions whose motor vehicle assembly were larger than their motor vehicle sales, whereas the MENA, Africa and the Americas were only regions whose motor vehicle assembly were smaller than their motor vehicle sales in both 2005 and 2015.

Last, Table 2.8 indicates that in 2005, Turkey's motor vehicle sales were around 715 thousand units, 61.3% of which were passenger cars, making up about 1.1% of the world motor vehicle sales. On the other hand, in 2015 Turkey's motor vehicle sales were more than 1 million units, 71.8% of which were passenger cars, constituting around 1.1% of the world motor vehicle sales translating into an increase of 41.4% in units, 17% in share of passenger cars, and 4.5% in the world motor vehicle sales share. During the period of 2005 and 2015, these relative increases of motor vehicle sales of Turkey were larger than comparable country of Thailand's and smaller than comparable country of Argentina's. Compared with passenger cars' average share in motor vehicle sales of Europe, passenger cars' share in motor vehicle sales of Turkey indicated that there was a lower demand for passenger cars in Turkey in both 2005 and 2015. On the other hand, share of passenger cars in motor vehicle sales of Turkey experienced the largest increase in Europe and the fourth largest increase after Malaysia's amongst major motor vehicle markets in the world between 2005 and 2015. Despite a larger share of commercial vehicles in motor vehicle assembly and a larger demand for commercial vehicles in Turkey than Europe, the gap between share of commercial vehicles in motor vehicle assembly and share of commercial vehicles in motor vehicle sales in Turkey also widened in 2015. Furthermore, 71.4% of motor vehicle sales of Turkey were imported in 2015 increased by 14.4% from 62.5% in 2005. This increase was larger than corresponding average increase of Europe but the share was still well below the average of Europe. Finally, Turkey's motor vehicle sales, in 2015 were 25.6% smaller than its motor vehicle assembly, whilst they were 18.6% smaller in 2005 a lower difference in relation to comparable countries'.[35]

[35] Please note that the Turkish motor vehicle market is further examined in section 3.2.

Table 2.8 Motor Vehicle Sales across Regions and Major Countries (in thousand units)

	2005			2015			Change 05/15			Share of Import			Sales in relation to Assembly		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2005	2015	Change	2005	2015	Change
Africa	759.8	67.4	1.2	798.6	67	0.9	5.1	-0.5	-22.3	45.4	49.1	8.2	42.3	29.7	-29.7
Remaining	142.4	64.7	0.2	180.9	67.8	0.2	27	4.8	-6.1						
South Africa	617.4	68	0.9	617.7	66.8	0.7	0.1	-1.8	-26	55.9	63.5	13.7	17.5	0.3	-98.1
Americas	23335.5	49.8	35.4	25231.9	50.2	28.3	8.1	0.7	-20.1	50.4	54.8	8.9	20.8	20.1	-3.3
Argentina	402.7	72.2	0.6	605.9	71.1	0.7	50.5	-1.4	11.3	70.6	58.7	-16.8	25.9	13.5	-47.8
Brazil	1714.6	84	2.6	2569	82.6	2.9	49.8	-1.6	10.8	6	15.6	158.2	-32.2	5.7	-117.8
Canada	1630.1	52	2.5	1939.9	36.8	2.2	19	-29.3	-12	97.1	97.1	-0.1	-39.4	-15	-61.8
Chile	200	70	0.3	297.8	71.2	0.3	48.9	1.7	10.1	106.3	102.9	-3.2			
Colombia	150	80	0.2	272.4	86.9	0.3	81.6	8.7	34.3	73.2	105.1	43.6	170.6	248.9	45.9
Mexico	1168.5	61.1	1.8	1351.6	66	1.5	15.7	8	-14.5	92	75	-18.5	-30	-62.1	106.6
Remaining	625.2	66.7	0.9	724.6	66.6	0.8	15.9	-0.1	-14.3	109.5	107.3	-2			
USA	17444.3	43.9	26.5	17470.7	43.3	19.6	0.2	-1.3	-25.9	44.1	50.5	14.3	45.6	44.4	-2.7
Asia-Pacific	18165.3	72.5	27.6	40135.8	82	45	120.9	13.1	63.4	18.9	13	-31.1	-27.9	-15	-46.3
Australia	988.3	61.6	1.5	1155.4	44.6	1.3	16.9	-27.5	-13.6	85	101.7	19.6	150.4	567.8	277.6
China	5758.2	69	8.7	24597.6	86	27.6	327.2	24.7	215.8	2.9	4.5	57.1	0.9	0.4	-56.5
India	1440.5	76.8	2.2	3425.3	80.9	3.8	137.8	5.3	75.8	0.8	0.5	-36.2	-11.5	-17	48.2
Indonesia	533.9	68.2	0.8	1031.4	73.3	1.2	93.2	7.4	42.8	13.5	11	-18.2	8	-6.1	-177
Japan	5852	81.1	8.9	5046.5	83.5	5.7	-13.8	3	-36.2	5	6.8	35.1	-45.8	-45.6	-0.4
Korea	1145.2	78	1.7	1833.8	83.6	2.1	60.1	7.2	18.4	6.5	19.3	195.7	-69	-59.7	-13.5
Malaysia	551	74.6	0.8	666.7	88.7	0.7	21	18.9	-10.5	80.2	49.9	-37.8	-2.3	8.5	-472.8
Pakistan	167	84.6	0.3	229.7	79.3	0.3	37.5	-6.2	1.7	156.2	109.3	-30	6.9	0	-100
Philippines	97.1	36.1	0.1	288.6	40.3	0.3	197.3	11.6	119.9	29.9	35.2	17.9	114.2	156.6	37.1
Remaining	493.2	78.6	0.7	800.6	69.9	0.9	62.3	-11.1	20	231	166.7	-27.8	287	219.2	-23.6

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Motor Vehicle Sales across Regions and Major Countries (Continued)

	2005			2015			Change 05/15			Share of Import			Sales in relation to Assembly		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2005	2015	Change	2005	2015	Change
Taiwan	446.5	73	0.7	262.6	80.8	0.3	-41.2	10.7	-56.5				0	-25.2	
Thailand	692.5	25.7	1.1	797.6	38.2	0.9	15.2	48.5	-14.8	16.1	13.1	-18.5	-38.5	-58.4	51.7
Europe	21205.2	85	32.2	19298.4	86.4	21.6	-9	1.6	-32.7	100.6	104.2	3.5	-0.4	-9.5	2046.9
EU (28)	17719.1	85.9	26.9	15897.7	86.9	17.8	-10.3	1.1	-33.7	107.3	110.7	3.2	-5.8	-14	139.7
Austria	345.6	89.1	0.5	349.6	88.3	0.4	1.2	-0.9	-25.2	146.4	130.2	-11.1	36.5	178.6	389.3
Belgium	551.5	87.1	0.8	571.5	87.7	0.6	3.6	0.7	-23.4	281.9	309.5	9.8	-40.6	39.6	-197.5
Czechia	175.9	86.2	0.3	260.1	88.8	0.3	47.8	2.9	9.3	139	111.8	-19.6	-70.9	-80	12.9
France	2598.2	81.5	3.9	2345.1	81.8	2.6	-9.7	0.3	-33.3	85.7	100.8	17.6	-26.8	19	-171.1
Germany	3614.9	91.8	5.5	3539.8	90.6	4	-2.1	-1.4	-27.6	78.6	74.5	-5.3	-37.2	-41.3	11
Hungary	219.5	90.7	0.3	100.9	76.5	0.1	-54	-15.7	-66	114.9	181.2	57.7	44.4	-79.6	-279.5
Italy	2495.4	89.9	3.8	1725.4	91.3	1.9	-30.9	1.5	-48.9	88.2	95.3	8	140.3	70.1	-50
Netherlands	546	85.2	0.8	521.2	86.2	0.6	-4.5	1.2	-29.4	117.2	139.4	18.9	202.1	337	66.8
Poland	255.1	81.1	0.4	432.4	82.1	0.5	69.5	1.2	25.3	127.6	105.1	-17.7	-59.2	-34.5	-41.7
Remaining	1422	81.6	2.2	1036.9	85.1	1.2	-27.1	4.2	-46.1	193.2	197.7	2.3	490.6	359.5	-26.7
Romania	248.5	86.5	0.4	120.6	81.5	0.1	-51.5	-5.8	-64.1	69.7	97.2	39.6	27.5	-68.9	-350
Slovakia	75	75.9	0.1	90.1	86.5	0.1	20.1	14.1	-11.2	202.7	139.7	-31.1	-65.6	-91	38.6
Slovenia	67.9	87.4	0.1	69	86.2	0.1	1.6	-1.4	-24.8	143.5	211.7	47.5	-61.9	-48.2	-22.1
Spain	1959.5	78	3	1277.1	85.7	1.4	-34.8	9.8	-51.8	96.2	75.6	-21.4	-28.8	-53.3	84.9
Sweden	316.1	86.8	0.5	396.7	87	0.4	25.5	0.3	-7.2	117.2	121.5	3.7	-6.6	109.9	-1756
UK	2828.1	86.3	4.3	3061.4	86	3.4	8.2	-0.3	-20	98.7	104.1	5.5	56.9	82	44.2
Other Europe	3486.1	80.2	5.3	3400.7	83.9	3.8	-2.5	4.6	-27.9	66.7	73.7	10.5	40.4	19.3	-52.2
Israel	156	83.3	0.2	260.2	95	0.3	66.8	14.1	23.3	83.4	99.2	19			
Remaining	514.8	85.7	0.8	328.7	83.2	0.4	-36.1	-2.9	-52.8	109.5	216.2	97.4	103.4	207.5	100.6
Russia	1806.6	84.1	2.7	1437.9	89.3	1.6	-20.4	6.1	-41.2	47.7	27.5	-42.4	33.7	3.9	-88.5

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Motor Vehicle Sales across Regions and Major Countries (Continued)

	2005			2015			Change 05/15			Share of Import			Sales in relation to Assembly		
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	2005	2015	Change	2005	2015	Change
Switzerland	293.5	90.9	0.4	362.7	89.3	0.4	23.6	-1.8	-8.6	109.4	115.6	5.6			
Turkey	715.2	61.3	1.1	1011.2	71.8	1.1	41.4	17	4.5	62.5	71.4	14.4	-18.6	-25.6	37.2
MENA	2468.9	77.4	3.7	3710.3	81.9	4.2	50.3	5.7	11.1	67.5	63.9	-5.4	173.9	179.6	3.2
Algeria	99.4	71.5	0.2	181.4	73.9	0.2	82.5	3.5	34.9	170.2	162.9	-4.3		807	
Egypt	121.4	77.8	0.2	332.1	77.8	0.4	173.5	-0.1	102.2	52	70.1	34.9	75.4	822.5	990.4
Iran	857.5	85.1	1.3	1222	86.4	1.4	42.5	1.5	5.4				4.9	24.4	394.7
Morocco	63.7	88.3	0.1	131.9	91.6	0.1	107.2	3.8	53.2	97.5	75.5	-22.6	327.8	-54.3	-116.6
Remaining	731	72.2	1.1	964.3	78.9	1.1	31.9	9.2	-2.5	107.1	70.8	-33.8			
Saudi Arabia	562.9	72.3	0.9	830.1	81	0.9	47.5	12	9	96	116.6	21.4			
Tunisia	33	75.8	0.1	48.5	74.4	0.1	47	-1.7	8.7	151.3	191.8	26.8			
World	65934.7	68.6	100	89175.1	73.8	100	35.2	7.5		58.4	47	-19.5	-2	-2.5	30.1

Notes: Data is based on reporting of each national motor vehicle assemblers association and estimates of the OICA. Data does not include farm tractors. Shares are rounded, so they may not add up to 100%. QTY means quantity. PC stands for passenger car. PCT means percent.

Source: Calculations are based on OICA's dataset and UN Comtrade.

2.4.2 Motor Vehicle in Use across Regions and Major Countries

Table 2.9 reports size of motor vehicle fleet of regions and major countries in million units, passenger cars' share in motor vehicle fleet, regions and major countries' share in the world motor vehicle fleet in 2005 and 2014, percent change in motor vehicle fleet size, passenger cars' share in motor vehicle fleet and world motor vehicle fleet share between 2005 and 2014, and motorisation rate per 1000 inhabitants in the world and across regions and major countries in 2014.[36,37]

Table 2.9 presents that size of motor vehicle fleet worldwide was more than 1.2 billion units in 2014 increased by 38.5% from about 893 million units in 2005. 73.4% of motor vehicle fleet worldwide, in 2014 were passenger cars up by 0.2% from 73.2% in 2005, while the remaining were commercial vehicles. In 2014, the Americas made up 32.7% of the world motor vehicle fleet decreased by 11.1% the second largest fall after Europe's amongst regions from 36.7% in 2005 still leading the Americas to have the largest motor vehicle fleet in the world in both 2005 and 2014. 57.3% of motor vehicle fleet of the Americas were passenger cars in 2014 decreased by 6.9% the largest fall from 61.6% in 2005 leading the Americas to have the lowest share in both 2005 and 2014. Europe, in 2014 constituted 31.1% of the world motor vehicle fleet decreased by 14.3% the largest fall amongst regions from 36.2% in 2005 just lower than Americas' leading Europe to have the second largest motor vehicle fleet in the world in both 2005 and 2014. 85.8% of motor vehicle fleet of Europe were passenger cars in 2014 decreased by 0.1% from 85.9% in 2005 leading Europe to have the highest share in both 2005 and 2014. Asia-Pacific, in 2014 made up 29.6% of the world motor vehicle fleet increased by 36.5% the largest rise amongst regions from 21.7% in 2005 still resulting in Asia-Pacific having the third largest motor vehicle fleet in the world in both 2005 and 2014. 78.3% of motor vehicle fleet of Asia-Pacific were passenger cars in 2014 increased by 7.8% the largest rise from 72.6% in 2005 still leading Asia-Pacific to have the second highest share after Europe's in both 2005 and 2014. The MENA, in 2014 constituted 4.6% of the world motor vehicle fleet increased by 28.3% the second largest rise after Asia-Pacific's amongst regions from 3.6% in 2005 still leading the MENA to have the fourth largest motor vehicle fleet in the world in both 2005 and 2014. 74.5% of motor vehicle fleet of the MENA, in 2014 were passenger cars increased by 3.4% the third largest rise after Asia-Pacific and Africa's from 72% in 2005 still leading the MENA to have the third highest share in both 2005 and 2014. Africa, in 2014 made up 2% of the world motor vehicle fleet increased by 16.1% the third largest rise after Asia-Pacific and MENA's amongst regions from 1.7% in 2005 still resulting in

[36] Please note that 2003 and 2015 motor vehicle fleet data is unavailable, instead 2005 and 2014 motor vehicle fleet data is utilised in this subsection. Data on motorisation rate per 1000 inhabitants is also just available for 2014.

[37] Please note that while import and export data include farm tractors, motor vehicle fleet data does not include farm tractors. Therefore, motor vehicle fleet data consists of data on passenger car and commercial vehicle fleet, which is also valid for motorisation rate per 1000 inhabitants. Please see section 2.3 for definitions of passenger cars and commercial vehicles and the dataset used in this subsection.

Africa having the smallest motor vehicle fleet in the world in both 2005 and 2014. 66% of motor vehicle fleet of Africa were passenger cars in 2014 increased by 3.9% the second largest rise after Asia-Pacific's from 63.6% in 2005 still leading Africa to have the fourth highest share in both 2005 and 2014.

Table 2.9 also reports that motorisation rate (motor vehicle (passenger car and commercial vehicle) ownership) per 1000 inhabitants was 179.8 units in the world in 2014. Europe ranked the first region with the highest motorisation rate of 495.9 units in the world in 2014. Europe was followed by the Americas having a motorisation rate of 350.6 units in the world in 2014. Asia-Pacific had the third highest motorisation rate of 266.6 units almost half of Europe's. Asia-Pacific was followed by the MENA having a motorisation rate of 150.9 units in the world in 2014. On the other hand, Africa had the lowest motorisation rate of 114.2 units in the world in 2014.

Last, Table 2.9 reveals that in 2005, Turkey's motor vehicle fleet was around 8.4 million units, 68.5% of which were passenger cars, making up about 0.9% of the world motor vehicle fleet. On the other hand, in 2014 Turkey's motor vehicle fleet was around 14.4 million units, 68.6% of which were passenger cars, constituting around 1.2% of the world motor vehicle fleet translating into an increase of 70.6% in units, 0.1% in share of passenger cars, and 23.2% in the world motor vehicle fleet share. During the period of 2005 and 2014, these relative increases of motor vehicle fleet of Turkey were the largest in Europe and larger than comparable country of Thailand's but smaller than comparable country of Argentina's. Passenger cars' share in motor vehicle fleet of Turkey was well below passenger cars' average share in motor vehicle fleet of Europe and even passenger cars' share in worldwide motor vehicle fleet in both 2005 and 2014. Turkey also had a motorisation rate of 189.4 units in 2014. Therefore, motor vehicle ownership was much lower than Europe's average and comparable countries' but larger than the world average.[38]

[38] Please note that the Turkish motor vehicle market is further examined in section 3.2.

Table 2.9 Motor Vehicle in Use across Regions and Major Countries (in million units)

	2005			2014			Change 05/14			Motorisation
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	Rate (2014)
Africa	15.4	63.6	1.7	24.7	66	2	60.8	3.9	16.1	114.2
Remaining	8.5	61.2	1	15.1	65.8	1.2	77.9	7.5	28.5	47.9
South Africa	6.9	66.6	0.8	9.6	66.5	0.8	39.7	-0.1	0.9	180.5
Americas	327.9	61.6	36.7	403.8	57.3	32.7	23.2	-6.9	-11.1	350.6
Argentina	7	74.7	0.8	13.4	75.8	1.1	90.9	1.6	37.9	320
Brazil	23	79.8	2.6	41.7	78.4	3.4	81.3	-1.8	30.9	206.5
Canada	18.9	95.8	2.1	22.8	95.1	1.8	20.8	-0.8	-12.7	643.7
Chile	2.4	66.2	0.3	4.3	69.8	0.3	78	5.5	28.5	241
Colombia	2.9	56.8	0.3	5.1	60	0.4	76.1	5.6	27.2	103.8
Mexico	21.6	66.4	2.4	35.8	71.4	2.9	65.9	7.7	19.8	288.8
Remaining	14.4	68	1.6	22.6	63.3	1.8	57.5	-7	13.8	193
USA	237.7	55.9	26.6	258	46.9	20.9	8.6	-16.1	-21.6	807.7
Asia-Pacific	193.8	72.6	21.7	366.4	78.3	29.6	89.1	7.8	36.5	266.6
Australia	13.6	80.9	1.5	16.9	78.9	1.4	23.8	-2.5	-10.6	714.1
China	31.6	67.5	3.5	142.4	81.3	11.5	350.8	20.5	225.5	102.2
India	10.3	73.8	1.2	28	78.5	2.3	171	6.3	95.7	22.1
Indonesia	9.1	56	1	20.9	60.3	1.7	130.3	7.7	66.3	82.5
Japan	75.7	75.4	8.5	77.2	78.6	6.2	2	4.2	-26.4	607.3
Korea	15.4	72.2	1.7	20.1	78.3	1.6	30.7	8.4	-5.6	406.4
Malaysia	7.4	88.4	0.8	12.2	90.2	1	64.9	2	19.1	404.9
Pakistan	1.8	80.1	0.2	3	82.4	0.2	68	3	21.3	16
Philippines	2.9	88.9	0.3	3.5	87.6	0.3	21.8	-1.4	-12	35.3
Remaining	9.9	75.2	1.1	19.1	80.1	1.5	94	6.5	40.1	255.3

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Motor Vehicle in Use across Regions and Major Countries (Continued)

	2005			2014			Change 05/14			Motorisation
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	Rate (2014)
Taiwan	6.7	84.7	0.7	7.5	85.5	0.6	12.6	0.9	-18.7	320.2
Thailand	9.5	41.3	1.1	15.6	53.7	1.3	63.6	29.9	18.1	232.2
Europe	323.5	85.9	36.2	384.2	85.8	31.1	18.7	-0.1	-14.3	495.9
EU (28)	262.9	87	29.5	291.1	86.8	23.5	10.7	-0.2	-20	536.3
Austria	4.5	91.9	0.5	5.1	91.4	0.4	13.6	-0.6	-18	604.6
Belgium	5.5	87.8	0.6	6.3	87.1	0.5	14.3	-0.8	-17.4	570.1
Czechia	4.5	88.2	0.5	5.6	87.4	0.5	25.8	-0.8	-9.2	527.7
France	36.3	82.9	4.1	38.4	82.8	3.1	5.8	-0.2	-23.6	582.8
Germany	49.2	93.6	5.5	47.6	93.2	3.9	-3.2	-0.5	-30.1	578.3
Hungary	3.3	87	0.4	3.6	85.9	0.3	9	-1.3	-21.3	365.3
Italy	39.1	88.7	4.4	41.9	88.4	3.4	7.3	-0.3	-22.5	686.5
Netherlands	8.2	86.9	0.9	9.2	88.7	0.7	13.2	2.1	-18.3	549.9
Poland	14.8	83.3	1.7	23.7	84.4	1.9	59.7	1.4	15.3	619.7
Remaining	26.8	82.2	3	30.9	83.5	2.5	15.3	1.6	-16.8	569.5
Romania	3.9	86.3	0.4	5.7	86	0.5	46.4	-0.4	5.7	264.1
Slovakia	1.5	86.4	0.2	2.3	85.9	0.2	50.5	-0.5	8.7	413.2
Slovenia	1	93	0.1	1.2	91.8	0.1	13.1	-1.3	-18.3	558.4
Spain	25.2	80.5	2.8	27.1	81.2	2.2	7.8	0.9	-22.2	575.7
Sweden	4.6	89.7	0.5	5.2	88.5	0.4	11.9	-1.4	-19.2	539.7
UK	34.4	88.6	3.9	37.1	87.9	3	7.9	-0.8	-22.1	575.4
Other Europe	60.6	81.2	6.8	93	82.9	7.5	53.5	2.1	10.8	366.7
Israel	1.9	86.9	0.2	2.8	87.3	0.2	48.8	0.5	7.4	362.2
Remaining	14.9	83.3	1.7	20.5	83	1.7	38	-0.3	-0.4	338.4
Russia	31.2	81.9	3.5	50.5	85.9	4.1	61.8	4.9	16.8	354.4

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Motor Vehicle in Use across Regions and Major Countries (Continued)

	2005			2014			Change 05/14			Motorisation
	QTY	PC	PCT	QTY	PC	PCT	QTY	PC	PCT	Rate (2014)
Switzerland	4.2	91.6	0.5	4.8	90.8	0.4	14.6	-0.9	-17.2	588.9
Turkey	8.4	68.5	0.9	14.4	68.6	1.2	70.6	0.1	23.2	189.4
MENA	32.2	72	3.6	57.2	74.5	4.6	77.7	3.4	28.3	150.9
Algeria	2.9	65.2	0.3	5.1	67.9	0.4	75.5	4.1	26.8	128.6
Egypt	3.2	80.8	0.4	5.1	76.4	0.4	61.8	-5.5	16.8	61.5
Iran	7.4	88.3	0.8	13.4	89.7	1.1	81.5	1.5	31.1	170.2
Morocco	2	73.3	0.2	3.4	71.3	0.3	71.7	-2.6	24	101.4
Remaining	12.2	63.5	1.4	22.6	69.8	1.8	84.8	9.9	33.4	257.4
Saudi Arabia	3.6	60.3	0.4	6.2	65.9	0.5	74.3	9.2	25.9	212.2
Tunisia	1	87.5	0.1	1.4	67.6	0.1	42.7	-22.7	3.1	125
World	892.8	73.2	100	1236.3	73.4	100	38.5	0.2		179.8

Notes: Data is based on reporting of each national motor vehicle assemblers association and estimates of the OICA. Data does not include farm tractors. Shares are rounded, so they may not add up to 100%. QTY means quantity. PC stands for passenger car. PCT means percent.

Source: Calculations are based on OICA's dataset.

2.5 Findings on Automotive Sector Structures of Major Countries

A close examination of Table 2.1 to Table 2.9 provides five particular patterns revealing major countries' international automotive trade, and motor vehicle assembly and market structures. These five patterns are based on thorough examination of compositions of automotive imports and exports, comparison of shares of motor vehicle exports and imports, share of automotive imports and exports in total imports and exports, and relative difference between these two shares, share of motor vehicle assembly exported, share of motor vehicle sales imported, and sales in relation to assembly as well as trends in these indicators between 2003 and 2015. It should be noted that these five patterns do not strictly hold for every individual country as all classifying indicators may not align with indicators of every country. If a particular indicator does not hold for a country, an explanation is made in the footnote of the country.

The first pattern is that particular countries specialise in assembly of motor vehicles. First, such countries source more than 50% of their automotive imports in the form of automotive parts, while dispatching more than 50% of their automotive exports in the form of motor vehicles. Second, these countries' shares of motor vehicles in the automotive exports exceed their shares of motor vehicles in the automotive imports. Third, shares of automotive imports and exports in countries' total imports and exports are larger than 10% and even the latter share is larger than the former share, so there is a larger involvement in automotive exports than automotive imports. Fourth, these countries' shares of motor vehicle assembly exported are larger than 50% and these countries' shares of motor vehicle sales imported usually exceed 50%, hence a larger portion of motor vehicles assembled are for export markets and there is usually high demand for imported motor vehicles, as well. As a result, such countries are highly engaged with the global automotive industry in terms of both motor vehicle assembly and market. Fifth, units of motor vehicles assembled are greater than units of motor vehicle sales. Therefore, such countries assemble a greater number of motor vehicles than their internal demand for motor vehicles. Argentina,[39] Belgium,[40] Brazil,[41] Canada, Germany, Japan,[42] Korea,[43]

[39] Share of automotive exports in Argentina's total exports was only 6.1% in 2003. Motor vehicle sales were also larger than motor vehicle assembly in both 2005 and 2015.

[40] 46.1% and 35.2% of the automotive imports of Belgium were in the form of automotive parts in 2003 and 2015, respectively. Motor vehicle sales were also larger than motor vehicle assembly in 2015.

[41] Not all relevant indicators of Brazil were consistent with indicators of this pattern's.

[42] Share of automotive imports in Japan's total imports was 4.5% and 5.4% in 2003 and 2015, respectively. Share of motor vehicle sales imported was also smaller than 50% in both 2005 and 2015.

[43] Share of automotive imports in Korea's total imports was 3.6% and 5.4% in 2003 and 2015, respectively. Share of motor vehicle sales imported was also smaller than 50% in both 2005 and 2015.

Mexico,[44] Morocco,[45] the Netherlands,[46] Russia,[47] Slovakia, Slovenia,[48] South Africa,[49] Spain, Sweden,[50] Thailand,[51] Turkey and the UK[52] fall within this pattern.[53]

Theories of comparative advantage argue that economies with relatively abundant labour are to specialise in "tasks" or "activities" requiring relatively more labour (Samuelson, 2004; Baldone et al., 2007; Helpman, 2011; Grossman and Rossi-Hansberg, 2012; Hanson, 2012; R. Baldwin and Robert-Nicoud, 2014; Timmer et al., 2014). In line with this argument, economies in the first pattern specialise in assembly of motor vehicles. Nevertheless, there are particular economies, for example Germany that have relatively abundant capital but they fall in the first pattern contradicting the argument of comparative advantage. On the other hand, these contradicting economies have high skills related to the automotive industry and account for a sizeable part of the global automotive industry. Therefore, these contradicting economies have competitive advantage in the automotive industry (Porter, 1990; Porter, 1998a; Porter, 1998b). It should be noted that economies in the first pattern are also engaged in production of automotive parts in addition to assembly of motor vehicles.

The second pattern is that despite being major motor vehicle assembly locations, specific countries offshore their motor vehicle assembly activity. First, these countries source less than 50% of their automotive imports in the form of automotive parts, so they source more than 50% of their automotive imports in the form of motor vehicles. These countries dispatch less than 50% of their automotive exports in the form of motor vehicles, instead they dispatch more than 50% of their automotive exports in the form of automotive parts. Second, such countries' shares of motor vehicles in the automotive exports do not exceed their shares of motor vehicles in the automotive imports in line with their practice of offshoring motor vehicle assembly. Third, shares of automotive imports and exports in countries' total imports and exports are larger than 10% that is the same as the first pattern and even the former share is larger than the latter share, so there is a larger involvement in motor vehicle imports than motor vehicle exports. Except more than 10% automotive imports and exports in the total imports and exports features of this pattern, all remaining features of this pattern are opposite to the first pattern. As a result, despite having major

[44] 47.7% of the automotive exports of Mexico were in the form of motor vehicles in 2003.

[45] This pattern for Morocco has been recently emerged due to recent investment by an international motor vehicle group but specific indicators of Morocco did not still align with this pattern's.

[46] Not all relevant indicators of the Netherlands were consistent with indicators of this pattern's.

[47] Not all relevant indicators of Russia were consistent with indicators of this pattern's.

[48] Not all relevant indicators of Slovenia were consistent with indicators of this pattern's.

[49] This pattern for South Africa has been observed in recent years due to recent investments by intentional motor vehicle groups but particular indicators of South Africa did not still align with this pattern's.

[50] Motor vehicle sales of Sweden was larger than its motor vehicle assembly in 2015.

[51] 41.5% and 47.9% of the automotive exports of Thailand were in the form of motor vehicles in 2003 and 2015, respectively. Share of automotive imports in Thailand's total imports was 7.3% and 7.2% in 2003 and 2015, respectively. Share of automotive exports in Thailand's total exports was 8% in 2003. Share of motor vehicle sales imported was smaller than 50% in both 2005 and 2015.

[52] Not all relevant indicators of the UK were consistent with indicators of this pattern's.

[53] Japan, Korea, Germany and Russia are only motor vehicle assembling countries having major motor vehicle brands.

motor vehicle brands and groups, and assembly plants, such countries dispatch a larger portion of their automotive exports in the form of automotive parts to overseas motor vehicle assembly plants and source a larger portion of their automotive imports in the form of motor vehicles. These countries serve their relatively large internal markets by imported motor vehicles and internally assembled motor vehicles. Fourth, these countries' shares of motor vehicle assembly exported and motor vehicle sales imported are larger than 50%, hence a larger portion of motor vehicles assembled are for export markets and there is also higher demand for imported motor vehicles similar to the first pattern. As a result, such countries are highly engaged with the global automotive industry in terms of both motor vehicle assembly and market. Fifth, units of motor vehicle sales are larger than units of motor vehicles assembled opposite to the first pattern. Therefore, such countries assemble a smaller number of motor vehicles than their internal demand for motor vehicles. France[54], Italy and the USA[55] fall within this pattern.

Theories of comparative advantage also suggest that economies with relatively abundant capital are to specialise in "tasks" or "activities" that are capital intensive (Samuelson, 2004; Baldone et al., 2007; Helpman, 2011; Grossman and Rossi-Hansberg, 2012; Hanson, 2012; R. Baldwin and Robert-Nicoud, 2014; Timmer et al., 2014). Consistent with this suggestion, economies in the second pattern specialise in production of automotive parts. As indicated earlier that these economies dispatch automotive parts to overseas motor vehicle assembly plants and source motor vehicles assembled overseas. This pattern is called "offshoring" assembly activities (Grossman and Rossi-Hansberg, 2006; Grossman and Rossi-Hansberg, 2008; Casson and Wadeson, 2012; R. Baldwin and Venables, 2013; Casson and Wadeson, 2013). It should be noted that economies in the second pattern are also engaged in assembly of motor vehicles in addition to production of automotive parts.

The third pattern is that particular countries specialise in the automotive industry by producing and exporting automotive parts, importing automotive parts and also assembling motor vehicles. First, such countries source more than 50% of their automotive imports in the form of automotive parts the same as the first pattern and they also dispatch more than 50% of their automotive exports in the form of automotive parts opposite to the first pattern. Second, these countries' shares of motor vehicles in the automotive exports tend not to exceed their shares of motor vehicles in the automotive imports opposite to the first pattern, but the gap between the two becomes smaller and even positive overtime. Third, since such countries specialise in the automotive industry, shares of automotive imports and exports in countries' total imports and exports are larger than 10% and the latter share is larger than the former share the same as the first pattern, so there is a larger involvement in automotive exports than automotive imports. Existence of this pattern is due mainly to the practice that such countries provide automotive parts for overseas motor vehicle assembly plants of major international motor vehicle groups. In addition to this, motor

[54] This pattern of offshoring motor vehicle assembly had been more observable for France by 2015.
[55] Share of motor vehicle assembly of the USA exported was smaller than 50% in both 2003 and 2015.

vehicles dispatched by these countries tend to have lower unit value of export compared to other European countries'. Fourth, these countries' shares of motor vehicle assembly exported are larger than 50% and these countries' shares of motor vehicle sales imported usually exceed 50%, hence a larger portion of motor vehicles assembled are for export markets and there is usually high demand for imported motor vehicles the same as the first pattern. As a result, such countries are highly engaged with the global automotive industry in terms of both motor vehicle assembly and market. Fifth, units of motor vehicles assembled are larger than units of motor vehicle sales the same as the first pattern. Hence, such countries assemble a greater number of motor vehicles than their internal demand for motor vehicles. Austria,[56] Czechia,[57] Hungary,[58] Poland and Romania[59] fall within this pattern.[60]

Economies in the third pattern display characteristics of both the first and second patterns (Samuelson, 2004; Grossman and Rossi-Hansberg, 2006; Baldone et al., 2007; Grossman and Rossi-Hansberg, 2008; Helpman, 2011; Casson and Wadeson, 2012; Grossman and Rossi-Hansberg, 2012; Hanson, 2012; R. Baldwin and Venables, 2013; Casson and Wadeson, 2013; R. Baldwin and Robert-Nicoud, 2014; Timmer et al., 2014). These economies are widely engaged in both production of automotive parts and assembly of motor vehicles, and respective cross-border trade thereof. This is due mainly to that economies in the third pattern have developed specific skills related to the automotive industry, and hence they have competitive advantage in the automotive industry (Porter, 1990; Porter, 1998a; Porter, 1998b). It should be noted that economies in the third pattern are highly interacted with the European automotive sector.

The fourth pattern is that particular countries are identified with motor vehicle assembly for their relatively large internal markets and less involvement in the international automotive trade. First, such countries source more than 50% of their automotive imports in the form of automotive parts the same as the first pattern and they also dispatch more than 50% of their automotive exports in the form of automotive parts opposite to the first pattern. Second, these countries' shares of motor vehicles in the automotive exports tend not to exceed their shares of motor vehicles in the automotive imports opposite to the first pattern reflecting these countries' orientation towards serving their internal markets. Third, since there is less involvement in the international automotive trade, shares of automotive

[56] Share of automotive exports in the total exports of Austria was smaller than share of automotive imports in the total imports of Austria in 2003. Motor vehicle sales were also larger than motor vehicle assembly in both 2005 and 2015.

[57] Share of motor vehicles in the automotive exports of Czechia exceeded its share of motor vehicles in the automotive imports in both 2003 and 2015.

[58] Share of motor vehicles in the automotive exports of Hungary exceeded its share of motor vehicles in the automotive imports in 2015. Motor vehicle sales were also larger than motor vehicle assembly in 2005.

[59] Share of automotive imports in the total imports of Romania was 7.4% in 2003 and share of automotive exports in the total exports of Romania was 8.3% in 2003. Share of motor vehicle assembly exported was also smaller than 50% in 2003. Furthermore, motor vehicle sales were larger than motor vehicle assembly in 2005.

[60] These countries do not have major international motor vehicle brands as in the case of particular countries in the first pattern.

imports and exports in these countries' total imports and exports are smaller than 10% and even the former share is larger than the latter share opposite to the first pattern. As a result, these countries have high motor vehicle assembly capacities as in the case of the first pattern but they are more engaged with serving their large internal markets, rather than involving in export of their assembled motor vehicles. These countries do not also have major international motor vehicle brands as in the case of particular countries in the first pattern. Fourth, these countries' shares of motor vehicle assembly exported and motor vehicle sales imported are smaller than 50% opposite to the first pattern. As a result, such countries have limited engagement with the global automotive industry in terms of both motor vehicle assembly and market. Fifth, units of motor vehicles assembled are larger than units of motor vehicle sales the same as the first pattern. Hence, such countries assemble a greater number of motor vehicles than their internal demand for motor vehicles. China,[61] India,[62] Indonesia[63] and Malaysia[64] fall within this pattern.

Economies in the fourth pattern tend to impose restrictions and conduct interventions specific to the automotive industry (Womack et al., 1990; Humphrey, 2003; Ito, 2004; Sutton, 2005; Liu and Dicken, 2006; Thun, 2006). These restrictions and interventions can be in the form of tariff or non-tariff barriers or direct involvement. For example, the Chinese government requires international enterprises to form joint ventures with local enterprises for investment in the Chinese automotive industry (Sutton, 2005; Liu and Dicken, 2006; Thun, 2006). Therefore, such restrictions and interventions shape automotive sectors of economies in the fourth pattern.

The fifth pattern is that particular countries are internal market oriented and have small motor vehicle assembly capacities if they are engaged with assembling motor vehicles, source motor vehicles abroad, and have low engagement with automotive exports. First, these countries source less than 50% of their automotive imports in the form of automotive parts, so they source more than 50% of their automotive imports in the form of motor vehicles opposite to the first pattern. These countries dispatch less than 50% of their automotive exports in the form of motor vehicles, instead they dispatch more than 50% of their automotive exports in the form of automotive parts opposite to the first pattern. Second, such countries' shares of motor vehicles in the automotive exports do not exceed their shares of motor vehicles in the automotive imports opposite to the first pattern reflecting their small motor vehicle assembly capacities if they are engaged with assembling motor vehicles and their internal market oriented structure. Third, shares of automotive exports in

[61] Motor vehicle sales of China was larger than its motor vehicle assembly in both 2005 and 2015.

[62] Share of motor vehicles in the automotive exports of India was larger than its share of motor vehicles in the automotive imports in both 2003 and 2015, and share of automotive exports in the total exports of India was larger than its share of automotive imports in the total imports in both 2003 and 2015.

[63] Share of motor vehicles in the automotive exports of Indonesia was larger than its share of motor vehicles in the automotive imports in 2015. Motor vehicle sales of Indonesia were also larger than its motor vehicle assembly in 2005.

[64] Share of motor vehicle sales of Malaysia imported was larger than 50% in 2005. Motor vehicle sales of Malaysia were also larger than its motor vehicle assembly in 2015.

countries' total exports are smaller than 10% that is one of the distinguishing points of this pattern from the first three patterns but similar to the fourth pattern, so there is a relatively low involvement in the automotive exports.[65] Shares of automotive exports in countries' total exports are much smaller than shares of automotive imports in countries' total imports consistent with internal market oriented structure of countries in this pattern. As a result, this pattern is almost complete opposite to the first pattern. Fourth, these countries' shares of motor vehicle assembly exported are smaller than 50% opposite to the first pattern and these countries' shares of motor vehicle sales imported exceed 50% similar to the first pattern. Hence, such countries are engaged in the global automotive industry in terms of motor vehicle market. Fifth, units of motor vehicle sales are larger than units of motor vehicles assembled opposite to the first pattern. Therefore, such countries assemble a smaller number of motor vehicles than their internal demand for motor vehicles. Algeria,[66] Australia,[67] Chile,[68] Colombia,[69] Egypt,[70] Israel, Pakistan, Philippines,[71] Saudi Arabia,[72] Switzerland and Tunisia[73] fall within this pattern.

Economies in the fifth pattern tend to have comparative disadvantage in assembly of motor vehicles (Samuelson, 2004; Baldone et al., 2007; Helpman, 2011; Grossman and Rossi-Hansberg, 2012; Hanson, 2012; R. Baldwin and Robert-Nicoud, 2014; Timmer et al., 2014). This is because mainly of that minimum efficient scale is high for motor vehicle assembly (Husan, 1997; Thun, 2006) resulting in economies in the fifth pattern likely having small motor vehicle assembly capacities if they have any as underlined earlier.

[65] There is not any threshold for shares of automotive imports in countries' total imports as there are large variations in overall import structures of countries in this pattern.

[66] More than 50% of automotive exports of Algeria were in the form of motor vehicles in 2003.

[67] More than 50% of automotive exports of Australia were in the form of motor vehicles in both 2003 and 2015. Share of motor vehicle assembly exported was also larger than 50% in 2015.

[68] Share of motor vehicle assembly of Chile exported was also larger than 50% in 2003.

[69] More than 50% of automotive exports of Colombia were in the form of motor vehicles in 2015.

[70] More than 50% of automotive imports of Egypt were in the form of automotive parts in 2003.

[71] More than 50% of automotive imports of Philippines were in the form of automotive parts in 2003 and share of automotive exports in the total exports of Philippines exceeded its share of automotive imports in the total imports in both 2003 and 2015. Automotive exports of Philippines were almost all in the form of automotive parts in both 2003 and 2015. This was due to the fact that exports of automotive parts of Philippines constituted a larger share of the total exports of Philippines. Share of motor vehicle sales imported was also smaller than 50% in both 2005 and 2015.

[72] More than 50% of automotive exports of Saudi Arabia were in the form of motor vehicles in both 2003 and 2015. This was due mainly to the practice of Saudi Arabia to export a large volume of second-hand motor vehicles.

[73] Automotive exports of Tunisia were almost all in the form of automotive parts in both 2003 and 2015. This was due to the fact that exports of automotive parts of Tunisia constituted a larger share of the total exports of Tunisia. Share of motor vehicle assembly exported was also larger than 50% in 2015.

2.6 Summary

First, this chapter briefly introduced the global automotive sector within its historical context with reference to the value chain of the automotive sector, main parties and trends, and described government policies implemented in the automotive industry. Second, it reported characteristics of automotive imports and exports, and cross-border trade and assembly of motor vehicles in the world and across regions. Third, it presented motor vehicle sales, fleet and ownership characteristics in the world and across regions. Last, it identified automotive sector structures of individual major countries based on automotive import and export compositions and intensities, and motor vehicle assembly and market structures of individual major countries.

There are fifteen highly large motor vehicle groups in the world constituting about 82% of the world motor vehicle assembly. There are also around one hundred global mega suppliers in the world. These largest motor vehicle groups and global mega suppliers are head-quartered in Japan, Germany, the USA, Korea, France, Italy, China and Canada. Furthermore, there are growing trends in clustering, follow source and regionalisation in the automotive sector. On the other hand, in spite of implementation of widespread liberal economic policies around the world, governments still highly affect decision-making in the automotive sector via regulations, investment incentives and supports, monetary and fiscal policies.

Turkey accounts for more than 1% of the world automotive imports, exports, motor vehicle assembly and market. The Turkish automotive sector has also showed performance in automotive imports, exports, and motor vehicle assembly and market similar to or better than comparable countries' during the last decade. Automotive imports and exports make up more than 10% of Turkey's total imports and exports. Import of automotive parts constitutes the majority of Turkey's automotive imports, whilst export of motor vehicles constitutes the majority of Turkey's automotive exports. More than 70% of Turkey's motor vehicle assembly are also exported. Imported motor vehicles account for more than 70% of Turkey's motor vehicle sales. Furthermore, motor vehicle assembly of Turkey is larger than its sales by one third. Therefore, the Turkish automotive sector is highly open and well integrated with the global automotive industry as a motor vehicle assembly hub. On the other hand, Turkey has a lower motor vehicle ownership rate than comparable countries' resulting in potentials for the automotive industry. As result, the Turkish automotive sector is a major regional motor vehicle assembly hub and market that has significant opportunities for the automotive industry.[74]

A close examination of the recent characteristics of the global and Turkish automotive sectors indicates four major points. First, being in the neighbourhood of Europe, receiving a large amount of automotive investment from Europe and having a Customs Union with the EU, Turkey makes around 80% of its international automotive trade with Europe

[74]Further descriptive analysis of the Turkish automotive sector is carried out in chapter 3.

as reported in section 3.3. Therefore, intra-regional trade is highly prominent in the Turkish automotive sector. Second, most growth in the global automotive sector originates from Asia-Pacific. Nonetheless, the Turkish automotive sector is highly focused on the European automotive sector and its cross-border trade relations with Asia-Pacific are weak. Therefore, the Turkish automotive sector should also forge more cross-border trade relations with Asia-Pacific to diversify its cross-border relations as well as advantage from the recent substantial growth of the Asia-Pacific automotive sector. Third, being in close geographic proximity to the MENA, Turkey has developed substantial cross-border trade relations with this region. Nonetheless, the Turkish automotive industry, in particular, has not developed extensive economic relations with the MENA whose automotive sector has experienced substantial expansion during the last decade. Therefore, the Turkish automotive industry should forge more economic relations with this growing market, as well. Last, cross-border trade of automotive parts obtains more prominence in the world automotive trade as reported in section 2.3 generating more opportunities for the automotive industry. Therefore, automotive enterprises should pay more attention to the automotive parts supply section of the industry to advantage more from this growing trend.

Chapter 3

Descriptive Analysis of the Turkish Automotive Sector

3.1 Introduction

This chapter further develops the understanding of the Turkish automotive sector, in addition to examination of general international automotive trade, motor vehicle assembly and market characteristics of the Turkish automotive sector made in chapter 2. This chapter first introduces the Turkish automotive sector within its historical context with reference to distinct periods of the Turkish economy. Second, this chapter determines the recent cross-border automotive trade relations of Turkey with regions and how these relations have changed relative to 2003. Third, this chapter establishes cross-border automotive trade patterns of Turkey with its individual major partners.

In contrast to former studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) on the Turkish automotive industry, this chapter examines both automotive parts and motor vehicle imports and exports characteristics of the Turkish automotive sector. This chapter also considers characteristics of the Turkish motor vehicle market that has not been widely analysed before. Therefore, this chapter can provide more accurate analyses and insights into the Turkish automotive sector.

Turkey's place in the world automotive imports and exports, motor vehicle assembly and market have already been examined in subsection 2.3.1, subsection 2.3.2, subsection 2.3.3 and section 2.4, respectively. In addition to this, significance of the Turkish automotive industry in the Turkish manufacturing sector is to be identified in section 4.2 and economic characteristics of international and local motor vehicle assembling and automotive parts supplying enterprises are to be reported in section 4.3. Therefore, descriptive analysis on such topics is not made in this chapter.

Building upon its experience in motor vehicle assembly since 1960s, and having a large and competitive automotive parts supply base, the Turkish automotive industry has not only become a regional motor vehicle assembly hub but it has also developed substantial skills in design and innovation. The Turkish automotive industry is integrated with the global automotive industry, especially well with the European automotive value chain. Despite still having a lower motor vehicle ownership rate, Turkey also has a relatively large and growing motor vehicle market in its region and its motor vehicle market is far away from saturated, thereby creating opportunities for the Turkish automotive industry.

International automotive trade constitutes more than 10% of Turkey's total cross-border trade. Therefore, it is one of the most significant contributors to Turkey's international trade. More than three quarters of automotive imports and exports of Turkey are carried out with Europe. Turkey generally imports automotive parts from and exports motor vehicles to Europe in line with Turkey's regional motor vehicle assembly hub structure. Nevertheless, having a large internal motor vehicle market, Turkey has recently been importing motor vehicles as a larger share of its automotive imports from Europe. The MENA is the second largest destination of Turkey's automotive exports After Europe. Nonetheless, despite having wide cross-border trade relations with the MENA in other sectors, Turkey has not developed extensive cross-border trade relations with the MENA in the automotive sector. Asia-Pacific is the second largest source of Turkey's automotive imports after Europe. The vast majority of these automotive imports are in the form of automotive parts. On the other hand, Asia-Pacific is the fourth largest destination of Turkey's automotive exports after Europe, the MENA and Americas, and most of these automotive exports are in the form of automotive parts. Nevertheless, Asia-Pacific is one of the largest growing motor vehicle markets in the world as reported in section 2.4 but Turkey has not extensively involved in this market. The Americas are a growing partner of the Turkish automotive sector, as well.

This study identifies four specific cross-border automotive trade patterns of Turkey with its individual major partners based on compositions of automotive imports and exports. The first pattern is identified with Turkey's regional motor vehicle assembly hub structure established in section 2.5 and motor vehicle market structures of Turkey's partners within this pattern e.g., Italy. Turkey's automotive trade engagement with such countries is based on sourcing automotive parts for its motor vehicle assembly and then dispatching motor vehicles assembled. The second pattern also, to some extent, is identified with Turkey's regional motor vehicle assembly hub structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., South Africa. Turkey sources automotive parts for its motor vehicle assembly and dispatches automotive parts to supply motor vehicle assembly abroad. The third pattern reflects Turkey's motor vehicle market structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., Germany. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles, while Turkey dispatches more than 50% of its automotive exports to such countries in the form of automotive parts. The fourth pattern is characterised by Turkey's motor vehicle market and regional motor vehicle assembly hub structures as well as motor vehicle market and assembly structures of Turkey's partners within this pattern e.g., Spain. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles and dispatches more than 50% of its automotive exports to such countries in the form of motor vehicles.

Section 3.2 explains structure of the Turkish automotive sector. Section 3.3 reports international automotive trade characteristics of Turkey. Section 3.4 puts forward findings on Turkey's international automotive trade patterns with its individual major partners. Section 3.5 summarises main findings on the Turkish automotive sector.

3.2 Structure of the Turkish Automotive Sector

This section first describes general structure of the Turkish automotive industry. Second, this section briefly explains development phases of the Turkish automotive industry with special reference to corresponding economic periods.[1] Third, this section briefly describes structure of the Turkish motor vehicle market in addition to what is explained in section 2.4.

In Turkey, almost all motor vehicle assemblers are joint ventures with European, Asian and American assemblers, and there are local motor vehicle assemblers, as well. Table 3.1 lists motor vehicle assembling enterprises operating in Turkey along with their major enterprise characteristics.[2] In Turkey, there are fourteen major motor vehicle assembling enterprises manufacturing passenger cars, commercial vehicles and farm tractors under licences of major international motor vehicle groups. The Turkish automotive industry, in particular, the automotive value chain is located in the western regions of Turkey in close geographic proximity to Europe.[3] Its establishment dating back to mid-1950s and mainly to late 1960s during the period of the import substituting industrialisation policy, the Turkish motor vehicle assembly industry firstly grew in 1980s due to then export oriented economic policies. The Turkish motor vehicle assembly industry was secondly expanded by international investment from Asian motor vehicle groups in mid-1990s owning to the Customs Union of Turkey with the EU in 1996. The Turkish motor vehicle assembly industry thirdly developed in 2000s due mainly to its increased competitiveness.

Table 3.1 also reports that average international ownership amongst motor vehicle assembling enterprises in Turkey weighted by motor vehicle assembly of corresponding enterprises was around 52.9% in 2015. Furthermore, Table 3.1 presents that around 1.4 million units of motor vehicles including farm tractors were assembled in Turkey that resulted in a capacity utilisation of about 78.5% in 2015.[4,5]

[1] Please see Taymaz and Yilmaz (2008b) for an overview of the Turkish economy.

[2] Please see Eraslan and Bulu (2007) for a review of each motor vehicle assembling enterprises operating in Turkey.

[3] Please see subsubsection 4.3.2.1 for further examination of location of the automotive value chain in Turkey.

[4] Please note assembly data reported in Table 2.7 did not include farm tractors but data reported in Table 3.1 included farm tractors. Therefore, in 2015 around 51.2 thousand units of farm tractors were assembled in Turkey.

[5] Please see subsection 4.3.1 for a detailed descriptive analysis of motor vehicle assembling enterprises in Turkey by ownership.

Table 3.1 Motor Vehicle Assembling Enterprises in Turkey in 2016

Enterprise	Plant Location	Est. Date	Licence	MV Type Mainly Assembled	International Ownership (%)	Capacity Thousand (2016)	Assembled Thousand (2015)	Share in Assembly (%)	Capacity Utilisation
Anadolu Isuzu	Kocaeli	1966	Isuzu	CV	29.7	13.2	11.2	0.8	84.8
Ford Otosan	Eskisehir	1983	Ford	CV	41	415	334.6	23.7	80.6
	Golcuk/Kocaeli	2001							
	Yenikoy/Kocaeli	2014							
Hattat Tarim	Tekirdag	2002	Valtra, Universal, Hattat	FT	0	15	3.7	0.3	24.7
Honda Turkiye	Kocaeli	1997	Honda Motor Europe	PC	100	50	12.7	0.9	25.4
Hyundai Assan	Kocaeli	1997	Hyundai Motor	PC	70	245	226.5	16.1	92.4
Karsan	Bursa	1966	Hyundai Motor, Breda Menarini Bus	CV	0	52.2	7.2	0.5	13.8
M.A.N. Turkiye	Ankara	1966	Man Truck & Bus AG	CV	99.9	1.7	1.7	0.1	100
M.Benz Turk	Istanbul	1968	Mercedes Benz	CV	85	21.5	23.9	1.7	111.2
	Aksaray	1985							
Otokar	Sakarya	1963	Land Rover, Fruehauf	CV	0	10.3	4.6	0.3	44.7
Oyak Renault	Bursa	1971	Renault	PC	51	360	339.2	24.1	94.2
Temsa Global	Adana	1987	Temsa	CV	0	11.5	2.9	0.2	25.2
Tofas	Bursa	1971	Fiat	CV	37.8	400	278.3	19.7	69.6
Toyota	Sakarya	1994	Toyota	PC	100	150	115.9	8.2	77.3
Turk Traktor	Ankara	1954	CNHI	FT	37.5	50	47.5	3.4	95
	Sakarya	2014							
Total					52.9	1795.4	1409.9	100	78.5

Notes: This list includes only motor vehicle assembling enterprises in Turkey those are members of the OSD. Nevertheless, enterprises listed here account for almost all motor vehicle including farm tractor assembly in Turkey. MV stands for motor vehicle. CV means commercial vehicle. FT stands for farm tractor. PC means passenger car.

Source: The OSD, accessed at http://www.osd.org.tr/homepage.

Largest automotive parts suppliers in Turkey are also generally joint ventures with international automotive parts suppliers or fully international owned.[6] Therefore, both assembly and supply sections of the Turkish automotive industry are highly international in terms of ownership. On the other hand, locally owned small enterprises constitute the vast majority of automotive parts suppliers in Turkey.[7] As indicated earlier that the automotive industry including automotive parts supplying enterprises generally concentrate in the western regions of Turkey.[8,9,10]

The Turkish automotive or motor vehicle assembly industry established in mid-1950s and mainly late 1960s initially assembled farm tractors and commercial vehicles, and then passenger cars under licence with joint ventures providing technical assistance and support to satisfy internal motor vehicle demand. This initiative was the result of import substituting industrialisation policy period of 1960 to 1980 in Turkey. This economic approach was a reflection of the economic policy adopted around the world especially in developing countries. Heavy government involvements and interventions were common economic policies in Turkey. Highly protectionist economic policies, i.e. quotas, high customs tariff and local content requirements, foreign exchange allocations were implemented in Turkey to create a protected economy based on five-year development plans. These policies created protective walls around the motor vehicle market in Turkey against international competition in the early days of the Turkish motor vehicle assembly industry. These policies also had implications for the Turkish automotive parts industry: due to local content requirements in the automotive industry, motor vehicle assembling enterprises were required to collaborate with and transfer technology to local automotive parts supplying enterprises, especially after 1970s. On the other hand, product and process technologies lagged behind their contemporaries. Since the automotive industry was inward oriented and local demand was not particularly sufficient and stable, the automotive industry had excessive capacity, and hence it was on an inefficient scale. This period was more identified with satisfying internal demand, local capability building, and in particular localisation of motor vehicle assembly and automotive parts production in Turkey. As a result, these policies resulted in balance of payment crises in Turkey, and hence they were unsustainable.

After unsustainable policies of import substituting industrialisation during the period of 1960 to 1980, export oriented economic policies in Turkey were implemented from 1981 reflecting the worldwide common economic policies. There was widespread opening-up and liberalisation in the movements of first product and then capital. Therefore,

[6] Please see subsubsection 4.3.2.1 for detail.

[7] Please see section 4.2 for detail.

[8] Please see subsection 4.3.2 for a detailed descriptive analysis of automotive parts supplying enterprises in Turkey by ownership.

[9] The Association of Automotive Parts & Components Manufacturers, abbreviated as TAYSAD, represents major automotive parts supplying enterprises in Turkey. Please see http://www.taysad.org.tr/en for detail.

[10] Please see Cambazoglu and Simay Karaalp (2014), Berument et al. (2015), and Aydogan (2017) for an overview of inward international direct investment into Turkey. Please also see Onder and Karal (2013), Aybar (2016), and Cergibozan and Demir (2017) for an overview of outward international direct investment from Turkey.

all protectionist policies implemented in the preceding period were eliminated one by one. During this period, the Turkish automotive industry underwent restructuring, in particular vertical disintegration; assemblers leaving production of certain automotive parts to suppliers reflecting the trend in the global automotive industry. There was also more involvement of international ownership enabling the Turkish automotive industry to adopt modern product and process technologies. Therefore, there were investments in the Turkish automotive industry during this period that resulted in capacity building. Compared to the previous period, there was higher internal demand for motor vehicles. The automotive industry also increasingly engaged in exports. Nevertheless, due to the economic crisis of 1994 in Turkey, motor vehicle sales plummeted putting the automotive industry in decline.

Opening-up of the Turkish economy was advanced by Turkey's economic integration with the EU.[11] In 1995, the Turkish government of that term signed a Customs Union agreement with the EU coming into effect in 1996. With this agreement, tariffs and non-tariff barriers between Turkey and the EU on all industrial and processed agricultural products were removed. In other words, relevant to the context that tariffs on motor vehicles and automotive parts became effectively zero in 1996. The prospect of the Customs Union led to investment of first Toyota and then Honda and Hyundai in the Turkish motor vehicle assembly industry. These investments also enabled a large automotive parts supply base to thrive. During this period, there were significant increases in quality of the motor vehicles and automotive parts produced by the Turkish automotive industry resulting in acquirement of competitiveness in the global automotive industry.

Internal demand in Turkey for motor vehicles was severely disrupted by economic crises of 1999 and 2001 resulting in fluctuations in the motor vehicle market. Therefore, motor vehicle assemblers in Turkey constantly sought external markets especially in Europe. During early 2000s, both motor vehicle assembling and automotive parts supplying enterprises developed further capability and integration with the European automotive value chain (please see Gules and Burgess, 1996; Burgess and Gules, 1998; S. N. Wasti, Kozan, et al., 2006; S. N. Wasti and S. A. Wasti, 2008, for motor vehicle assembler and supplier relations in the Turkish automotive industry). Compared to the previous period, after 2004 internal motor vehicle market has been relatively strong and expanding. External motor vehicle demand is also large, on average around two thirds of the motor vehicle output of the industry are destined for export markets.

Since 2004 average capacity utilisation in the Turkish motor vehicle assembly industry has been about 80% with varying rates similar to that of the industry average (Klein and Koske, 2013) but the Turkish motor vehicle assembly industry was characterised by excessive capacity and had an average capacity utilisation of around 50% during non-crises years of 1990s.[12]

[11] It was the European Community at that time.
[12] The OSD, accessed at http://www.osd.org.tr/homepage.

After gaining strong competitiveness, the Turkish automotive industry has had several capacity building investments in motor vehicle assembly during the post-2000 period. In addition to these investments, the Turkish automotive industry has extensively engaged in design and R&D activities to maintain its competitiveness and further develop skills in innovation.[13,14] The Turkish government also regards the automotive industry as one of the key industries and provides generous R&D and capacity building investment incentives to both motor vehicle assembling and automotive parts supplying enterprises.[15]

As a result, building upon its experience in motor vehicle assembly since 1960s and having a large and competitive automotive parts supply base, the Turkish automotive industry has not only become a regional motor vehicle assembly hub but it has also developed substantial skills in design and innovation. Therefore, the Turkish automotive industry is integrated with the global automotive industry, especially well with the European automotive value chain.

As stated in subsection 2.4.2 that in 2014, units of motor vehicles per 1,000 inhabitants or motorisation rate in Turkey was around 189.4 corresponding to a motor vehicle ownership rate that was much lower than Europe's average and comparable countries'. There are a number of reasons for lower motor vehicle ownership in Turkey. First, per capita income in Turkey is much lower than Europe's average and income distribution in Turkey is not particularly favourable for the motor vehicle market, either. Therefore, affordability of motor vehicles across a large section of the society is very low in Turkey. Second, during 1990s macroeconomic environment in Turkey was not stable especially there were high fluctuations in the foreign exchange markets coupled with high inflation rates. In particular, economic crises of 1994, 1999 and 2001 resulted in plummeting of motor vehicle sales. Therefore, unstable macroeconomic environment rendered the Turkish motor vehicle market unsteady and weak, and hence resulted in excessive capacity in the motor vehicle assembly industry during 1990s and early 2000s. Third, high interest rates and lack of finance in Turkey are other major reasons directly resulting in lower motor vehicle ownership. Fourth, there are high taxes on purchase of passenger cars, which significantly increases prices of motor vehicles in Turkey. Fifth, there high taxes on ownership of motor vehicles after purchase considerably affecting motor vehicle ownership decisions. Sixth, there are large taxes levied on oil resulting in higher oil prices in Turkey. Last, demographic dynamics in Turkey are highly different from EU's. In 2015, median age in Turkey was 30.7, whereas it was 42.4 in the EU reducing the segment of the society

[13]This industry is the most R&D intensive industry in Turkey. Please see section 4.2 for related descriptive statistics.

[14]A case in point is that in early 2000s a project on design of a light commercial motor vehicle for small and medium-sized enterprises (SMEs) financially supported by the EU was realised thanks to wide collaborations of several European automotive groups. A substantial part of design of this project was carried out in Turkey. Subsequently, the Turkish automotive industry has acquired key skills in design and become the largest commercial vehicle assembler in Europe.

[15]Please see subsubsection 4.3.1.2 and subsubsection 4.3.2.2 for explanation for R&D support provided by the Turkish government and related descriptive statistics on this.

that can own motor vehicles.[16] As a result, real cost of owning motor vehicles is very high for low income individuals constituting a large portion of the Turkish society resulting in low motor vehicle ownership in Turkey. In addition to relatively lower motor vehicle ownership, average age of motor vehicle fleet of Turkey was higher than average age of motor vehicle fleet of the EU. In 2014, average age of motor vehicle fleet in Turkey was about 11.5, while it was around 9.6 in the EU (Anfac, 2014). Therefore, motor vehicle in use in Turkey was about 2 years older than motor vehicle in use in the EU in 2014.

On the other hand, during the recent years compared to 1990s the Turkish motor vehicle market has been relatively strong and expanding thanks to stable macroeconomic environment and rising living standards in Turkey. As reported in subsection 2.4.2 that motor vehicle fleet in Turkey increased by around 70% between 2005 and 2014, while it rose by about 11% in the EU. In addition to this, units of passenger cars per 1,000 inhabitants in Turkey expanded by about 55%, whilst it was around 7.8% in the EU between 2005 and 2014 (Anfac, 2014). Therefore, despite still having a lower motor vehicle ownership rate, motor vehicle market, and hence motor vehicle fleet in Turkey has grown significantly during the last decade.

Motor vehicle demand in Turkey mainly comes from relatively wealthy regions, namely the western regions of Turkey, these regions also home the Turkish automotive value chain as underlined earlier. These regions constituted about two thirds of the motor vehicle sales and about 65% of the motor vehicle fleet in Turkey in 2014.[17] Therefore, both the automotive value chain and motor vehicle market concentrate in the western regions of Turkey.

A major trend in Turkey is that motor vehicle import intensity in Turkey was about 25% during early 1990s. After the Customs Union with the EU in 1996, motor vehicle import intensity started to rise and became around 70% in 2015.[18] There are two main reasons for this level of penetration of imported motor vehicles in the Turkish motor vehicle market. First, the Turkish motor vehicle assembly industry particularly specialises in manufacture of light commercial vehicles and small engine sized motor vehicles. On the other hand, motor vehicle demand has been recently shifted towards passenger cars with relatively large engines. Second, there is high demand for motor vehicle variety in Turkey. In this respect, 435 models of passenger cars and light commercial vehicles were sold in Turkey in 2015.[19] As a result, there is variation between motor vehicles assembled and demanded, and high demand for motor vehicle variety in Turkey resulting in growing motor vehicle import intensity.

[16] Please see Eurostat's online data coded demo_pjanind.

[17] Please see http://www.turkstat.gov.tr/PreTablo.do?alt_id=1051 to access TurkStat's Road Motor Vehicle Statistics.

[18] The OSD, accessed at http://www.osd.org.tr/homepage.

[19] The Automotive Distributors' Association (ODD), accessed at http://www.odd.org.tr/web_2837_2/index.aspx.

In addition to providing R&D and capacity building investment incentives to the Turkish automotive industry stated earlier, the Turkish government has implemented motor vehicle scrap programmes to directly stimulate the motor vehicle demand and extensively undertaken investments in transportation infrastructure, namely roads and motorways, bridges and tunnels laying the foundation for a developed motor vehicle market during the last decade. For example, asphalt concrete road network in Turkey more than doubled between 2005 and 2015.[20] Therefore, the Turkish government has supported the automotive sector on both supply and demand sides.[21]

As a result, Turkey has a relatively large and growing motor vehicle market in its region and its motor vehicle market is far away from saturated compared to other countries in Europe, thereby creating opportunities for the Turkish automotive industry.

3.3 International Automotive Trade Characteristics

This section also carries out a descriptive analysis of automotive and motor vehicle imports and exports characteristics of the Turkish automotive industry, while section 2.3 includes all regions and major countries, and the world. International trade data of Turkey presented in this section is retrieved from UN Comtrade the same database utilised in section 2.3. The main difference between data reported in this section and section 2.3 is that the former is based just on reporting of Turkey, hence it is just on Turkey's imports and exports, while the latter is based on reporting of every individual country so it includes all regions and major countries, and the world. Further explanation on UN Comtrade and the data is made in section 2.3. The following subsections explain total, automotive and motor vehicle imports and exports of Turkey, respectively.

3.3.1 Total, Automotive and Motor Vehicle Imports of Turkey from Regions and Major Countries

This subsection reports total imports, automotive imports and motor vehicle imports of Turkey sourced from regions and major countries in 2003 and 2015, and changes between these periods.

[20] General Directorate of Highways cited by the TurkStat, accessed at http://www.turkstat.gov.tr/PreTablo.do?alt_id=1051.

[21] Environment related policies and regulations, especially emission standards are aligned with those of EU's. This is due to Turkey's Customs Union with the EU and Turkey's EU accession process.

3.3.1.1 Total Imports of Turkey from Regions and Major Countries

Table 3.2 reports value of total imports of Turkey by origin in current million US dollars, origin's share in Turkey's imports in 2003 and 2015, percent change in total imports of Turkey by origin and origin's import share between 2003 and 2015.[22]

Table 3.2 presents that Turkey's total imports, in 2015 were around $207 billion increased by almost twofold from around $69 billion in 2003 as also reported in Table 2.1. In 2015, Turkey sourced 52.3% of its imports from Europe decreased by 21.1% the second largest fall after free zones' amongst regions from 66.3% in 2003 still leading Europe to be the largest source of Turkey's imports in both 2003 and 2015. Asia-Pacific, in 2015 constituted 26.3% of Turkey's imports increased by 76.9% the largest increase amongst regions from 14.9% in 2003 still leading Asia-Pacific to be the second largest source of Turkey's imports in both 2003 and 2015. Turkey, in 2015 sourced 8.1% of its imports from the Americas increased by 13.9% the second largest rise after Asia-Pacific's amongst regions from 7.1% in 2003 leading the Americas to overtake the place of the MENA in 2003 and resulting in the Americas being the third largest source of Turkey's imports in 2015. The MENA, in 2015 made up 7% of Turkey's imports decreased by 20.9% the third largest fall after free zones and Europe's amongst regions from 8.8% in 2003 leading the MENA to lose its third place to the Americas in 2003 and resulting in the MENA being the fourth largest source of Turkey's imports in 2015. Turkey, in 2015 sourced 4.7% of its imports from areas NES that became the fifth largest source of Turkey's imports in 2015. Africa, in 2015 constituted around 1% of Turkey's imports decreased by 14.8% from about 1.2% in 2003 leading Africa to be the sixth largest source of Turkey's imports in 2015. In 2015, Turkey sourced 0.6% of its imports from free zones decreased by 65.2% the largest fall from 1.8% in 2003 leading free zones to have the smallest share in 2015.

Table 3.2 Total Imports of Turkey from Regions and Major Countries (in current million US dollars)

	2003		2015		Change 03/15	
	Value	PCT	Value	PCT	Value	PCT
Africa	812.2	1.2	2067.7	1	154.6	-14.8
Remaining	476.5	0.7	1149.1	0.6	141.1	-19.3
South Africa	335.7	0.5	918.5	0.4	173.6	-8.4
Americas	4922.5	7.1	16757.6	8.1	240.4	13.9
Argentina	265	0.4	234.5	0.1	-11.5	-70.4
Brazil	401.8	0.6	1792.2	0.9	346	49.3
Canada	244.9	0.4	929	0.4	279.4	27

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[22]Please note that there is not a classification of areas NES (not elsewhere specified) in 2003. Therefore, international trade data is unavailable for areas NES in 2003.

Total Imports of Turkey from Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	Value	PCT	Value	PCT	Value	PCT
Chile	160.5	0.2	282.6	0.1	76.1	-41.1
Colombia	75.7	0.1	800.8	0.4	957.8	254
Mexico	100	0.1	860.7	0.4	760.9	188.1
Remaining	177.9	0.3	729.8	0.4	310.1	37.2
USA	3496.6	5	11128	5.4	218.3	6.5
Areas NES			9788.3	4.7		
Asia-Pacific	10298.5	14.9	54443.9	26.3	428.7	76.9
Australia	228.7	0.3	544.8	0.3	138.3	-20.3
China	2610.3	3.8	24873.5	12	852.9	218.9
India	722.9	1	5613.6	2.7	676.6	159.9
Indonesia	450.4	0.6	1638.2	0.8	263.8	21.7
Japan	1927.1	2.8	3140.3	1.5	63	-45.5
Korea	1312.4	1.9	7057.4	3.4	437.7	79.9
Malaysia	390.7	0.6	1339.2	0.6	242.8	14.7
Pakistan	192	0.3	310.5	0.1	61.7	-45.9
Philippines	59.6	0.1	115.8	0.1	94.4	-34.9
Remaining	2112.6	3	8600.9	4.2	307.1	36.2
Thailand	291.9	0.4	1209.8	0.6	314.4	38.7
Europe	45941.2	66.3	108381.5	52.3	135.9	-21.1
EU (28)	35191.3	50.8	78668.8	38	123.5	-25.2
Austria	824.2	1.2	1567.9	0.8	90.2	-36.3
Belgium	1523.6	2.2	3146.9	1.5	106.5	-30.9
Czechia	443.9	0.6	2218.3	1.1	399.7	67.2
France	4164.1	6	7584	3.7	82.1	-39.1
Germany	9453	13.6	21352	10.3	125.9	-24.4
Hungary	416.9	0.6	1305.8	0.6	213.2	4.8
Italy	5471.6	7.9	10639.1	5.1	94.4	-34.9
Netherlands	1656.7	2.4	2914.7	1.4	75.9	-41.1
Poland	415.4	0.6	2977.7	1.4	616.9	139.9
Remaining	3241.2	4.7	8445.3	4.1	160.6	-12.8
Romania	956	1.4	2599.9	1.3	172	-9
Slovakia	205.9	0.3	858.6	0.4	317.1	39.6
Slovenia	93	0.1	343.8	0.2	269.6	23.7
Spain	2003.8	2.9	5588.5	2.7	178.9	-6.7
Sweden	822.2	1.2	1585	0.8	92.8	-35.5
UK	3500	5	5541.3	2.7	58.3	-47
Other Europe	10749.9	15.5	29712.8	14.3	176.4	-7.5

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Total Imports of Turkey from Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	Value	PCT	Value	PCT	Value	PCT
Israel	459.5	0.7	1672.5	0.8	264	21.8
Remaining	1868.7	2.7	5190.8	2.5	177.8	-7
Russia	5451.3	7.9	20399.8	9.8	274.2	25.2
Switzerland	2970.3	4.3	2449.6	1.2	-17.5	-72.4
Free Zones	1240.2	1.8	1290.1	0.6	4	-65.2
MENA	6125.1	8.8	14477.3	7	136.4	-20.9
Algeria	1081.6	1.6	740.5	0.4	-31.5	-77.1
Egypt	189.4	0.3	1215.9	0.6	542	114.8
Iran	1860.7	2.7	6096.2	2.9	227.6	9.6
Morocco	77	0.1	710.6	0.3	823	208.9
Remaining	1849.2	2.7	3452.7	1.7	86.7	-37.5
Saudi Arabia	969.1	1.4	2117.2	1	118.5	-26.9
Tunisia	98.1	0.1	144.1	0.1	46.8	-50.9
Total	69339.7	100	207206.5	100	198.8	

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. PCT stands for percent. Areas NES means areas not elsewhere specified.

Source: Calculations are based on UN Comtrade.

3.3.1.2 Automotive Imports of Turkey from Regions and Major Countries

Table 3.3 presents value of automotive imports of Turkey by origin in current million US dollars, motor vehicles' share in automotive imports, origin's share in Turkey's automotive imports in 2003 and 2015, percent change in automotive imports of Turkey by origin, motor vehicles' share in automotive imports and origin's automotive import share between 2003 and 2015, and origin's share of automotive imports in its total imports in 2003 and 2015, and change in this share between 2003 and 2015.

Table 3.3 indicates that Turkey's automotive imports, in 2015 were about $25.8 billion increased by 228% from about $7.9 billion in 2003 as also presented in Table 2.2. This increase in the automotive imports of Turkey was larger than the increase in Turkey's total imports. In 2015, Turkey sourced 77.4% of its automotive imports from Europe decreased by 9.3% the only fall amongst regions from 85.3% in 2003 still resulting in Europe becoming the largest source of Turkey's automotive imports in both 2003 and 2015. Share of Europe in Turkey's automotive imports was also well larger than share of Europe in Turkey's total imports in both 2003 and 2015 and even the gap widened in 2015. Europe was the only region that had an automotive import share in Turkey's automotive imports larger than its total import share in Turkey's imports. Turkey's automotive imports from

Asia-Pacific, in 2015 constituted 16.4% of its automotive imports increased by 34.4% from 12.2% in 2003 leading Asia-Pacific to be the second largest source of Turkey's automotive imports in both 2003 and 2015. On the other hand, share of Asia-Pacific in Turkey's automotive imports was well smaller than share of Asia-Pacific in Turkey's total imports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Turkey, in 2015 sourced 4.1% of its automotive imports from the Americas increased by 109.9% the third largest increase after MENA and free zones' amongst regions from 1.9% in 2003 leading the Americas to be the third largest source of Turkey's automotive imports in both 2003 and 2015. On the other hand, share of the Americas in Turkey's automotive imports was well smaller than share of the Americas in Turkey's total imports in both 2003 and 2015 but the gap diminished by a large extent in 2015. Turkey's automotive imports from the MENA, in 2015 made up 1.1% of its automotive imports increased by more than elevenfold the largest increase amongst regions from about 0.1% in 2003 leading the MENA to overtake the place of Africa in 2003 and resulting in the MENA becoming the fourth largest source of Turkey's automotive imports in 2015. On the other hand, share of the MENA in Turkey's automotive imports was much smaller than share of the MENA in Turkey's total imports in both 2003 and 2015 but the gap contracted in 2015. Turkey, in 2015 sourced 0.6% of its automotive imports from Africa increased by 85.1% the fourth largest increase after MENA, free zones and Americas' amongst regions from 0.4% in 2003 still leading Africa to lose its place to the MENA in 2003 and resulting in Africa being the fifth largest source of Turkey's automotive imports in 2015. On the other hand, share of Africa in Turkey's automotive imports was well smaller than share of Africa in Turkey's total imports in both 2003 and 2015 but the gap diminished by a large extent in 2015. Turkey's automotive imports from free zones, in 2015 constituted 0.4% of its automotive imports increased by 243.1% the second largest increase after MENA's amongst regions from about 0.1% in 2003 still leading free zones to become the sixth largest source of Turkey's automotive imports in 2015. On the other hand, share of free zones in Turkey's automotive imports was much smaller than share of free zones in Turkey's total imports in both 2003 and 2015 but the gap contracted by a large extent in 2015. Areas NES was the smallest source of Turkey's automotive imports in 2015. Share of areas NES in Turkey's automotive imports was much smaller than share of areas NES in Turkey's total imports in 2015.

Table 3.3 also reports that in 2015, 46.3% of Turkey's total automotive imports were in the form of motor vehicles increased by 4.3% from 44.4% in 2003, while the remaining automotive imports of Turkey were in the form of automotive parts as also reported in Table 2.2. In 2015, 76.2% of Turkey's automotive imports from the MENA were in the form of motor vehicles increased by 210.8% the largest increase amongst regions from 24.5% in 2003 leading the vast majority of automotive imports of Turkey from the MENA to be in the form of motor vehicles and also resulting in the MENA having the highest share in 2015. 58.7% of Turkey's automotive imports from the Americas, in 2015 were in the form of motor vehicles increased by 151.3% the second largest increase after MENA's amongst regions from 23.3% in 2003 leading the majority of automotive imports of Turkey from the Americas to be in the form of motor vehicles and also resulting in the Americas having the second highest share in 2015. 51.4% of Turkey's automotive imports from Europe, in 2015 were in the form of motor vehicles increased by 9.7% from 46.8% in 2003 leading more than 50% of automotive imports of Turkey from Europe to be in the form of motor vehicles and resulting in Europe having the third highest share in 2015. 28% of automotive imports of Turkey from Africa, in 2015 were in the form of motor vehicles leading Africa to have the fourth highest share. 19.2% of Turkey's automotive imports from Asia-Pacific, in 2015 were in the form of motor vehicles decreased by 41.5% the second largest fall after free zones' amongst regions from 32.8% in 2003 leading the vast majority of automotive imports of Turkey from Asia-Pacific to be in the form of automotive parts and resulting in Asia-Pacific having the fifth highest share in 2015. In 2015, 3.5% of automotive imports of Turkey from areas NES were in the form of motor vehicles leading areas NES to have the sixth highest share. About 0.1% of Turkey's automotive imports from free zones, in 2015 were in the form of motor vehicles decreased by 99.6% the largest fall amongst regions from 14.7% in 2003 resulting in free zones having the smallest share in 2015.

Last, Table 3.3 presents that in 2015, Turkey's automotive imports constituted around 12.4% of Turkey's total imports increased by 9.7% from 11.3% in 2003 as also presented in Table 2.2. 18.4% of Turkey's imports from Europe were in the automotive industry in 2015 increased by 26.1% from 14.6% in 2003 leading Europe to have the largest automotive import intensity amongst regions in both 2003 and 2015. 8.1% of Turkey's imports from Africa were in the automotive industry in 2015 increased by 138.5% the third largest rise after MENA and free zones' amongst regions from 3.4% in 2003 leading Africa to overtake the place of Asia-Pacific in 2003 and resulting in Africa having the second largest automotive import intensity amongst regions in 2015. 7.8% of Turkey's imports from Asia-Pacific were in the automotive industry in 2015 decreased by 16.6% the only fall amongst regions from 9.3% in 2003 leading Asia-Pacific to lose its place to Africa in 2003 and also resulting in Asia-Pacific having the third largest automotive import intensity amongst regions in 2015. 7.1% of Turkey's imports from free zones were in the automotive industry in 2015 increased by about tenfold the second largest rise after MENA's amongst regions from about 0.7% in 2003 leading free zones to have the fourth largest automotive import intensity amongst regions in 2015. 6.2% of Turkey's imports from the Americas were in the automotive industry in 2015 more than doubled from 3.1% in 2003 leading the Americas to have the fifth largest automotive import intensity amongst regions in 2015. About 2% of Turkey's imports from the MENA were in the automotive industry in 2015 increased by more than sixteenfold the largest rise amongst regions from about 0.1% in 2003 still leading the MENA to have the sixth largest automotive import intensity amongst regions in 2015. Areas NES had the smallest automotive import share amongst regions in 2015.

Table 3.3 Automotive Imports of Turkey from Regions and Major Countries (in current million US dollars)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Africa	27.6	0	0.4	167.5	28	0.6	507.1		85.1	3.4	8.1	138.5
Remaining	0	0	0	0.2	22.4	0	1587.1		414.4	0	0	599.6
South Africa	27.6	0	0.4	167.2	28	0.6	506.5		84.9	8.2	18.2	121.7
Americas	151.8	23.3	1.9	1044.6	58.7	4.1	588.3	151.3	109.9	3.1	6.2	102.2
Argentina	0.7	0	0	55.9	96.3	0.2	7944.2		2352.8	0.3	23.9	8992.2
Brazil	61.3	0.3	0.8	54.8	0	0.2	-10.7	-100	-72.8	15.3	3.1	-80
Canada	5.8	52	0.1	18.5	20	0.1	220.1	-61.5	-2.4	2.4	2	-15.6
Chile	0	0	0	0	0	0	1827.4		487.7	0	0	994.7
Colombia	0	0	0	0	0	0	590.1		110.4	0	0	-34.8
Mexico	4.1	78.2	0.1	354.7	90.4	1.4	8451.4	15.6	2507.4	4.1	41.2	893.4
Remaining	0.2	0	0	0.2	0	0	-12.1		-73.2	0.1	0	-78.6
USA	79.6	36.5	1	560.5	41.9	2.2	604.3	14.9	114.7	2.3	5	121.3
Areas NES				0.8	3.5	0					0	
Asia-Pacific	960.7	32.8	12.2	4235.3	19.2	16.4	340.9	-41.5	34.4	9.3	7.8	-16.6
Australia	0.1	0	0	1.6	0	0	1220.7		302.7	0.1	0.3	454.3
China	111.9	0.4	1.4	1277.4	2.8	5	1042	574.2	248.2	4.3	5.1	19.8
India	22.1	13.6	0.3	831.8	17.4	3.2	3666.2	28.3	1048.4	3.1	14.8	385
Indonesia	4.5	0	0.1	30.8	0	0.1	591.6		110.9	1	1.9	90.1
Japan	431.2	48.2	5.5	724.4	26.1	2.8	68	-45.8	-48.8	22.4	23.1	3.1
Korea	300.3	26.7	3.8	997.2	29.1	3.9	232	8.9	1.2	22.9	14.1	-38.3
Malaysia	18.3	0	0.2	23.5	0	0.1	28.2		-60.9	4.7	1.8	-62.6
Pakistan	0.2	0	0	1.5	0	0	656.3		130.6	0.1	0.5	367.6

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Automotive Imports of Turkey from Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Philippines	0.8	0	0	6.5	0	0	691.6		141.4	1.4	5.6	307.2
Remaining	36	1.8	0.5	118.8	2.4	0.5	230.2	30.9	0.7	1.7	1.4	-18.9
Thailand	35.3	63.6	0.4	221.8	66.9	0.9	528.2	5.2	91.5	12.1	18.3	51.6
Europe	6704.3	46.8	85.3	19941.8	51.4	77.4	197.4	9.7	-9.3	14.6	18.4	26.1
EU (28)	6680.9	46.8	85	19820.4	51.5	76.9	196.7	10.1	-9.5	19	25.2	32.7
Austria	65.6	76.5	0.8	160.6	36.4	0.6	144.8	-52.5	-25.4	8	10.2	28.7
Belgium	126.5	73.7	1.6	224.1	77.2	0.9	77.2	4.8	-46	8.3	7.1	-14.2
Czechia	93.1	60.6	1.2	1176.1	45.4	4.6	1163.9	-25.1	285.4	21	53	152.9
France	1434	40.8	18.2	1624.5	38.2	6.3	13.3	-6.5	-65.5	34.4	21.4	-37.8
Germany	2174.6	57	27.7	7146.2	60.9	27.7	228.6	6.8	0.2	23	33.5	45.5
Hungary	36	5	0.5	461	62.6	1.8	1180.8	1157.8	290.5	8.6	35.3	308.9
Italy	843.5	15	10.7	1640.2	31.8	6.4	94.5	112.8	-40.7	15.4	15.4	0
Netherlands	193.8	88.2	2.5	340.1	86.2	1.3	75.5	-2.3	-46.5	11.7	11.7	-0.3
Poland	52.3	40.9	0.7	1349.1	42	5.2	2479.5	2.6	686.5	12.6	45.3	259.8
Remaining	36	6.3	0.5	523.5	18.7	2	1353.6	197.9	343.2	1.1	6.2	457.9
Romania	24.4	49.4	0.3	809.5	47.5	3.1	3220.6	-3.9	912.5	2.6	31.1	1121
Slovakia	35.8	55	0.5	444.5	42.6	1.7	1142.7	-22.6	278.9	17.4	51.8	197.9
Slovenia	40	28.7	0.5	50.6	11.7	0.2	26.5	-59.1	-61.4	43	14.7	-65.8
Spain	633.4	81.1	8.1	1943.3	69.9	7.5	206.8	-13.9	-6.5	31.6	34.8	10
Sweden	87.1	75.1	1.1	103.9	43.4	0.4	19.3	-42.3	-63.6	10.6	6.6	-38.1
UK	804.9	19.7	10.2	1823.1	39.9	7.1	126.5	102.6	-30.9	23	32.9	43.1
Other Europe	23.4	42.4	0.3	121.4	24.6	0.5	418.1	-41.9	58	0.2	0.4	87.4
Israel	2.3	6.3	0	2	22.1	0	-14.6	253.8	-74	0.5	0.1	-76.5
Remaining	3.1	2.4	0	68.8	40	0.3	2125	1597.6	578.4	0.2	1.3	701

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Automotive Imports of Turkey from Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Russia	12.2	70.4	0.2	31.8	1.9	0.1	160	-97.3	-20.7	0.2	0.2	-30.5
Switzerland	5.8	19.2	0.1	18.8	7.5	0.1	226.1	-61.2	-0.6	0.2	0.8	295.4
Free Zones	8.2	14.7	0.1	92.1	0.1	0.4	1025.2	-99.6	243.1	0.7	7.1	981.6
MENA	7.2	24.5	0.1	295	76.2	1.1	3992.9	210.8	1148	0.1	2	1631.6
Algeria	0	0	0	0.2	0	0	992.8		233.2	0	0	1496
Egypt	2.9	3.8	0	28	0	0.1	878.3	-100	198.3	1.5	2.3	52.4
Iran	1.2	25.7	0	14.7	0.4	0.1	1169.7	-98.3	287.1	0.1	0.2	287.5
Morocco	1	0	0	235.9	94.8	0.9	22419.6		6766.5	1.4	33.2	2339.8
Remaining	1.1	70.7	0	4.4	20.1	0	302.3	-71.6	22.7	0.1	0.1	115.5
Saudi Arabia	0.7	80.4	0	0.1	21.7	0	-85.5	-73	-95.6	0.1	0	-93.4
Tunisia	0.3	0	0	11.6	1.7	0	3851.6		1104.9	0.3	8.1	2591.7
Total	7859.8	44.4	100	25777.1	46.3	100	228	4.3		11.3	12.4	9.7

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. MV means motor vehicle. PCT stands for percent. Areas NES means areas not elsewhere specified. Appendix D: Table D.4 lists 6-digit automotive parts and motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

3.3.1.3 Motor Vehicle Imports of Turkey from Regions and Major Countries

Table 3.4 indicates units of motor vehicle[23] imports of Turkey by origin, origin's share in Turkey's motor vehicle imports in 2003 and 2015, percent change in motor vehicle imports of Turkey by origin and origin's motor vehicle import share between 2003 and 2015.

Table 3.4 presents that Turkey's motor vehicle imports, in 2015 were about 722.5 thousand units increased by more than twofold from around 234.5 thousand units in 2003 as also revealed in Table 2.3. This increase in units of motor vehicle imports of Turkey was smaller than the increase in value of automotive imports of Turkey by around 20 percentage points between 2003 and 2015. In 2015, Turkey sourced 80.6% of its motor vehicle imports from Europe decreased by 7.7% the third largest fall after free zones and Asia-Pacific's amongst regions from 87.3% in 2003 still leading Europe to be the largest source of Turkey's motor vehicle imports in both 2003 and 2015. Share of Europe in Turkey's motor vehicle imports was larger than share of Europe in Turkey's automotive imports in both 2003 and 2015 and even the gap widened in 2015. Asia-Pacific, in 2015 constituted 10.9% of Turkey's motor vehicle imports decreased by 9.3% the second largest fall after free zones' amongst regions from 12% in 2003 still leading Asia-Pacific to be the second largest source of Turkey's motor vehicle imports in both 2003 and 2015. Share of Asia-Pacific in Turkey's motor vehicle imports was smaller than share of Asia-Pacific in Turkey's automotive imports in both 2003 and 2015 and even the gap widened in 2015. Turkey, in 2015 sourced 4.6% of its motor vehicle imports from the Americas increased by more than sixfold the second largest rise after MENA's amongst regions from 0.6% in 2003 resulting in the Americas being the third largest source of Turkey's motor vehicle imports in both 2003 and 2015. Share of the Americas in Turkey's motor vehicle imports was smaller than share of the Americas in Turkey's automotive imports in 2003 but share of the Americas in Turkey's motor vehicle imports turned to become larger than share of the Americas in Turkey's automotive imports by a small margin in 2015. The MENA, in 2015 constituted 3.6% of Turkey's motor vehicle imports having the largest increase amongst regions and resulting in the MENA being the fourth largest source of Turkey's motor vehicle imports in both 2003 and 2015. Share of the MENA in Turkey's motor vehicle imports was smaller than share of the MENA in Turkey's automotive imports in 2003 but it turned to become larger by a great margin in 2015. Africa constituted around 0.3% of Turkey's motor vehicle imports leading Africa to be the fifth largest source of Turkey's motor vehicle imports in 2015. Share of Africa in Turkey's motor vehicle imports was smaller than share of Africa in Turkey's automotive imports in both 2003 and 2015 but the gap diminished in 2015. Free zones was the sixth largest source of Turkey's motor vehicle imports in 2015. Share of free zones in Turkey's motor vehicle imports was smaller than share of free zones in Turkey's automotive imports in both 2003 and 2015 and the gap widened in 2015. Areas NES was the smallest source of Turkey's motor vehicle imports in 2015.

[23] Import data on motor vehicles includes passenger cars, commercial vehicles and farm tractors.

Table 3.4 Motor Vehicle Imports of Turkey from Regions and Major Countries (in units)

	2003		2015		Change 03/15	
	QTY	PCT	QTY	PCT	QTY	PCT
Africa	0	0	2310	0.3		
Remaining	0	0	2	0		
South Africa	0	0	2308	0.3		
Americas	1435	0.6	33378	4.6	2226	655.1
Argentina	0	0	2378	0.3		
Brazil	10	0	0	0	-100	-100
Canada	118	0.1	86	0	-27.1	-76.3
Chile	0	0	0	0		
Colombia	0	0	0	0		
Mexico	186	0.1	24570	3.4	13109.7	4188.5
Remaining	0	0	0	0		
USA	1121	0.5	6344	0.9	465.9	83.7
Areas NES			1	0		
Asia-Pacific	28193	12	78736	10.9	179.3	-9.3
Australia	0	0	0	0		
China	261	0.1	18136	2.5	6848.7	2155.9
India	321	0.1	13691	1.9	4165.1	1284.6
Indonesia	0	0	0	0		
Japan	14963	6.4	9813	1.4	-34.4	-78.7
Korea	10845	4.6	27438	3.8	153	-17.9
Malaysia	0	0	0	0		
Pakistan	0	0	0	0		
Philippines	0	0	0	0		
Remaining	45	0	332	0	637.8	139.5
Thailand	1758	0.7	9326	1.3	430.5	72.2
Europe	204841	87.3	582151	80.6	184.2	-7.7
EU (28)	202741	86.4	580399	80.3	186.3	-7.1
Austria	1267	0.5	1317	0.2	3.9	-66.3
Belgium	6883	2.9	7045	1	2.4	-66.8
Czechia	5025	2.1	36022	5	616.9	132.7
France	48665	20.7	36897	5.1	-24.2	-75.4
Germany	59957	25.6	202352	28	237.5	9.6
Hungary	81	0	13247	1.8	16254.3	5209.4
Italy	8865	3.8	28569	4	222.3	4.6
Netherlands	3417	1.5	4135	0.6	21	-60.7
Poland	1140	0.5	39482	5.5	3363.3	1024.4

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Motor Vehicle Imports of Turkey from Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	QTY	PCT	QTY	PCT	QTY	PCT
Remaining	73	0	4823	0.7	6506.8	2044.9
Romania	2260	1	42834	5.9	1795.3	515.3
Slovakia	1086	0.5	14028	1.9	1191.7	319.3
Slovenia	1203	0.5	26	0	-97.8	-99.3
Spain	52451	22.4	112057	15.5	113.6	-30.6
Sweden	1022	0.4	1163	0.2	13.8	-63.1
UK	9346	4	36402	5	289.5	26.4
Other Europe	2100	0.9	1752	0.2	-16.6	-72.9
Israel	2	0	4	0	100	-35.1
Remaining	6	0	1734	0.2	28800	9282.3
Russia	2075	0.9	2	0	-99.9	-100
Switzerland	17	0	12	0	-29.4	-77.1
Free Zones	25	0	5	0	-80	-93.5
MENA	47	0	25871	3.6	54944.7	17770
Algeria	0	0	0	0		
Egypt	1	0	0	0	-100	-100
Iran	10	0	2	0	-80	-93.5
Morocco	0	0	25441	3.5		
Remaining	18	0	426	0.1	2266.7	668.3
Saudi Arabia	18	0	1	0	-94.4	-98.2
Tunisia	0	0	1	0		
Total	234541	100	722452	100	208	

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. QTY means quantity. PCT stands for percent. Areas NES means areas not elsewhere specified. Appendix D: Table D.4 lists 6-digit motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

3.3.2 Total, Automotive and Motor Vehicle Exports of Turkey to Regions and Major Countries

This subsection reports total exports, automotive exports and motor vehicle exports of Turkey dispatched to regions and major countries in 2003 and 2015, and changes between these periods.

3.3.2.1 Total Exports of Turkey to Regions and Major Countries

Table 3.5 reports value of total exports of Turkey by destination in current million US dollars, destination's share in Turkey's exports in 2003 and 2015, percent change in total exports of Turkey by destination and destination's export share between 2003 and 2015.

Table 3.5 presents that Turkey's total exports, in 2015 were about \$144 billion increased by almost twofold from around \$47 billion in 2003 as also reported in Table 2.4. This increase in the total exports of Turkey was larger than the increase in the total imports of Turkey by a small margin. In 2015, Turkey dispatched 55.5% of its exports to Europe decreased by 17.6% the third largest fall after free zones and Americas' amongst regions from 67.4% in 2003 leading Europe to be the largest destination of Turkey's exports in both 2003 and 2015. Share of Europe in Turkey's exports was larger than share of Europe in Turkey's imports in both 2003 and 2015 and even the gap widened by a moderate margin in 2015. The MENA, in 2015 made up 23.9% of Turkey's exports increased by 103.6% the second largest rise after Africa's amongst regions from 11.8% in 2003 resulting in the MENA being the second largest destination of Turkey's exports in both 2003 and 2015. Share of the MENA in Turkey's exports was larger than share of the MENA in Turkey's imports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Asia-Pacific, in 2015 constituted 9.8% of Turkey's exports increased by 54.2% the third largest increase after Africa and MENA's amongst regions from 6.3% in 2003 leading Asia-Pacific to overtake the place of the Americas in 2003 and resulting in Asia-Pacific being the third largest destination of Turkey's exports in 2015. Share of Asia-Pacific in Turkey's exports was much smaller than share of Asia-Pacific in Turkey's imports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Therefore, Asia-Pacific was the only region whose share in Turkey's exports was outweighed by its share in Turkey's imports in both 2003 and 2015. Turkey, in 2015 dispatched 6.4% of its exports to the Americas decreased by 29% the second largest fall after free zones' amongst regions from 9% in 2003 leading the Americas to lose their place to Asia-Pacific in 2003 and resulting in the Americas being the fourth largest destination of Turkey's exports in 2015. Share of the Americas in Turkey's exports was larger than share of the Americas in Turkey's imports in 2003 but it turned to become smaller in 2015. Africa, in 2015 constituted 2.4% of Turkey's exports increased by 129.8% the largest increase amongst regions from about 1% in 2003 still leading Africa to be the fifth largest destination of Turkey's exports in 2015. Share of Africa in Turkey's exports was smaller than share of Africa in Turkey's imports in 2003 but it turned to become larger in 2015. In 2015, Turkey dispatched 2% of its exports to free zones decreased by 55.8% the largest fall amongst regions from 4.5% in 2003 leading free zones to be the sixth largest destination of Turkey's exports in 2015. Share of free zones in Turkey's exports was larger than share of free zones in Turkey's imports in both 2003 and 2015 but the gap diminished by a moderate margin in 2015. Turkey, in 2015 dispatched 0.1% of its exports to areas NES, so areas NES was the smallest destination of

Turkey's exports in 2015. Share of areas NES in Turkey's exports was much smaller than share of areas NES in Turkey's imports in 2015.

Table 3.5 Total Exports of Turkey to Regions and Major Countries (in current million US dollars)

	2003		2015		Change 03/15	
	Value	PCT	Value	PCT	Value	PCT
Africa	485.1	1	3393.9	2.4	599.6	129.8
Remaining	363.6	0.8	2904.7	2	699	162.5
South Africa	121.5	0.3	489.2	0.3	302.5	32.2
Americas	4269.5	9	9225.3	6.4	116.1	-29
Argentina	10.8	0	118.3	0.1	994.7	259.6
Brazil	50.2	0.1	458.4	0.3	813.7	200.1
Canada	221.3	0.5	670.6	0.5	203	-0.5
Chile	15.5	0	187.9	0.1	1110.2	297.5
Colombia	16.6	0	185.9	0.1	1018.6	267.4
Mexico	40.4	0.1	344.1	0.2	751.2	179.6
Remaining	160.8	0.3	863.8	0.6	437.3	76.5
USA	3753.9	7.9	6396.3	4.4	70.4	-44
Areas NES			78	0.1		
Asia-Pacific	2988.7	6.3	14032.1	9.8	369.5	54.2
Australia	136.1	0.3	521.3	0.4	283	25.8
China	504.6	1.1	2414.9	1.7	378.6	57.2
India	71.4	0.2	650.3	0.5	811.3	199.3
Indonesia	47	0.1	207	0.1	340.7	44.8
Japan	156.3	0.3	334.8	0.2	114.2	-29.6
Korea	57.9	0.1	568.6	0.4	881.6	222.4
Malaysia	227.3	0.5	357.1	0.2	57.1	-48.4
Pakistan	70.4	0.1	289.2	0.2	311	35
Philippines	27.4	0.1	103.9	0.1	279.1	24.5
Remaining	1581.9	3.3	8410.9	5.8	431.7	74.7
Thailand	108.5	0.2	174.1	0.1	60.5	-47.3
Europe	31841.4	67.4	79843.5	55.5	150.8	-17.6
EU (28)	27803.5	58.8	64008.5	44.5	130.2	-24.4
Austria	473.2	1	1024.6	0.7	116.5	-28.9
Belgium	885.6	1.9	2557.9	1.8	188.8	-5.1
Czechia	188.8	0.4	768.6	0.5	307	33.7
France	2826.1	6	5850.7	4.1	107	-32
Germany	7484.9	15.8	13418.1	9.3	79.3	-41.1

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Total Exports of Turkey to Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	Value	PCT	Value	PCT	Value	PCT
Hungary	284.6	0.6	711.8	0.5	150.1	-17.9
Italy	3194.8	6.8	6887.9	4.8	115.6	-29.2
Netherlands	1525.9	3.2	3154.9	2.2	106.8	-32.1
Poland	486	1	2329.4	1.6	379.3	57.4
Remaining	3497.9	7.4	6643.5	4.6	89.9	-37.6
Romania	873.3	1.8	2815.6	2	222.4	5.9
Slovakia	59.9	0.1	545.8	0.4	810.8	199.2
Slovenia	102.6	0.2	810.5	0.6	690	159.5
Spain	1792.2	3.8	4742.9	3.3	164.7	-13.1
Sweden	457.5	1	1189	0.8	159.9	-14.6
UK	3670.1	7.8	10557.3	7.3	187.7	-5.5
Other Europe	4037.9	8.5	15835	11	292.2	28.8
Israel	1083	2.3	2698.1	1.9	149.1	-18.2
Remaining	1230.4	2.6	3866.6	2.7	214.3	3.2
Russia	1367.6	2.9	3589.5	2.5	162.5	-13.8
Switzerland	356.9	0.8	5680.8	3.9	1491.8	422.9
Free Zones	2113.3	4.5	2843.9	2	34.6	-55.8
MENA	5554.7	11.8	34433.6	23.9	519.9	103.6
Algeria	573	1.2	1826	1.3	218.7	4.7
Egypt	345.8	0.7	3125	2.2	803.7	196.9
Iran	533.8	1.1	3664.2	2.5	586.5	125.5
Morocco	180.8	0.4	1337.6	0.9	639.9	143
Remaining	2959.9	6.3	20189.2	14	582.1	124.1
Saudi Arabia	741.5	1.6	3472.6	2.4	368.3	53.8
Tunisia	220	0.5	819.1	0.6	272.3	22.3
Total	47252.8	100	143850.4	100	204.4	

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. PCT stands for percent. Areas NES means areas not elsewhere specified.

Source: Calculations are based on UN Comtrade.

3.3.2.2 Automotive Exports of Turkey to Regions and Major Countries

Table 3.6 reports value of automotive exports of Turkey by destination in current million US dollars, motor vehicles' share in automotive exports, destination's share in Turkey's automotive exports in 2003 and 2015, percent change in automotive exports of Turkey by destination, motor vehicles' share in automotive exports and destination's automotive export share between 2003 and 2015, and destination's share of automotive exports in its total exports in 2003 and 2015, and change in this share between 2003 and 2015.

Table 3.6 reveals first that Turkey's automotive exports, in 2015 were around $22.5 billion increased by 243.4% from about $6.6 billion in 2003 as also presented in Table 2.5. This increase in the automotive exports of Turkey was much larger than the increase in Turkey's total exports. Increase in the automotive exports of Turkey was also larger than the increase in Turkey's automotive imports. Nevertheless, value of automotive exports of Turkey was smaller than value of automotive imports of Turkey in both 2003 and 2015.

Second, in 2015, Turkey dispatched 80% of its automotive exports to Europe decreased by 1.1% from 80.9% in 2003 resulting in Europe becoming the largest destination of Turkey's automotive exports in both 2003 and 2015. Share of Europe in Turkey's automotive exports was also well larger than share of Europe in Turkey's total exports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Europe was the only region whose share in Turkey's automotive exports was larger than its share in Turkey's total exports in both 2003 and 2015. Share of Europe in Turkey's automotive exports was smaller than share of Europe in Turkey's automotive imports in 2003 but it turned to become larger in 2015. Nevertheless, value of automotive exports of Turkey to Europe was smaller than value of automotive imports of Turkey from Europe in both 2003 and 2015.

Third, Turkey's automotive exports to the MENA, in 2015 made up 8.6% of its automotive exports increased by 9.1% from 7.9% in 2003 leading the MENA to be the second largest destination of Turkey's automotive exports in both 2003 and 2015. On the other hand, share of the MENA in Turkey's automotive exports was much smaller than share of the MENA in Turkey's total exports in both 2003 and 2015 and even the gap grew by a large margin in 2015. Share of the MENA in Turkey's automotive exports was much larger than share of the MENA in Turkey's automotive imports in both 2003 and 2015.

Fourth, Turkey, in 2015 dispatched 6.2% of its automotive exports to the Americas increased by 155.3% the largest increase amongst regions from 2.4% in 2003 leading the Americas to overtake the place of free zones in 2003 and resulting in the Americas being the third largest destination of Turkey's automotive exports in 2015. On the other hand, share of the Americas in Turkey's automotive exports was smaller than share of the Americas in Turkey's total exports in both 2003 and 2015 but the gap diminished by a large margin in 2015. Share of the Americas in Turkey's automotive exports was larger than share of the Americas in Turkey's automotive imports in both 2003 and 2015 and even the gap widened in 2015.

Fifth, Turkey's automotive exports to Asia-Pacific, in 2015 constituted 3.2% of its automotive exports increased by 6.5% from 3% in 2003 leading Asia-Pacific to be the fourth largest destination of Turkey's automotive exports in both 2003 and 2015. On the other hand, share of Asia-Pacific in Turkey's automotive exports was well smaller than share of Asia-Pacific in Turkey's total exports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Share of Asia-Pacific in Turkey's automotive exports was much smaller than share of Asia-Pacific in Turkey's automotive imports in both 2003 and 2015 and even the gap widened in 2015. Asia-Pacific was the only region whose share in Turkey's automotive exports was much smaller than its share in Turkey's automotive imports in both 2003 and 2015. Therefore, value of automotive exports of Turkey to Asia-Pacific was much smaller than value of automotive imports of Turkey from Asia-Pacific in both 2003 and 2015 and even the gap significantly grew in 2015.

Sixth, Turkey, in 2015 dispatched 1.2% of its automotive exports to Africa increased by 49.3% from 0.8% in 2003 resulting in Africa being the fifth largest destination of Turkey's automotive exports in 2015. On the other hand, share of Africa in Turkey's automotive exports was smaller than share of Africa in Turkey's total exports in both 2003 and 2015 and even the gap widened by a large margin in 2015. Share of Africa in Turkey's automotive exports was larger than share of Africa in Turkey's automotive imports in both 2003 and 2015 and even the gap widened in 2015.

Seventh, Turkey's automotive exports to free zones, in 2015 constituted 0.7% of its automotive exports decreased by 86% the largest fall amongst regions from 4.9% in 2003 leading free zones to become the sixth largest destination of Turkey's automotive exports in 2015. On the other hand, share of free zones in Turkey's automotive exports was larger than share of free zones in Turkey's total exports in 2003 but it turned to become smaller by a large margin in 2015. Share of free zones in Turkey's automotive exports was larger than share of free zones in Turkey's automotive imports in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Eight, areas NES was the smallest destination of Turkey's automotive exports in 2015. Share of areas NES in Turkey's automotive exports was much smaller than share of areas NES in Turkey's total exports in 2015. Value of Turkey's automotive exports to areas NES was much larger than value of Turkey's automotive imports from areas NES in 2015.

Table 3.6 also reports first that in 2015, 57.4% of Turkey's total automotive exports were in the form of motor vehicles decreased by 7.1% from 61.7% in 2003, while the remaining automotive exports of Turkey were in the form of automotive parts as also presented in Table 2.5. Share of motor vehicles in total automotive exports of Turkey was much larger than share of motor vehicles in total automotive imports of Turkey in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Second, 61.7% of Turkey's automotive exports to Europe, in 2015 were in the form of motor vehicles decreased by 5.4% from 65.2% in 2003 leading more than 50% of automotive exports of Turkey to Europe to be in the form of motor vehicles and resulting in Europe having the highest share in both 2003 and 2015. Europe was the only region to which more than 50% of automotive exports of Turkey dispatched was in the form of motor vehicles in both 2003 and 2015. Share of motor vehicles in automotive exports of Turkey to Europe was much larger than share of motor vehicles in automotive imports of Turkey from Europe in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Third, in 2015, 58% of automotive exports of Turkey to areas NES were in the form of motor vehicles leading areas NES to have the second highest share. Share of motor vehicles in automotive exports of Turkey to areas NES was much larger than share of motor vehicles in automotive imports of Turkey from areas NES in 2015.

Fourth, 47.4% of Turkey's automotive exports to the Americas, in 2015 were in the form of motor vehicles increased by 48.8% the largest rise amongst regions from 31.9% in 2003 still leading the majority of automotive exports of Turkey to the Americas to be in the form of automotive parts in both 2003 and 2015 and also resulting in the Americas having the third highest share in 2015. Share of motor vehicles in automotive exports of Turkey to the Americas was larger than share of motor vehicles in automotive imports of Turkey from the Americas in 2003 but it turned to become smaller in 2015.

Fifth, 39.4% of Turkey's automotive exports to Africa, in 2015 were in the form of motor vehicles increased by 29% from 30.5% in 2003 leading the majority of automotive exports of Turkey to Africa to be in the form of automotive parts in both 2003 and 2015 and also resulting in Africa having the fourth highest share in 2015. Share of motor vehicles in automotive exports of Turkey to Africa was much larger than share of motor vehicles in automotive imports of Turkey from Africa in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Sixth, in 2015, 38.6% of Turkey's automotive exports to the MENA were in the form of motor vehicles decreased by 34.9% from 59.3% in 2003 leading the vast majority of automotive exports of Turkey to the MENA to be in the form of automotive parts in 2015 opposite to 2003 and also resulting in the MENA having the fifth highest share in 2015. Share of motor vehicles in automotive exports of Turkey to the MENA was larger than share of motor vehicles in automotive imports of Turkey from the MENA in 2003 but it turned to become smaller in 2015.

Seventh, 35.2% of Turkey's automotive exports to Asia-Pacific, in 2015 were in the form of motor vehicles decreased by 10.1% from 39.2% in 2003 leading the vast majority of automotive exports of Turkey to Asia-Pacific to be in the form of automotive parts in both 2003 and 2015 and resulting in Asia-Pacific having the sixth highest share in 2015. Share of motor vehicles in automotive exports of Turkey to Asia-Pacific was larger than share of motor vehicles in automotive imports of Turkey from Asia-Pacific in both 2003 and 2015 but the gap widened in 2015.

Eighth, 15.1% of Turkey's automotive exports to free zones, in 2015 were in the form of motor vehicles decreased by 63.8% the largest fall amongst regions from 41.6% in 2003 leading free zones to have the smallest share in 2015. Share of motor vehicles in automotive exports of Turkey to free zones was much larger than share of motor vehicles in automotive imports of Turkey from free zones in both 2003 and 2015 but the gap diminished by a large extent in 2015.

Furthermore, Table 3.6 presents first that in 2015, Turkey's automotive exports constituted around 15.7% of Turkey's total exports increased by 12.8% from 13.9% in 2003 as also presented in Table 2.5. Share of automotive exports in total exports of Turkey was larger than share of automotive imports in total imports of Turkey in both 2003 and 2015 and even the gap widened in 2015.

Second, 22.6% of Turkey's exports to Europe were in the automotive industry in 2015 increased by 35.5% the second largest increase after Americas' amongst regions from 16.7% in 2003 leading Europe to have the largest automotive export intensity amongst regions in both 2003 and 2015. Turkey's automotive export intensity to Europe was larger than Turkey's automotive import intensity from Europe in both 2003 and 2015 and even the gap widened in 2015.

Third, 15.2% of Turkey's exports to the Americas were in the automotive industry in 2015 increased by 305.8% the largest increase amongst regions from 3.8% in 2003 leading the Americas to overtake the place of free zones in 2003 and resulting in the Americas having the second largest automotive export intensity amongst regions in 2015. Turkey's automotive export intensity to the Americas was larger than Turkey's automotive import intensity from the Americas in both 2003 and 2015 and even the gap widened by a large margin in 2015.

Fourth, 7.8% of Turkey's exports to Africa were in the automotive industry in 2015 decreased by 26.7% from 10.6% in 2003 still leading Africa to have the third largest automotive export intensity amongst regions in both 2003 and 2015. Turkey's automotive export intensity to Africa was larger than Turkey's automotive import intensity from Africa in 2003 but it turned to be smaller in 2015.

Fifth, 5.7% of Turkey's exports to the MENA were in the automotive industry in 2015 decreased by 39.5% the second largest fall after free zones' amongst regions from 9.4% in 2003 still leading the MENA to have the fourth largest automotive export intensity amongst regions in both 2003 and 2015. Turkey's automotive export intensity to the MENA was much larger than Turkey's automotive import intensity from the MENA in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Sixth, 5.5% of Turkey's exports to free zones were in the automotive industry in 2015 decreased by 64.3% the largest fall amongst regions from 15.3% in 2003 leading free zones to have the fifth largest automotive export intensity amongst regions in 2015. Turkey's automotive export intensity to free zones was larger than Turkey's automotive import intensity from free zones in 2003 but it turned to be smaller in 2015.

Seventh, 5.2% of Turkey's exports to Asia-Pacific were in the automotive industry in 2015 decreased by 22.1% from 6.7% in 2003 leading Asia-Pacific to have the sixth largest automotive export intensity amongst regions in 2015. Turkey's automotive export intensity to Asia-Pacific was smaller than Turkey's automotive import intensity from Asia-Pacific in both 2003 and 2015. Asia-Pacific was the only region this held for both 2003 and 2015.

Eighth, areas NES had the smallest automotive export share amongst regions in 2015. Turkey's automotive export intensity to areas NES was much larger than Turkey's automotive import intensity from areas NES in 2015.

Table 3.6 Automotive Exports of Turkey to Regions and Major Countries (in current million US dollars)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Africa	51.5	30.5	0.8	264	39.4	1.2	412.6	29	49.3	10.6	7.8	-26.7
Remaining	27.2	30.2	0.4	146.5	37.6	0.6	438.5	24.5	56.8	7.5	5	-32.6
South Africa	24.3	30.9	0.4	117.5	41.7	0.5	383.6	34.7	40.8	20	24	20.2
Americas	160.3	31.9	2.4	1405.4	47.4	6.2	776.8	48.8	155.3	3.8	15.2	305.8
Argentina	0.8	0	0	48.4	35.9	0.2	5962.3		1665.2	7.4	40.9	453.8
Brazil	19.5	0	0.3	84.6	0	0.4	333		26.1	38.9	18.4	-52.6
Canada	1.7	0	0	51.6	55.8	0.2	2886.4		769.6	0.8	7.7	885.6
Chile	1.8	0	0	48.2	73.5	0.2	2545.5		670.3	11.7	25.6	118.6
Colombia	10	0	0.2	23	6.2	0.1	130.7		-32.8	60	12.4	-79.4
Mexico	19.1	0	0.3	100.6	32	0.4	425.6		53	47.4	29.2	-38.2
Remaining	5.4	18.9	0.1	38.4	48.8	0.2	611.6	158.7	107.2	3.4	4.4	32.4
USA	101.9	49.1	1.6	1010.6	52.7	4.5	891.8	7.3	188.8	2.7	15.8	482
Areas NES				3.2	58	0					4.1	
Asia-Pacific	199.4	39.2	3	729.3	35.2	3.2	265.8	-10.1	6.5	6.7	5.2	-22.1
Australia	27.7	29.3	0.4	80.2	69.8	0.4	190	138.5	-15.6	20.3	15.4	-24.3
China	49.9	34.3	0.8	40.1	0	0.2	-19.7	-99.9	-76.6	9.9	1.7	-83.2
India	2.1	0	0	38.4	0.6	0.2	1764.5		442.9	2.9	5.9	104.6
Indonesia	0.7	0	0	3.8	11.8	0	434.3		55.6	1.5	1.8	21.2
Japan	6.7	6.2	0.1	37.4	36	0.2	457.6	481.6	62.4	4.3	11.2	160.3
Korea	4.8	36.6	0.1	59.3	4.8	0.3	1148.8	-86.9	263.6	8.2	10.4	27.2
Malaysia	4.8	44.5	0.1	27.3	6.8	0.1	463.5	-84.8	64.1	2.1	7.6	258.6
Pakistan	10.8	2.2	0.2	19.3	3.7	0.1	77.9	68.8	-48.2	15.4	6.7	-56.7

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Automotive Exports of Turkey to Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Philippines	0.9	38.5	0	4.5	55.8	0	401.7	44.8	46.1	3.3	4.4	32.4
Remaining	89	53.6	1.4	398.5	44.6	1.8	347.9	-16.7	30.4	5.6	4.7	-15.8
Thailand	2	18.7	0	20.6	4.4	0.1	914	-76.4	195.3	1.9	11.8	531.9
Europe	5311.1	65.2	80.9	18040.4	61.7	80	239.7	-5.4	-1.1	16.7	22.6	35.5
EU (28)	4826.5	63.9	73.5	16813.8	61.5	74.6	248.4	-3.9	1.4	17.4	26.3	51.3
Austria	98.5	66	1.5	249.2	66.7	1.1	152.9	1.1	-26.4	20.8	24.3	16.8
Belgium	148.2	37.3	2.3	1009.1	65.6	4.5	581	76.1	98.3	16.7	39.4	135.8
Czechia	48.6	81.9	0.7	199.8	38.1	0.9	311	-53.4	19.7	25.7	26	1
France	826	69.1	12.6	2156.9	67.3	9.6	161.1	-2.6	-24	29.2	36.9	26.1
Germany	1171.5	44.5	17.8	3609.4	33.3	16	208.1	-25.1	-10.3	15.7	26.9	71.9
Hungary	99.9	95.1	1.5	237	61.3	1.1	137.3	-35.5	-30.9	35.1	33.3	-5.1
Italy	751.2	63.6	11.4	1973	69.8	8.8	162.6	9.9	-23.5	23.5	28.6	21.8
Netherlands	112.4	74.9	1.7	462.1	75	2	311.1	0.1	19.7	7.4	14.6	98.8
Poland	148.4	65.4	2.3	497.3	54	2.2	235	-17.4	-2.4	30.5	21.3	-30.1
Remaining	509.8	86.5	7.8	1075.9	74.8	4.8	111.1	-13.5	-38.5	14.6	16.2	11.1
Romania	123.3	67.8	1.9	523	17.9	2.3	324.2	-73.6	23.5	14.1	18.6	31.6
Slovakia	9.6	86.2	0.1	62.7	50.7	0.3	555.6	-41.1	90.9	16	11.5	-28
Slovenia	37	64.5	0.6	621	94.4	2.8	1576.4	46.3	388.1	36.1	76.6	112.2
Spain	327.6	80.1	5	1130.3	66.6	5	245	-16.8	0.5	18.3	23.8	30.4
Sweden	65.4	69.7	1	328.5	68.5	1.5	402.1	-1.7	46.2	14.3	27.6	93.2
UK	349	61.7	5.3	2678.6	79.9	11.9	667.6	29.5	123.5	9.5	25.4	166.9
Other Europe	484.6	78.2	7.4	1226.6	64.9	5.4	153.1	-17.1	-26.3	12	7.7	-35.5
Israel	173.9	86.5	2.6	500.7	87.3	2.2	188	0.9	-16.2	16.1	18.6	15.6
Remaining	108.8	83.2	1.7	282.8	58.8	1.3	159.8	-29.4	-24.3	8.8	7.3	-17.3

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Automotive Exports of Turkey to Regions and Major Countries (Continued)

	2003			2015			Change 03/15			Share of Automotive		
	Value	MV	PCT	Value	MV	PCT	Value	MV	PCT	2003	2015	Change
Russia	169.1	67.4	2.6	306.7	24.1	1.4	81.3	-64.3	-47.2	12.4	8.5	-30.9
Switzerland	32.8	73.1	0.5	136.5	86.9	0.6	316.4	18.9	21.3	9.2	2.4	-73.8
Free Zones	322.7	41.6	4.9	155.2	15.1	0.7	-51.9	-63.8	-86	15.3	5.5	-64.3
MENA	520.1	59.3	7.9	1949.1	38.6	8.6	274.8	-34.9	9.1	9.4	5.7	-39.5
Algeria	89.2	69	1.4	224.8	61.3	1	152.1	-11.1	-26.6	15.6	12.3	-20.9
Egypt	66	57.2	1	233.4	43.4	1	253.4	-24	2.9	19.1	7.5	-60.9
Iran	55.9	4.2	0.9	233.6	3.2	1	317.8	-23.8	21.6	10.5	6.4	-39.1
Morocco	21.8	24.9	0.3	310.7	60.7	1.4	1322.9	143.8	314.3	12.1	23.2	92.3
Remaining	124.4	49	1.9	686.4	34.3	3	451.8	-29.9	60.7	4.2	3.4	-19.1
Saudi Arabia	128.5	86.3	2	182	15	0.8	41.6	-82.6	-58.8	17.3	5.2	-69.8
Tunisia	34.2	85.8	0.5	78.2	68.8	0.3	128.5	-19.7	-33.5	15.6	9.5	-38.6
Total	6565.1	61.7	100	22546.6	57.4	100	243.4	-7.1		13.9	15.7	12.8

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. MV means motor vehicle. PCT stands for percent. Areas NES means areas not elsewhere specified. Appendix D: Table D.4 lists 6-digit automotive parts and motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

3.3.2.3 Motor Vehicle Exports of Turkey to Regions and Major Countries

Table 3.7 reports units of motor vehicle[24] exports of Turkey by destination, destination's share in Turkey's motor vehicle exports in 2003 and 2015, percent change in motor vehicle exports of Turkey by destination and destination's motor vehicle export share between 2003 and 2015.

Table 3.7 indicates first that Turkey's motor vehicle exports, in 2015 were more than 1 million units increased by 180.5% from around 370 thousand units in 2003 as also revealed in Table 2.6. This increase in units of motor vehicle exports of Turkey was much smaller than the increase in value of automotive exports of Turkey between 2003 and 2015. This increase in units of motor vehicle exports of Turkey was also much smaller than the increase in units of motor vehicle imports of Turkey between 2003 and 2015. Nevertheless, units of motor vehicle exports of Turkey were larger than units of motor vehicle imports of Turkey in both 2003 and 2015.

Second, in 2015, Turkey dispatched 87.6% of its motor vehicle exports to Europe increased by 2.8% from 85.2% in 2003 leading Europe to be the largest destination of Turkey's motor vehicle exports in both 2003 and 2015. Share of Europe in Turkey's motor vehicle exports was larger than share of Europe in Turkey's automotive exports in both 2003 and 2015 and even the gap widened in 2015. Europe was the only region whose share in Turkey's motor vehicle exports was larger than its share in Turkey's automotive exports in both 2003 and 2015. Share of Europe in Turkey's motor vehicle exports was smaller than share of Europe in Turkey's motor vehicle imports in 2003 but it turned to be larger in 2015. On the other hand, units of Turkey's motor vehicle exports to Europe were larger than units of Turkey's motor vehicle imports from Europe in both 2003 and 2015.

Third, the MENA, in 2015 constituted 7.1% of Turkey's motor vehicle exports decreased by 29.3% the third largest fall after free zones and Asia-Pacific's amongst regions and resulting in the MENA being the second largest destination of Turkey's motor vehicle exports in both 2003 and 2015. Share of the MENA in Turkey's motor vehicle exports was larger than share of the MENA in Turkey's automotive exports in 2003 but it turned to become smaller in 2015. Share of the MENA in Turkey's motor vehicle exports was larger than share of the MENA in Turkey's motor vehicle imports in both 2003 and 2015 but the gap diminished by a large margin in 2015.

Fourth, Turkey, in 2015 dispatched 3.4% of its motor vehicle exports to the Americas increased by 171.4% the largest rise amongst regions from 1.3% in 2003 leading the Americas to overtake the place of Asia-Pacific in 2003 and resulting in the Americas being the third largest destination of Turkey's motor vehicle exports in 2015. Share of the Americas in Turkey's motor vehicle exports was smaller than share of the Americas in Turkey's automotive exports in both 2003 and 2015. Share of the Americas in Turkey's motor vehicle exports was larger than share of the Americas in Turkey's motor vehicle imports in 2003 but it turned to be smaller in 2015. Nevertheless, units of Turkey's motor

[24]Export data on motor vehicles includes passenger cars, commercial vehicles and farm tractors.

vehicle exports to the Americas were larger than units of Turkey's motor vehicle imports from the Americas in both 2003 and 2015.

Fifth, Asia-Pacific, in 2015 constituted 1.1% of Turkey's motor vehicle exports decreased by 41.5% the second largest fall after free zones' amongst regions from 1.9% in 2003 leading Asia-Pacific to lose its place to the Americas in 2003 and resulting in Asia-Pacific being the fourth largest destination of Turkey's motor vehicle exports in 2015. Share of Asia-Pacific in Turkey's motor vehicle exports was smaller than share of Asia-Pacific in Turkey's automotive exports in both 2003 and 2015 and even the gap widened in 2015. Share of Asia-Pacific in Turkey's motor vehicle exports was much smaller than share of Asia-Pacific in Turkey's motor vehicle imports in both 2003 and 2015. Asia-Pacific was only region whose share in Turkey's motor vehicle exports was much smaller than its share in Turkey's motor vehicle imports in both 2003 and 2015.

Sixth, Turkey, in 2015 dispatched 0.6% of its motor vehicle exports to Africa increased by 158.4% the second largest rise after Americas' amongst regions from 0.2% in 2003 leading Africa to overtake the place of the Americas in 2003 and resulting in Africa being the fifth largest destination of Turkey's motor vehicle exports in 2015. Share of Africa in Turkey's motor vehicle exports was smaller than share of Africa in Turkey's automotive exports in both 2003 and 2015 but the gap diminished in 2015. Share of Africa in Turkey's motor vehicle exports was larger than share of Africa in Turkey's motor vehicle imports in both 2003 and 2015.

Seventh, free zones, in 2015 constituted 0.1% of Turkey's motor vehicle exports decreased by 90.7% the largest fall amongst regions from 1.4% in 2003 leading free zones to lose its place to Asia-Pacific in 2003 and resulting in free zones being the sixth largest destination of Turkey's motor vehicle exports in 2015. Share of free zones in Turkey's motor vehicle exports was smaller than share of free zones in Turkey's automotive exports in both 2003 and 2015. Share of free zones in Turkey's motor vehicle exports was larger than share of free zones in Turkey's motor vehicle imports in both 2003 and 2015 but the gap diminished by a large extent in 2015.

Eighth, areas NES was the smallest destination of Turkey's motor vehicle exports in 2015. Units of Turkey's motor vehicle exports to areas NES were much larger than units of Turkey's motor vehicle imports from areas NES in 2015.

Table 3.7 Motor Vehicle Exports of Turkey to Regions and Major Countries (in units)

	2003		2015		Change 03/15	
	QTY	PCT	QTY	PCT	QTY	PCT
Africa	867	0.2	6285	0.6	624.9	158.4
Remaining	320	0.1	1567	0.2	389.7	74.6
South Africa	547	0.1	4718	0.5	762.5	207.4

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Motor Vehicle Exports of Turkey to Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	QTY	PCT	QTY	PCT	QTY	PCT
Americas	4688	1.3	35688	3.4	661.3	171.4
Argentina	0	0	1249	0.1		
Brazil	0	0	1	0		
Canada	0	0	1761	0.2		
Chile	0	0	3840	0.4		
Colombia	0	0	77	0		
Mexico	0	0	2196	0.2		
Remaining	73	0	1251	0.1	1613.7	510.9
USA	4615	1.2	25313	2.4	448.5	95.5
Areas NES			204	0		
Asia-Pacific	7096	1.9	11641	1.1	64.1	-41.5
Australia	550	0.1	4254	0.4	673.5	175.7
China	1457	0.4	1	0	-99.9	-100
India	0	0	17	0		
Indonesia	0	0	30	0		
Japan	24	0	1242	0.1	5075	1744.6
Korea	126	0	183	0	45.2	-48.2
Malaysia	63	0	124	0	96.8	-29.8
Pakistan	7	0	12	0	71.4	-38.9
Philippines	25	0	94	0	276	34
Remaining	4830	1.3	5632	0.5	16.6	-58.4
Thailand	14	0	52	0	271.4	32.4
Europe	315322	85.2	909554	87.6	188.5	2.8
EU (28)	277427	75	843073	81.2	203.9	8.3
Austria	4608	1.2	13749	1.3	198.4	6.4
Belgium	4520	1.2	51037	4.9	1029.1	302.5
Czechia	3612	1	7138	0.7	97.6	-29.6
France	45981	12.4	121770	11.7	164.8	-5.6
Germany	49437	13.4	82503	7.9	66.9	-40.5
Hungary	8422	2.3	8104	0.8	-3.8	-65.7
Italy	43194	11.7	123007	11.9	184.8	1.5
Netherlands	8134	2.2	30085	2.9	269.9	31.8
Poland	9616	2.6	23814	2.3	147.6	-11.7
Remaining	41260	11.2	70582	6.8	71.1	-39
Romania	8235	2.2	7662	0.7	-7	-66.8
Slovakia	133	0	2963	0.3	2127.8	694.1
Slovenia	2050	0.6	41921	4	1944.9	628.9

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Motor Vehicle Exports of Turkey to Regions and Major Countries (Continued)

	2003		2015		Change 03/15	
	QTY	PCT	QTY	PCT	QTY	PCT
Spain	24918	6.7	66415	6.4	166.5	-5
Sweden	3678	1	17089	1.6	364.6	65.6
UK	19629	5.3	175234	16.9	792.7	218.2
Other Europe	37895	10.2	66481	6.4	75.4	-37.5
Israel	14548	3.9	38627	3.7	165.5	-5.4
Remaining	7846	2.1	12045	1.2	53.5	-45.3
Russia	13388	3.6	6856	0.7	-48.8	-81.7
Switzerland	2113	0.6	8953	0.9	323.7	51
Free Zones	5040	1.4	1322	0.1	-73.8	-90.7
MENA	36997	10	73338	7.1	98.2	-29.3
Algeria	10785	2.9	13852	1.3	28.4	-54.2
Egypt	7945	2.1	7987	0.8	0.5	-64.2
Iran	42	0	141	0	235.7	19.7
Morocco	1523	0.4	19074	1.8	1152.4	346.4
Remaining	3374	0.9	25169	2.4	646	165.9
Saudi Arabia	9826	2.7	1254	0.1	-87.2	-95.5
Tunisia	3502	0.9	5861	0.6	67.4	-40.3
Total	370010	100	1038032	100	180.5	

Notes: Data is based on reporting of Turkey. Shares are rounded, so they may not add up to 100%. QTY means quantity. PCT stands for percent. Areas NES means areas not elsewhere specified. Appendix D: Table D.4 lists 6-digit motor vehicle HS codes along with their descriptions.

Source: Calculations are based on UN Comtrade.

3.4 Findings on Turkey's International Automotive Trade Patterns with its Partners

A close examination of Table 3.2 to Table 3.7 provides four particular patterns, revealing Turkey's international automotive trade patterns with its individual major trading partners constituting a significant part of Turkey's international automotive trade. These four patterns are based on thorough examination of compositions of automotive imports and exports as well as trends in these indicators between 2003 and 2015. It should be noted that if there was a shift in the pattern of a particular country from 2003 to 2015, the shift is indicated in the footnote of the relevant country. It should also be noted that section 2.5 examines individual countries' automotive sector structures, whereas this section assesses international automotive trade patterns of Turkey with its individual major partners. The main finding is that international automotive trade patterns of Turkey with individual major countries are, to a large extent, in line with these countries' automotive sector structures.

The first pattern reflects Turkey's regional motor vehicle assembly hub structure and motor vehicle market structures of Turkey's partners falling into this pattern. First, Turkey sources more than 50% of its automotive imports from such countries in the form of automotive parts. On the other hand, second, Turkey dispatches more than 50% of its automotive exports to such countries in the form of motor vehicles. In 2015, around 39% of Turkey's major international automotive trade partners fell within this pattern increased by about 3 percentage points compared to 2003 corresponding to the most prevalent pattern in both 2003 and 2015. Algeria, Austria,[25] France, Israel, Italy, Poland, Slovakia,[26] Slovenia, Sweden,[27] Switzerland, Tunisia, the UK and the USA fell within this pattern in 2015. France, Italy and the USA are only countries in this pattern having major motor vehicle groups and motor vehicle assembly investments in Turkey. Their international automotive trade pattern with Turkey is consistent with their automotive sector structure of offshoring motor vehicle assembly activity stated in section 2.5 as they dispatch more than 50% of their automotive exports to Turkey in the form of automotive parts, while they source more than 50% of their automotive imports from Turkey in the form of motor vehicles to serve their large internal motor vehicle markets. On the other hand, other remaining countries do not have major motor vehicle groups and motor vehicle assembly investments in Turkey but they are well integrated with Turkey's regional motor vehicle assembly hub structure by proving automotive parts for international motor vehicle assembly plants in Turkey and acquiring motor vehicles assembled in Turkey to serve their internal motor vehicle markets. It should be noted that particular countries e.g., Poland in this pattern are also major motor vehicle assembly locations themselves as indicated in section 2.5 but motor vehicle exports from Turkey to such countries outweighs automotive parts exports from Turkey.

The second pattern also, to some extent, reflects Turkey's regional motor vehicle assembly hub structure and motor vehicle assembly structures of Turkey's partners within this pattern. First, Turkey sources more than 50% of its automotive imports from such countries in the form of automotive parts the same as the first pattern. Second, Turkey also dispatches more than 50% of its automotive exports to such countries in the form of automotive parts opposite to the first pattern. In 2015, around 36% of Turkey's major international automotive trade partners fell within this pattern increased by around 9

[25] Austria was identified with the fourth pattern in 2003 due to relatively larger share of motor vehicle imports to Turkey from Austria but in 2015 automotive parts imports dominated automotive imports to Turkey from Austria. Therefore, Austria was characterised with the first pattern in 2015.

[26] Please see footnote 25 for the shift the same as Slovakia's.

[27] Please see footnote 25 for the shift the same as Sweden's.

percentage points compared to 2003. Brazil, China, Czechia,[28] Egypt,[29] India, Iran, Japan, Korea, Romania,[30] Russia,[31] Saudi Arabia,[32] and South Africa fell within this pattern in 2015. Japan and Korea are only countries in this pattern having major motor vehicle groups and motor vehicle assembly investments in Turkey. Since Japan and Korea have motor vehicle assembly investments in Turkey, a larger share of automotive imports from Japan and Korea to Turkey was in the form of automotive parts to supply their motor vehicle assembly plants in Turkey opposite to Japan and Korea's automotive sector structures. A larger share of automotive exports from Turkey to Japan and Korea was also in the form of automotive parts to supply motor vehicle assembly plants in Japan and Korea. This automotive relation of Japan and Korea with Turkey is different from Italy, France and USA's automotive relation with Turkey also having motor vehicle assembly investments in Turkey since Italy, France and the USA source a larger share of their automotive imports from Turkey in the form of motor vehicles rather than automotive parts as in the case of Japan and Korea. On the other hand, other remaining countries in this pattern do not have major motor vehicle groups and motor vehicle assembly investments in Turkey but they are major motor vehicle assembly locations themselves except Egypt and Saudi Arabia. These motor vehicle assembly locations are more connected to the Turkish automotive industry with cross-border automotive parts trade, so these countries provide automotive parts for motor vehicle assembly plants in Turkey and acquire automotive parts produced in Turkey to supply their motor vehicle assembly plants.

The third pattern is identified with Turkey's motor vehicle market structure and motor vehicle assembly structures of Turkey's partners within this pattern. This third pattern is completely opposite to the first pattern. Therefore, this pattern is inconsistent with Turkey's automotive sector structure. First, Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles. On the other hand, second, Turkey dispatches more than 50% of its automotive exports to such countries in the form of automotive parts. In 2015, around 9% of Turkey's major international automotive trade partners fell within this pattern decreased by 3 percentage points compared to 2003 corresponding to the smallest prevalent pattern in both 2003 and 2015. Germany, Mexico

[28] In 2003, Czechia was characterised with the fourth pattern but it shifted to the second pattern in 2015. This shift was consistent with automotive sector structure of Czechia.

[29] Egypt is not a major motor vehicle assembly location different from other countries except Saudi Arabia in this category. Egypt was identified with the first pattern in 2003 due to relatively larger share of motor vehicle exports from Turkey to Egypt but in 2015 automotive parts exports dominated automotive exports from Turkey to Egypt. Therefore, Egypt was characterised with the second pattern in 2015.

[30] Romania was identified with the first pattern in 2003 due to relatively larger share of motor vehicle exports from Turkey to Romania but in 2015 automotive parts exports dominated automotive exports from Turkey to Romania. Therefore, Romania was characterised with the second pattern in 2015.

[31] In 2003, Russia was characterised with the fourth pattern but it shifted to the second pattern in 2015. Russia's automotive sector structure was not completely in line with its automotive trade pattern with Turkey in both 2003 and 2015.

[32] Saudi Arabia is not a major motor vehicle assembly location different from other countries except Egypt in this category. In 2003, Saudi Arabia was characterised with the fourth pattern but it shifted to the second pattern in 2015. Saudi Arabia's motor vehicle preference shifted from motor vehicles assembled in Turkey to automotive parts produced in Turkey.

and Thailand fell within this pattern in 2015. These countries are major motor vehicle assembling locations in the world, so they do not only serve their internal motor vehicle markets but they also dispatch motor vehicles abroad. Turkey being one of the largest markets in its region also sources relatively large units of motor vehicles from these countries. In addition to this, being major motor vehicle assembling locations, these countries source more of their automotive imports from Turkey in the form of automotive parts. Germany was the only country in this pattern having major motor vehicle groups and motor vehicle assembly investments in Turkey. Motor vehicle assembly investments of Germany in Turkey are related to commercial vehicle assembly. Therefore, passenger cars assembled in Germany are imported to Turkey resulting in a larger share of automotive imports to Turkey from Germany being in the form of motor vehicles rather than automotive parts. On the other hand, other countries, namely France, Italy, Japan, Korea and the USA also having motor vehicle assembly investments in Turkey dispatch a larger share of their automotive exports to Turkey in the form of automotive parts rather than motor vehicles as in the case of Germany. Nevertheless, Japan and Korea source more of their automotive imports from Turkey in the form of automotive parts the same as Germany.

The fourth pattern reflects Turkey's motor vehicle market and regional motor vehicle assembly hub structures as well as motor vehicle market and assembly structures of Turkey's partners within this pattern. First, Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles opposite to the first pattern. Second, Turkey dispatches more than 50% of its automotive exports to such countries in the form of motor vehicles the same as the first pattern. In 2015, around 15% of Turkey's major international automotive trade partners fell within this pattern decreased by around 9 percentage points compared to 2003. Belgium,[33] Hungary,[34] Morocco,[35] the Netherlands and Spain fell within this pattern in 2015. These countries do not have major motor vehicle groups and motor vehicle assembly investments in Turkey but they are major motor vehicle assembly locations themselves, so they do not only serve their internal motor vehicle markets but they also dispatch motor vehicles abroad. Turkey being one of the largest markets in its region also sources relatively large units of motor vehicles from these countries. Being a major motor vehicle assembling country in its region, Turkey also serves internal motor vehicle markets of these countries.

[33] Belgium was identified with the third pattern in 2003 due to relatively larger share of automotive part exports from Turkey to Belgium but in 2015 motor vehicle exports dominated automotive exports from Turkey to Belgium. Therefore, Belgium was characterised with the fourth pattern in 2015.

[34] Hungary was identified with the first pattern in 2003 due to relatively larger share of automotive parts imports to Turkey from Hungary but in 2015 motor vehicle imports dominated automotive imports to Turkey from Hungary. Therefore, Hungary was characterised with the fourth pattern in 2015.

[35] In 2003, Morocco was characterised with the second pattern but it shifted to the fourth pattern in 2015. This shift was due mainly to recent international motor vehicle assembly investments and higher internal motor vehicle demand in Morocco.

3.5 Summary

This chapter further extended the understanding of the Turkish automotive sector, in addition to examination of general cross-border automotive trade, motor vehicle assembly and market characteristics of the Turkish automotive sector made in chapter 2. This chapter first introduced the Turkish automotive sector within its historical context with reference to distinct periods of the Turkish economy. Second, this chapter identified the recent international automotive trade relations of Turkey with regions and how these relations have changed relative to 2003. Third, this chapter determined international automotive trade patterns of Turkey with its individual major partners.

Having experience in motor vehicle assembly since 1960s, and a large and competitive automotive parts supply base, the Turkish automotive industry has not only become a regional motor vehicle assembly hub but it has also acquired substantial skills in design and innovation. The Turkish automotive industry is integrated with the global automotive industry, especially well with the European automotive value chain. Despite still having a lower motor vehicle ownership rate, Turkey also has a relatively large and expanding motor vehicle market in its region and its motor vehicle market is far away from saturated resulting in opportunities for the Turkish automotive industry.

International automotive trade accounts for more than 10% of Turkey's total cross-border trade. Hence, it is one of the most significant contributors to Turkey's international trade. More than three quarters of automotive imports and exports of Turkey are carried out with Europe. Turkey tends to import automotive parts from and export motor vehicles to Europe consistent with Turkey's regional motor vehicle assembly hub structure as also identified in section 2.5. Nonetheless, having a large internal motor vehicle market, Turkey has recently been importing motor vehicles as a larger share of its automotive imports from Europe. The MENA is the second largest destination of Turkey's automotive exports After Europe. Nevertheless, despite having wide international trade relations with the MENA in other sectors, Turkey has not forged extensive international trade relations with the MENA in the automotive sector. Asia-Pacific is the second largest source of Turkey's automotive imports after Europe. The vast majority of these automotive imports are in the form of automotive parts. On the other hand, Asia-Pacific is the fourth largest destination of Turkey's automotive exports after Europe, the MENA and Americas, and most of these automotive exports are in the form of automotive parts. Nonetheless, Asia-Pacific is one of the largest expanding motor vehicle markets in the world as reported in section 2.4 but Turkey has not extensively engaged with this market. The Americas are a growing partner of the Turkish automotive sector, as well.

This study determined four specific international automotive trade patterns of Turkey with its individual major partners based on compositions of automotive imports and exports. The first pattern is identified with Turkey's regional motor vehicle assembly hub structure and motor vehicle market structures of Turkey's partners within this pattern e.g., Italy.

Turkey's automotive trade involvement with such countries is based on sourcing automotive parts for its motor vehicle assembly and then dispatching motor vehicles assembled. The second pattern also, to some extent, is characterised by Turkey's regional motor vehicle assembly hub structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., South Africa. Turkey sources automotive parts for its motor vehicle assembly and dispatches automotive parts to supply motor vehicle assembly abroad. The third pattern characterises Turkey's motor vehicle market structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., Germany. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles, while Turkey dispatches more than 50% of its automotive exports to such countries in the form of automotive parts. The fourth pattern is identified with Turkey's motor vehicle market and regional motor vehicle assembly hub structures as well as motor vehicle market and assembly structures of Turkey's partners within this pattern e.g., Spain. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles and dispatches more than 50% of its automotive exports to such countries in the form of motor vehicles.

Chapter 4

Descriptive Analysis of the Turkish Automotive Manufacturing Industry and Automotive Enterprises in Turkey

4.1 Introduction

Previous studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) on the Turkish automotive industry focus mostly on the motor vehicle assembly section of the Turkish automotive industry, so they do not widely analyse the automotive parts supply section of the automotive industry that is due mainly to lack of data in this field and restrictions on access to relevant data. Therefore, such studies cannot accurately analyse the supply section of the Turkish automotive industry that increasingly accounts for a larger section of the Turkish automotive industry. On the other hand, this chapter separately considers both assembly and supply sections of the Turkish automotive industry at enterprise level based on key economic indicators with particular attention on ownership characteristics of enterprises. Nevertheless, this chapter first determines relative place of the Turkish automotive industry in the Turkish manufacturing sector in terms of major economic indicators to identify this industry's significance for the Turkish economy.

This study approaches the Turkish automotive sector at different levels benefiting from various databases and datasets, and hence it considers numerous significant economic indicators that, as a result, enables development of a better understanding of the Turkish automotive sector. Therefore, chapter 2 and chapter 3 have already focused on Turkey's international automotive trade, motor vehicle assembly and market structure and patterns resulting in identification of the Turkish automotive sector's place in the global automotive sector by employing UN Comtrade and OICA's dataset. In contrast to descriptive economic analysis of the Turkish automotive sector at motor vehicle and automotive parts level in chapter 2 and chapter 3, this chapter in section 4.2 first identifies place of the Turkish automotive industry in the Turkish manufacturing sector to establish the significance of the

Turkish automotive industry for the Turkish economy by employing TurkStat's publicly available manufacturing sector related datasets. Second, this chapter in section 4.3 analyses characteristics of certified R&D centres, channels of international technology transfer, international trade and production of the Turkish automotive industry at motor vehicle assembling and automotive parts supplying enterprise level, while considering ownership characteristics of enterprises by utilising publicly available dataset of the Ministry of Science, Industry and Technology of the Republic of Turkey and TurkStat's confidential enterprise level datasets. As a result, this study in the preceding chapters and in this chapter makes a descriptive analysis of the Turkish automotive sector at sectoral, motor vehicle and automotive parts, industrial and enterprise levels.

This chapter determines seven particular points on economic characteristics of the Turkish automotive industry and the significance of the Turkish automotive industry in the Turkish manufacturing sector. First, small scaled enterprises employing fewer than 20 workers constitute about three quarters of all enterprises in the Turkish automotive industry but more than 90% of the employment, labour expenditure, investment and output of the Turkish automotive industry are created by automotive enterprises of the size of more than 20 employees. Second, the average size of automotive enterprises is well larger than the average size of manufacturing enterprises in Turkey. Third, international ownership in the Turkish automotive industry is one of the highest amongst the Turkish manufacturing industries. Fourth, the Turkish automotive industry is one of the largest importing and exporting manufacturing industries in Turkey and automotive imports and exports constitute a significant part of Turkey's total imports and exports as revealed in section 3.3. Fifth, the Turkish automotive industry is the largest R&D intensive manufacturing industry. It constitutes around one third of the Turkish manufacturing sector R&D expenditure and recruits around one fifth of the Turkish manufacturing sector R&D employees. Sixth, the Turkish automotive industry is the largest investment intensive manufacturing industry and even this rate becomes higher if only machinery and equipment investment is considered. Last, the Turkish automotive industry occupies a significant place in the Turkish manufacturing sector in terms of employment, labour expenditure and output. The Turkish automotive industry's R&D and labour expenditures per employee, investment and output per employee are also much larger than manufacturing sector average.

There are also five particular points on economic characteristics of automotive enterprises in Turkey during the period 2003-2011. First, international automotive parts supplying enterprises display a higher level of integration into the global automotive industry when import and export characteristics of both international and local automotive parts suppliers are compared (Bernard, Jensen, Redding, et al., 2007; Manova and Zhang, 2009; Bernard, Jensen, Redding, et al., 2012). International motor vehicle assembling enterprises even show a higher level of integration into the global automotive industry compared to international automotive parts supplying enterprises. Second, while none of ownership kinds clearly dominate the supply section of the Turkish automotive industry, it is enterprises with at least 10% international ownership clearly dominates the assembly section of the Turkish automotive industry in all economic terms. Third, international automotive parts supplying enterprises tend to use, on average, more material and capital machines or equipment, while local automotive parts supplying enterprises are inclined to utilise more labour and energy in their input mix (Blalock and Veloso, 2007; Inklaar and Timmer, 2007; Arnold and Javorcik, 2009; Elliott et al., 2013). This pattern is also observed in the assembly section of the Turkish automotive industry. Fourth, motor vehicle assembling enterprises utilise the majority of the material, while automotive parts supplying enterprises use the majority of the labour and energy. Capital stock, total investment and capital machines or equipment investment are, to some extent, also divided half amongst assembly and supply sections of the industry. Furthermore, automotive parts supplying enterprises create around 41% of all value added generated in the Turkish automotive industry. Last, on average international automotive parts supplying enterprises employ more, pay more, have more capital, invest more and in particular on capital machines or equipment, use more material and electricity inputs, and hence produce more output, create more value added, and are more productive in both relative and employment size adjusted terms than local automotive parts supplying enterprises, which is also argued in the general literature (Keller, 2004) and established in case studies (e.g., Yasar and Morrison Paul, 2007). A similar pattern also holds for the comparison of international and local motor vehicle assembling enterprises. Econometric analysis on similar considerations is also carried out in chapter 6.

Section 4.2 explains the significance of the Turkish automotive industry in the Turkish manufacturing sector. Section 4.3 makes a descriptive economic analysis of international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey. Section 4.4 summarises main findings on relative economic characteristics of the Turkish automotive manufacturing industry, and international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey.

4.2 Significance of the Turkish Automotive Industry in the Turkish Manufacturing Sector

This section identifies the significance of the Turkish automotive industry in the Turkish manufacturing sector in terms of average enterprise size, international ownership control, R&D expenditure and employment, workforce, labour cost, gross investment in tangible goods, gross investment in machinery and equipment, production value and value added at factor cost for 2003 and 2014 based on TurkStat's publicly available industry level datasets.

There are a number of points required to be made on the data reported in this section and section 4.3. First, data reported in this section is based on publicly available datasets of the TurkStat and it covers the whole automotive industry, data reported in section 4.3 is also based on TurkStat's datasets. Nevertheless, data reported in section 4.3 is at enterprise level and confidential accessed at the premises of the TurkStat with a special protocol. Second, data presented in section 4.3 does not cover the whole industry since particular enterprises are on full-enumeration, whereas others are on a random sampling basis but the data of full-enumeration accounts for the vast majority of the industry.[1] On the other hand, data reported in this section includes the whole industry as indicated earlier. Third, data reported in this section embodies both motor vehicle assembly and automotive parts supply sections of the Turkish automotive industry, whereas being at enterprise level, data reported in section 4.3 can distinguish between motor vehicle assembling and automotive parts supplying enterprises as well as international and local enterprises. Last, data presented in this section separately refers to 2003, provided it is available, and 2014. On the other hand, data reported in section 4.3 refers to the whole period 2003-2011. As a result, when data in this section and section 4.3 are interpreted, these points should be taken into consideration.

In 2003, there were 3082 automotive enterprises in Turkey. In 2003, average size of automotive enterprise was around 28.5 employees around 2.5 times larger than average size of manufacturing enterprises in Turkey. In 2014, there were 3858 automotive enterprises in Turkey. Therefore, there were 776 enterprises in net terms entering the Turkish automotive industry between 2003 and 2014. Nevertheless, only 23.6% or 909 of these automotive enterprises had more than 20 employees in 2014.[2] Therefore, small-sized enterprises constitute the vast majority of the enterprises in the Turkish automotive industry. On the other hand, in 2014 average size of automotive enterprise was around 45.8 employees around 3.5 times larger than average size of manufacturing enterprises in Turkey. This corresponded to an increase of around 17.4 employees per enterprise in average size of automotive enterprises in Turkey between 2003 and 2014. The differential between average sizes of automotive and manufacturing enterprises in Turkey also became much larger between 2003 and 2014.[3]

The whole automotive industry in Turkey had the second highest international ownership control rate of 48.8% after tobacco industry amongst manufacturing industries in Turkey in 2014. As reported earlier in section 3.2 that in 2015, this rate was around 52.9% for only motor vehicle assembling enterprises in Turkey. It should be noted that the former rate includes all automotive enterprises in 2014, whereas the latter is just for motor vehicle assembling enterprises in 2015.[4]

Characteristics of Turkey's international automotive trade and its significance in the Turkish economy are explained in section 3.3 in detail, hence no further elaboration is going to be made here.

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[1] Please note that only enterprises on full-enumeration are considered in section 4.3 for the sake of having a consistent dataset.

[2] Please note that these enterprises also tend to be on full-enumeration, so they are analysed in section 4.3 in detail.

[3] Calculations are based on TurkStat's Annual Industry and Service Statistics Dataset. Please see http://www.turkstat.gov.tr/PreTablo.do?alt_id=1035 to access this dataset.

[4] Please see http://www.turkstat.gov.tr/PreTablo.do?alt_id=1058 to access TurkStat's Foreign Controlled Enterprise Statistics.

In 2014, the Turkish automotive industry constituted 33.8% of R&D expenditure of the Turkish manufacturing sector leading the Turkish automotive industry to have the highest R&D expenditure share amongst manufacturing industries in Turkey. The Turkish automotive industry's R&D expenditure per employee was also about 66.5% larger than average manufacturing R&D expenditure per employee in 2014. The Turkish automotive industry also had a R&D workforce of 7101 employees constituting 20.3% of the manufacturing sector R&D personnel resulting in the Turkish automotive industry having the largest R&D personnel share amongst manufacturing industries in Turkey in 2014.[5,6] It should be noted that in 2014, R&D employees constituted around 4% of the workforce of the Turkish automotive industry.[7]

In 2003, the Turkish automotive industry had a workforce of about 88 thousand employees constituting 4.6% of the Turkish manufacturing sector workforce. In 2014, the Turkish automotive industry had a workforce of about 177 thousand employees making up 5.2% of the Turkish manufacturing sector workforce. This meant that the employment of the Turkish automotive industry was more than doubled and the Turkish automotive industry also constituted a larger share of the Turkish manufacturing sector workforce between 2003 and 2014. In 2014, about 94% of employment of the Turkish automotive industry were accounted by automotive enterprises having more than 20 employees. Therefore, despite constituting 23.6% of enterprises in the automotive industry as stated earlier, automotive enterprises of the size of more than 20 employees made up about 94% of employment of the Turkish automotive industry in 2014.[8]

In 2003, the Turkish automotive industry made up 7.5% of labour cost of the Turkish manufacturing sector. In 2003, the Turkish automotive industry's labour cost per employee was also about 61.5% larger than average manufacturing sector labour cost per employee. In 2014, the Turkish automotive industry constituted 7.6% of labour cost of the Turkish manufacturing sector. The Turkish automotive industry's labour cost per employee was also about 45.4% larger than average manufacturing sector labour cost per employee in 2014. This meant that labour cost differential between the automotive industry and manufacturing sector average contracted between 2003 and 2014 but the Turkish automotive industry still had a much higher labour cost per employee and accounted for almost the same share of labour cost of the Turkish manufacturing sector in 2014 relative to 2003. Furthermore, automotive enterprises having more than 20 employees constituted about 97.6% of the Turkish automotive industry labour cost in 2014.[9]

[5]Calculations are based on TurkStat's Research and Development Activities. Please see http://www.turkstat.gov.tr/PreTablo.do?alt_id=1082 to access this dataset.

[6]Please see subsubsection 4.3.1.2 and subsubsection 4.3.2.2 for details on certified R&D centres in the Turkish automotive industry and their comparison with other industries'.

[7]Calculations are based on TurkStat's Annual Industry and Service Statistics Dataset, and Research and Development Activities. Please see footnote 3 and footnote 5 on how to access these datasets.

[8]Please see footnote 3.

[9]Please see footnote 3.

In 2014, the Turkish automotive industry constituted 14.5% of gross investment in tangible goods of the Turkish manufacturing sector leading the Turkish automotive industry to have the largest share amongst manufacturing industries in Turkey. In 2014, the Turkish automotive industry's gross investment in tangible goods per employee was also about 178.3% larger than manufacturing sector average. In 2014, automotive enterprises having more than 20 employees also constituted about 97.3% of the Turkish automotive industry gross investment in tangible goods. On the other hand, the Turkish automotive industry, in 2014 made up 18.1% of gross investment in machinery and equipment of the Turkish manufacturing sector leading the Turkish automotive industry to have the largest share amongst manufacturing industries in Turkey. Therefore, the Turkish automotive industry even occupied a more significant place in the Turkish manufacturing sector in terms of gross investment in machinery and equipment compared to gross investment in tangible goods. In 2014, the Turkish automotive industry's gross investment in machinery and equipment per employee was also about 2.5 times larger than manufacturing sector average. This translated into even a larger differential between the Turkish automotive industry's gross investment in machinery and equipment per employee and manufacturing sector average.[10]

In 2003, the Turkish automotive industry made up 8% of production value of the Turkish manufacturing sector. In 2003, the Turkish automotive industry's production value per employee or labour productivity was also 71.9% larger than manufacturing sector average. In 2014, the Turkish automotive industry constituted 8.1% of production value of the Turkish manufacturing sector. In 2014, the Turkish automotive industry's production value per employee was also about 55.7% larger than manufacturing sector average. This meant that the labour productivity differential between the Turkish automotive and manufacturing sector average diminished between 2003 and 2014 but the Turkish automotive industry still had a much higher labour productivity and almost the same share of production value in the Turkish manufacturing sector in 2014 relative to 2003. Furthermore, automotive enterprises of the size of more than 20 employees accounted for about 98.2% of the Turkish automotive industry production value in 2014.[11]

In 2003, the Turkish automotive industry made up 8.5% of value added at factor cost of the Turkish manufacturing sector. In 2003, the Turkish automotive industry's value added at factor cost per employee was also about 83.5% larger than manufacturing sector average. In 2014, the Turkish automotive industry constituted 7.1% of value added at factor cost of the Turkish manufacturing sector. Therefore, the Turkish automotive industry, in 2014 accounted for a smaller share of the Turkish manufacturing sector value added at factor cost in comparison with 2003. The Turkish automotive industry's value added at factor cost per employee was also about 35.6% larger than manufacturing sector average in 2014. This resulted in the differential between the Turkish automotive industry's value

[10] Please see footnote 3.

[11] Please see footnote 3.

added at factor cost per employee and manufacturing sector average diminishing by a large margin between 2003 and 2014. Furthermore, automotive enterprises having more than 20 employees accounted for about 98% of the Turkish automotive industry value added at factor cost in 2014.[12]

4.3 Descriptive Economic Analysis of International and Local Automotive Enterprises in Turkey

This section makes a descriptive analysis of various economic characteristics of international[13] and local motor vehicle assembling and automotive parts supplying enterprises in Turkey for the period 2003-2011. Tables[14] in this section are based on merge of a number of datasets[15] by unique enterprise identifiers. This section utilises NACE[16] Rev. 2 codes 29.10, 29.20, 29.31 and 29.32[17] to identify relevant enterprises and distinguish between motor vehicle assembling and automotive parts supplying enterprises. This section focuses on enterprises on full-enumeration, thereby not considering enterprises selected on random sampling basis since enterprises selected on random sampling basis are not consistently surveyed throughout the period of the datasets, on average they have fewer than 20 employees, and data on such enterprises is not also accurate.

This section first comparatively identifies key economic characteristics of international and local motor vehicle assembling enterprises in Turkey, second comparatively determines critical economic characteristics of international and local automotive parts supplying enterprises in Turkey and compare important economic characteristics of both motor vehicle assembling and automotive parts supplying enterprises in Turkey with each other by ownership.

4.3.1 International and Local Motor Vehicle Assemblers

This subsection reports major findings on general economic characteristics, characteristics of certified R&D centres, characteristics of channels of international technology

[12]Please see footnote 3.

[13]Enterprises having at least 10% international ownership are identified as international throughout this study.

[14]Monetary values expressed in this section are in the Turkish lira, abbreviated as TL, Turkey's currency unit.

[15]Please see Appendix A: Data Sources for detail.

[16]The Statistical Classification of Economic Activities in the European Community, abbreviated as NACE, "is the classification of economic activities in the EU. NACE is a 4-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic statistics (e.g., production, employment and national accounts) and in other statistical domains."

[17]NACE Rev. 2 codes 29.10, 29.20, 29.31 and 29.32 correspond to "manufacture of motor vehicles", "manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers", "manufacture of electrical and electronic equipment for motor vehicles" and "manufacture of other parts and accessories for motor vehicles", respectively. 29.10 identifies motor vehicle assembling enterprises, while 29.20, 29.31 and 29.32 identify automotive parts supplying enterprises.

transfer, international trade characteristics and production characteristics of motor vehicle assembling enterprises in Turkey by ownership, respectively.[18]

4.3.1.1 General Economic Characteristics

Table 4.1 reports general economic characteristics of motor vehicle assembling enterprises in Turkey by ownership. On average, around 21% of all observations of motor vehicle assembling enterprises in Turkey have at least 10% international ownership during the period 2003-2011. As indicated above, these observations include enterprises which are on full-enumeration or have at least 20 employees. As Table 4.1 indicates, on average, international ownership intensity amongst international motor vehicle assembling enterprises in Turkey is 64%. Nevertheless, this high international ownership intensity corresponds to varying levels of international ownership amongst motor vehicle assembling enterprises as clearly indicated by international direct investment intensity categories (II). This pattern of varying level international ownership is also confirmed by the origin of controlling stake of international motor vehicle assembling enterprises, around 31% of international observations' controlling origin are Turkish[19], while 20% of international observations' controlling stake are equally of German and Japanese origins making up 40% of all international observations. On the other hand, by definition, origin of controlling stake of local motor vehicle assembling enterprises are Turkish.

Table 4.1 also reveals the following characteristics: international motor vehicle assembling enterprises are more experienced than their local counterparts by more than one and half times. Approximately 65% of all observations of international motor vehicle assembling enterprises have 36 years or more operational experience, while observations of local motor vehicle assembling enterprises are distributed across different age categories in similar proportions. The interesting point on the difference between international and local motor vehicle assembling enterprises in Turkey is that around 89% of all observations of international motor vehicle assembling enterprises have at least 500 employees, whereas approximately 75% of all observations of local motor vehicle assembling enterprises have fewer than 50 employees. This finding on enterprise size clearly reveals that motor vehicle assembly industry in Turkey is dominated by the enterprises with at least 10% international ownership. The number of local units including the headquarters of enterprise if it is based in Turkey is, on average, 2 for international enterprises, whereas it is about 1.5 for local enterprises.

[18]Please note that engine and engine parts manufacturers, and motor vehicle re-manufacturing, modification and alteration enterprises are also coded as motor vehicle assemblers in the datasets. Nevertheless, the vast majority of the data are accounted by motor vehicle assembling enterprises including farm tractor assembling enterprises in Turkey.

[19]Please note that these particular observations have at least 10% international ownership but their ultimate controlling stake is of Turkish origin.

In addition to these characteristics, Table 4.1 presents locations[20] of centres of motor vehicle assembling enterprises in Turkey by ownership. These locations can be headquarters of enterprises or locations of plants of enterprises. In spite of varying levels, both international and local motor vehicle assembling enterprises are located in similar regions, in the western regions, especially in the north western regions of Turkey that is the major route to Europe and the economic hub of Turkey. 41% of all observations of international motor vehicle assembling enterprises are reported to be based in Istanbul but these locations are places of their centres, and locations of their plants are generally in Bursa, Kocaeli or Adana regions. Another important point on location is that Izmir is reported to be a centre of local motor vehicle assembly.

Table 4.1 General Characteristics of Motor Vehicle Assemblers

	Time	International		Local	
	Period	Obs	Share	Obs	Share
International Direct Investment (FDI)	2003-11	91	100	336	0
International Direct Investment Intensity (FDIS)	2003-11	91	64	336	0
FDIS Categories (I)	2003-11	91		336	
FDIS=0%		2	2	336	100
1%<=FDIS<=49%		34	37	0	0
50%<=FDIS<=100%		55	60	0	0
FDIS Categories (II)	2003-11	91		336	
FDIS<10%		2	2	336	100
10%<=FDIS<=39%		22	24	0	0
40%<=FDIS<=69%		23	25	0	0
70%<=FDIS<=99%		24	26	0	0
FDIS=100%		20	22	0	0
Origin of Controlling Stake (ORIGIN)	2003-11	91		336	
Germany		18	20	0	0
Italy		6	7	0	0
France		9	10	0	0
Turkey		28	31	336	100
Japan		18	20	0	0
United States		2	2	0	0

Continued on the next page

[20] This is based on the Nomenclature of Territorial Units for Statistics, abbreviated as NUTS, that is a "a hierarchical system for dividing up the economic territory of the EU for the collection, development and harmonisation of European regional statistics." Being a recognised candidate country for the EU, Turkey is also classified according to the NUTS system with 12 regions at NUTS 1 level, 26 subregions at NUTS 2 level and 81 provinces at NUTS 3 level. Location of enterprises are recorded at NUTS 2 level in the Annual Industry and Service Statistics Dataset, so this study uses this level of NUTS in analyses. Please see Appendix D: Table D.2 for a list of statistical regions of Turkey at NUTS 1, NUTS 2 and NUTS 3 levels, and Appendix F: Figure F.1 for the map of statistical regions of Turkey at NUTS 2 level.

General Characteristics of Motor Vehicle Assemblers (Continued)

	Time	International		Local	
	Period	Obs	Share	Obs	Share
South Korea		9	10	0	0
Others		1	1	0	0
Age (AGE)	2005-11	68	36	268	23
Age Square (AGE2)	2005-11	68	1505	268	712
Age Categories	2005-11	68		268	
<=4		1	1	1	0
5-10		0	0	50	19
11-15		2	3	39	15
16-20		7	10	49	18
21-25		14	21	41	15
26-30		0	0	14	5
31-35		0	0	27	10
36-40		21	31	7	3
41<=		23	34	40	15
Size Categories (SIZE)	2003-11	91		253	
SMALL (<50)		6	7	189	75
MEDIUM (50-99)		0	0	11	4
LARGE (100<=)		85	93	53	21
Size Categories (II)	2003-11	91		253	
<=49		6	7	189	75
50-99		0	0	11	4
100-249		0	0	12	5
250-499		4	4	5	2
500-999		13	14	13	5
1000-4999		47	52	23	9
5000<=		21	23	0	0
Number of Local Units (UNIT)	2003-11	91	2	336	1.43
Location of Centre (LOCATION)	2003-11	91		336	
Bursa (TR41)		3	3	67	20
Istanbul (TR10)		37	41	52	15
Kocaeli (TR42)		37	41	19	6
Izmir (TR31)		4	4	80	24
Tekirdag (TR21)		0	0	5	1
Ankara (TR51)		9	10	49	15
Aydin (TR32)		0	0	7	2
Samsun (TR83)		0	0	17	5
Konya (TR52)		0	0	20	6

Continued on the next page

General Characteristics of Motor Vehicle Assemblers (Continued)

	Time	International		Local	
	Period	Obs	Share	Obs	Share
Kayseri (TR72)		0	0	9	3
Adana (TR62)		1	1	11	3
Others		0	0	0	0

Notes: Shares are rounded, so they may not add up to 100%.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.1.2 Motor Vehicle Assemblers of the Status of Certified R&D Centre

In 2008, the Turkish government passed a law of "Number 5746 Research and Development Activities Support" to be implemented by the Ministry of Science, Industry and Technology with the aim of stimulation of R&D and innovation activities. This law provides enterprises with a wide range of monetary incentives and support on the condition that they have sufficient innovation capabilities and infrastructure, establish an exclusive R&D centre and employ at least 30 full-time equivalent R&D specialists.

Table 4.2 reports ownership and location characteristics of motor vehicles assembling enterprises in Turkey under the status of certified R&D centres by ownership.[21] As of June 2016, there are 261 R&D centres certified and supported by the Ministry of Science, Industry and Technology of the Republic of Turkey. Certified R&D centres of motor vehicle assembling and automotive parts supplying enterprises constitute approximately 30% of all certified R&D centres. Therefore, the Turkish automotive industry as a whole is benefiting from R&D support scheme of the government. 18% of all certified R&D centres are internationally owned, while 44% of certified R&D centres operating in the Turkish automotive industry are international. In addition to this, 74% of all internationally owned certified R&D centres operate in the Turkish automotive industry. Hence, there is relatively high involvement of internationally owned certified R&D centres in the Turkish automotive industry. Around 21% of certified R&D centres in the Turkish automotive industry operate in the motor vehicle assembly section of the industry and motor vehicle assembling enterprises with at least 10% international ownership constitute 63% of certified R&D centres of the assembly section of the Turkish automotive industry. On the other hand, overall international ownership intensity of certified R&D centres of motor vehicle assembling enterprises is not high, 3 out of 16 enterprises have 50% or more international

[21] Please note that while enterprise level data used and reported elsewhere in section 4.3 and chapter 6 is compiled by the TurkStat and confidential, data on certified R&D centres is provided by the Ministry of Science, Industry and Technology of the Republic of Turkey, Directorate General for Science and Technology and publicly available. Ownership related data is compiled from websites and reports of relevant enterprises. It should also be noted that enterprises can establish more than one certified R&D centre.

ownership. This low international ownership intensity is also evident in the origin of controlling stake of certified R&D centres of motor vehicle assembling enterprises, around 81% of origin of controlling stake of certified R&D centres of motor vehicle assembling enterprises are Turkish. As a result, despite the local dominance in controlling stake of ownership of certified R&D centres of motor vehicle assembling enterprises, there is cooperation between local and international stake holders in operating such R&D centres.

Table 4.2 also indicates locations of certified R&D centres of motor vehicle assembling enterprises in Turkey by ownership.[22] These certified R&D centres are located in the western regions of Turkey that is, to some extent, in line with locations of motor vehicle assembling enterprises reported earlier[23] and Adana region.[24] Despite being located mostly in the western regions of Turkey, distribution of certified R&D centres across such regions is not very different from each other ranging from 2 to 4. Adana is the only region without an internationally owned certified R&D centre operating in the motor vehicle assembly section of the industry.

Table 4.2 Motor Vehicle Assemblers of the Status of Certified R&D Centre

	All		International	Local	International in relation to All
	Number	Share	Number	Number	
R&D Centres	261		46	215	18
Assemblers and Suppliers	77	30	34	43	44
Motor Vehicle Assemblers	16	21	10	6	63
FDIS Categories (I)	16				
FDIS=0%	6	38			
1%<=FDIS<=49%	7	44			
50%<=FDIS<=100%	3	19			
FDIS Categories (II)	16				
FDIS<10%	6	38			
10%<=FDIS<=39%	3	19			
40%<=FDIS<=69%	5	31			
70%<=FDIS<=99%	1	6			
FDIS=100%	1	6			
Origin of Controlling Stake	16				
Turkey	13	81			
Germany	2	13			

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[22] Please note these reported data on locations directly reveal locations of certified R&D centres rather than headquarters of enterprises, different from location data collected by the TurkStat.

[23] Please note that international motor vehicle assembling enterprises of Asian origin and most small local motor vehicle assembling enterprises do not have certified R&D centres.

[24] Please see footnote 20.

Motor Vehicle Assemblers of the Status of Certified R&D Centre (Continued)

	All		International	Local	International in relation to All
	Number	Share	Number	Number	
France	1	6			
Others	0	0			
Location of R&D Centre	16				
Ankara (TR51)	4	25	2	2	50
Bursa (TR41)	3	19	3	0	100
Kocaeli (TR42)	3	19	2	1	67
Istanbul (TR10)	2	13	2	0	100
Izmir (TR31)	2	13	1	1	50
Adana (TR62)	2	13	0	2	0
Others	0	0	0	0	0

Notes: This table includes R&D centres certified by the Ministry of Science, Industry and Technology of the Republic of Turkey under the law of "Number 5746 Research and Development Activities Support" as of 30 June 2016. Shares are rounded, so they may not add up to 100%.

Source: Ministry of Science, Industry and Technology of the Republic of Turkey, Directorate General for Science and Technology. Ownership related data is compiled from websites and reports of relevant enterprises.

4.3.1.3 Characteristics of Channels of International Technology Transfer

Table 4.3 presents characteristics of international technology transfer channels, namely international ownership, import and export for motor vehicle assembling enterprises by ownership during the period 2003-2011. As Table 4.3 indicates, around 98% of all observations of motor vehicle assembling enterprises with at least 10% international ownership get engaged in all three kinds of international technology transfer channels. On the other hand, about 52% of all observations of local motor vehicle assembling enterprises, as they by definition do not get engaged in international ownership, get involved in both import and export activities. Approximately 33% of all observations of local motor vehicle assembling enterprises do not get engaged in any international economic activities at all.

Table 4.3 also reports that almost all motor vehicle assembling enterprises engage in import and export, while only about 60% of all observations of local motor vehicle assembling enterprises are related to import and export individually that is evident from approximately 33% of non-involvement of all observations of all local motor vehicle assembling enterprises in any international economic activities reported earlier.

As also reported in Table 4.1, on average, international ownership intensity of international motor vehicle assembling enterprises is around 64%.[25] On average, import and

[25] Please see subsubsection 4.3.1.1 for more explanation on international ownership.

export intensities of international motor vehicle assembling enterprises are about 57% and 50%, respectively. On the contrary, import and export intensities of local motor vehicle assembling enterprises are, on average, around 17% and 15%, respectively. Therefore, there are large differences between international trade intensities of international and local motor vehicle assembling enterprises in Turkey. It should also be noted that both international and local motor vehicle assembling enterprises are more import intensive than export intensive but it is more the case for international motor vehicle assembling enterprises with a larger margin of 7 percentage points. As a result, international motor vehicle assembling enterprises in Turkey highly engage in international trade activities compared to their local counterparts that can result in international technology transfer (Grossman and Helpman, 1995; Eaton and Kortum, 2002; Saggi, 2002; Keller, 2010).

Table 4.3 Characteristics of Channels of International Technology Transfer for Assemblers

	Time	International		Local	
	Period	Obs	Share	Obs	Share
Channels of International Technology Transfer	2003-11	91		336	
All Channels		89	98	0	0
FDI (Only)		1	1	0	0
FDI and Import (Only)		0	0	0	0
FDI and Export (Only)		1	1	0	0
Import (Only)		0	0	25	7
Import and Export (Only)		0	0	175	52
Export (Only)		0	0	26	8
No involvement		0	0	110	33
Existence Measures of Channels		91		336	
International Direct Investment (FDI)	2003-11	91	100	0	0
Import (IMP)	2003-11	89	98	200	60
Export (EXP)	2003-11	90	99	201	60
Intensity Measures of Channels					
International Direct Investment Intensity (FDIS)	2003-11	91	64	336	0
Import Intensity (IMPS)	2003-11	91	57	253	17
Export Intensity (EXPS)	2003-11	91	50	253	15

Notes: Shares are rounded, so they may not add up to 100%.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.1.4 International Trade Characteristics

Table 4.4 reports both import and export related characteristics of international and local motor vehicle assembling enterprises in Turkey during the period 2003-2011. On average, international motor vehicle assembling enterprises import around TL 1.1 billion, while local motor vehicle assembling enterprises import about TL 38 million during the period 2003-2011. This highly large differential of import value between international and local motor vehicle assembling enterprises is due the fact that international motor vehicle assembling enterprises are highly large in size and they also widely engage in import. This pattern is also reflected in large import intensity of international motor vehicle assemblers reported in Table 4.3. Approximately 92% of all import of the assembly section of the Turkish automotive industry are made by international motor vehicle assembling enterprises. Even after adjusting for enterprise size, international motor vehicle assembling enterprises import around TL 343 thousand per employee, whilst local motor vehicle assembling enterprises import around TL 134 thousand per employee. Hence, international motor vehicle assembling enterprises import more than 2.6 times per employee than their local counterparts. On the other hand, unit value of import of local motor vehicle assembling enterprises is higher by TL 1.39 than their international counterparts. Therefore, local motor vehicle assembling enterprises import, on average, more valuable items. On average, international motor vehicle assembling enterprises import about 54 kinds of items[26] related to the automotive industry and these items are imported from around 27 different countries, while local motor vehicle assembling enterprises import fewer than 14 kinds of items from more than 7 different countries during the period. As a result, on average international motor vehicle assembling enterprises are involved in a large value of import in both overall and per employee basis with lower unit import value and import of a larger number of related automotive items from more diverse countries than their local counterparts.

Table 4.4 also presents export related characteristics of international and local motor vehicle assembling enterprises. On average, international motor vehicle assembling enterprises export around TL 1.2 billion, while local motor vehicle assembling enterprises export more than TL 16 million during the period 2003-2011. This highly large difference of export value is also reflected in large export intensity reported in Table 4.3. Approximately 97% of all export of the assembly section of the Turkish automotive industry are made by international motor vehicle assembling enterprises. Even after controlling for enterprise size, international motor vehicle assembling enterprises export about TL 372 thousand per employee, whilst local motor vehicle assembling enterprises export about TL 58 thousand per employee. Hence, international motor vehicle assembling enterprises export about 6.4 times per employee more than their local counterparts. On the other hand, unit value of export of local motor vehicle assembling enterprises is higher by about TL 2 than their international counterparts. Therefore, local motor vehicle assembling enterprises export more valuable items than their local equivalents. On average, international motor vehicle

[26] These items are at 6-digit HS level.

assembling enterprises export approximately 36 kinds of items[27] related to the automotive industry and these items are exported to fewer than 38 different countries, while local motor vehicle assembling enterprises export around 10 kinds of items to about 8 different countries during the period. As a result, on average international motor vehicle assembling enterprises are involved in a large value of export in both overall and per employee basis with lower unit export value and export of a larger number of related automotive items to more destinations than their local counterparts.

It can be inferred from Table 4.4 that international motor vehicle assembling enterprises display specialisation in assembly of motor vehicles with a high integration into the global automotive industry since such enterprises source a large value of highly varied automotive items from a large number of import origins to export a larger value of assembled motor vehicles and other more diversified automotive items to a larger number of export destinations. On the other hand, local motor vehicle assembling enterprises are highly small, generally integrated with the local industry and mainly serve the local market as local motor vehicle assembling enterprises' imports and import intensity are very low and they import fewer automotive items from fewer destinations compared to their international counterparts. Local motor vehicle assembling enterprises' exports and export intensity are also much lower and they export fewer automotive items to fewer destinations in comparison with their international counterparts. As a result, international motor vehicle assembling enterprises are positioned well in the global automotive industry in sourcing their inputs and marketing their output, while local motor vehicle assembling enterprises being small in size mostly interact with the local environment which is evident from characteristics of sourcing their inputs and marketing their output (Bernard, Jensen, Redding, et al., 2007; Manova and Zhang, 2009; Bernard, Jensen, Redding, et al., 2012).

[27] Please see footnote 26.

Table 4.4 International Trade Characteristics of Motor Vehicle Assemblers

	Time	International		Local		Share of International Enterprises
	Period	Obs	Mean	Obs	Mean	
Import (million of constant TL)	2003-11	90	1107.72	226	37.79	92
Import per employee (thousand of constant TL)	2003-11	90	343.02	226	134.25	
Unit value of import (TL/kg)	2003-11	90	11.2	226	12.59	
Number of related products imported	2003-11	90	53.71	226	13.59	
Number of import origin engaged with	2003-11	90	27.42	226	7.37	
Export (million of constant TL)	2003-11	90	1200.06	226	16.29	97
Export per employee (thousand of constant TL)	2003-11	90	371.61	226	57.86	
Unit value of export (TL/kg)	2003-11	90	11.2	226	13.2	
Number of related products exported	2003-11	90	36.03	226	10.19	
Number of export destination engaged with	2003-11	90	37.68	226	8	

Notes: Monetary values are in constant 2003 Turkish lira (TL). Means and shares are rounded.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.1.5 Production Characteristics

Table 4.5 presents input and output characteristics of international and local motor vehicle assembling enterprises in Turkey during the period 2003-2011. On the labour input side, on average international motor vehicle assembling enterprises employ approximately 3.2 thousand workers, while local motor vehicle assembling enterprises have, on average, around 251 workers. Therefore, international motor vehicle assembling enterprises are about 13 times larger in size than local motor vehicle assembling enterprises in Turkey during the period 2003-2011. This results in international motor vehicle assembling enterprises employing about 82% of all labour force in the assembly section of the Turkish automotive industry. This pattern of employment size differential between international and local motor vehicle assembling enterprises can also be observed in terms of total hours worked. Table 4.5 also reveals female worker shares. On average, about 7% of all labour force of international motor vehicle assembling enterprises are female, whilst this figure is about 9.5% for local motor vehicle assembling enterprises. Since international motor vehicle assembling enterprises are, on average, much larger in employment size than their local counterparts, overall labour costs of international motor vehicle assembling enterprises are much greater than their local counterparts by less than 16 times. Despite employing 82% of workers in the assembly section of the Turkish automotive industry, international motor vehicle assembling enterprises incur 85% of all labour costs paid in the assembly section of the Turkish automotive industry. On the other hand, average yearly labour cost per employee is less than TL 35 thousand for international motor vehicle assembling enterprises, whereas it is more than TL 15 thousand for local motor vehicle assembling enterprises during the period 2003-2011. Therefore, international motor vehicle assembling enterprises' spending on labour per employee is about 2.3 times larger than their local equivalents. This translates into that on average, international motor vehicle assembling enterprises pay more or incur more unit labour costs than their local counterparts. International motor vehicle assembling enterprises also employ more in overall and average terms.

On the capital input side[28], on average international motor vehicle assembling enterprises have a capital stock of about TL 473 million, while local motor vehicle assembling enterprises have a capital stock of approximately TL 18 million during the period. This gives rise international motor vehicle assembling enterprises to account for about 90% of all capital stock of the assembly section of the Turkish automotive industry. When controlling for employment size, international motor vehicle assembling enterprises' capital stock per employee is around 1.9 times greater than their local counterparts. Relative figures on total investment are not very different from figures on capital stock just reported.

[28]Please note that investment, and hence capital data is not accurate since investment data is not properly edited by the TurkStat. In addition to this, there are high fluctuations in the investment data stemming from poor quality of the investment data as just stated, and high and unstable investment in the Turkish automotive industry during the post-2002 period. As a result, findings related to investment and capital should be considered with high caution.

International motor vehicle assembling enterprises invest about TL 80 million, whereas local motor vehicle assembling enterprises invest around TL 3.8 million during the period. This leads international motor vehicle assembling enterprises to make up about 88% of all investment in the assembly section of the Turkish automotive industry during the period. When controlling for employment size, international motor vehicle assembling enterprises' investment per employee is around 1.9 times larger than their local counterparts. Table 4.5 also reveals investment on capital machines or equipment. On average, international motor vehicle assembling enterprises invest approximately TL 55 million on capital machines or equipment, while local motor vehicle assembling enterprises invest approximately TL 1 million on capital machines or equipment. This results in international motor vehicle assembling enterprises accounting for approximately 95% of all capital machines or equipment investment in the assembly section of the Turkish automotive industry that is even a larger share compared to corresponding shares of capital stock and total investment. This figure translates into that on average, about 69% of all investments of international motor vehicle assembling enterprises are channelled to investment on capital machines or equipment, while this figure is about 27% for local motor vehicle assembling enterprises. Therefore, investment composition of international motor vehicle assembling enterprises is mostly made of capital machines or equipment, while it is not the case for local motor vehicle assembling enterprises. On the other hand, when adjusting for employment size, international motor vehicle assembling enterprises' investment on capital machines or equipment per employee is around 4.2 times larger than their local equivalents. As a result, international motor vehicle assembling enterprises are more capital intensive, and hence more investment intensive and in particular more capital machines or equipment investment intensive than their local counterparts.

On the material input[29] side, on average international motor vehicle assembling enterprises spend approximately TL 1.1 billion on material, while local motor vehicle assembling enterprises spend more than TL 37 million on material during the period. This results in international motor vehicle assembling enterprises accounting for about 92% of all material used in the assembly section of the Turkish automotive industry. When accounting for employment differential between international and local motor vehicle assembling enterprises, material used per employee is less than TL 354 thousand for international motor vehicle assembling enterprises, whereas it is more than TL 146 thousand for local motor vehicle assembling enterprises during the period 2003-2011. Hence, international motor vehicle assembling enterprises' spending on material per employee is around 2.4 times greater than their local equivalents. As a result, international motor vehicle assembling enterprises are more material intensive than their local counterparts on overall, average and per employee basis.

[29] Material input corresponds to the total purchase value of inputs, intermediate inputs, processing and packaging items for the use in the production process of goods and services with changes in inventory considered during the accounting period.

On the energy input side, on average international motor vehicle assembling enterprises spend around TL 4 million on electricity, while local motor vehicle assembling enterprises spend about TL 200 thousand on electricity. This leads international motor vehicle assembling enterprises to account for about 88% of all electricity used in the assembly section of the Turkish automotive industry. On average, international motor vehicle assembling enterprises utilise approximately TL 2.6 million worth of fuel, while local motor vehicle assembling enterprises utilise around TL 170 thousand worth of fuel. This results in international motor vehicle assembling enterprises accounting for about 85% of all fuel utilised in the assembly section of the Turkish automotive industry. While overall electricity and fuel use of international motor vehicle assembling enterprises are different from each other, overall electricity and fuel use of local motor vehicle assembling enterprises are highly close to each other. This can suggest differentiation in use of capital equipments, and hence production technologies amongst international and local motor vehicles assembling enterprises. This variation is also indicated above as differentiation in the capital compositions of international and local motor vehicle assembling enterprises. On average, international motor vehicle assembling enterprises use around TL 6.6 million worth of energy[30], while local motor vehicle assembling enterprises utilise about TL 370 thousand worth of energy during the period. This leads international motor vehicle assembling enterprises to account for about 87% of all energy utilised in the assembly section of the Turkish automotive industry. When adjusting for employment size, international motor vehicle assembling enterprises' energy use per employee is around 1.4 times larger than their local counterparts. This energy input per employee differential between international and local motor vehicle assembling enterprises is the lowest differential followed by capital, labour and material differentials, respectively. As a result, international motor vehicle assembling enterprises use more energy than their local counterparts in overall, average and per employee terms.

Table 4.5 also reports output characteristics of international and local motor vehicle assembling enterprises in Turkey during the period 2003-2011. On average, international motor vehicle assembling enterprises produce about TL 1.9 billion worth of output, while local motor vehicle assembling enterprises produce less than TL 72 million worth of output during the period. This gives rise international motor vehicle assembling enterprises to produce about 90% of all output of the assembly section of the Turkish automotive industry. On the other hand, labour productivity or output per employee is less than TL 502 thousand for international motor vehicle assembling enterprises, whilst it is less than TL 186 thousand for local motor vehicle assembling enterprises during the period 2003-2011. Therefore, international motor vehicle assembling enterprises' average labour productivity or output per employee is about 2.7 times larger than their local equivalents during the period. On the other hand, the output differential between international and local motor

[30] Please note that energy input consists of electricity and fuel.

vehicle assembling enterprises is smaller in value added terms.[31] On average, international motor vehicle assembling enterprises create value added of less than TL 725 million, while local motor vehicle assembling enterprises generate value added of more than TL 34 million. This results in international motor vehicle assembling enterprises still producing about 89% of all value added of the assembly section of the Turkish automotive industry. When controlling for employment size, average value added per employee is about TL 227 thousand for international motor vehicle assembling enterprises, while it is less than TL 134 thousand for local motor vehicle assembling enterprises during the period 2003-2011. Hence, international motor vehicle assembling enterprises' value added per employee is around 1.7 times greater than their local counterparts. Therefore, the output differential between international and local motor vehicle assembling enterprises becomes smaller in value added terms. As a result, international motor vehicle assembling enterprises generate more output and value added than their local counterparts in overall, average and per employee terms.

Three main points can be inferred from shares of international motor vehicle assembling enterprises in the assembly section of the Turkish automotive industry reported in Table 4.5. First, international motor vehicle assembling enterprises account for more than 80% of the assembly section of the Turkish automotive industry in all measures. Therefore, the assembly section of the Turkish automotive industry is clearly dominated by enterprises with at least 10% international ownership. Second, use of material inputs and capital machines or equipment by international motor vehicle assembling enterprises as proportions in the assembly section of the Turkish automotive industry are larger compared to use of labour and energy inputs by international motor vehicle assembling enterprises as proportions in the assembly section of the Turkish automotive industry by at least 6 percentage points. Therefore, international motor vehicle assembling enterprises are, on average, more material and capital intensive, while local motor vehicle assembling enterprises are more labour and energy intensive. Therefore, production technology and sourcing structure of international motor vehicle assembling enterprises are based more on material inputs and capital machines or equipment compared their local counterparts. In other words, to a certain extent local motor vehicle assembling enterprises relatively rely more on labour and energy in their production structures. Last, the largest item of expenditure is material by a large margin that is followed by labour, capital and energy, respectively in overall, average and per employee terms. This pattern of ranking of expenditure items holds for both international and local motor vehicle assembling enterprises (Blalock and Veloso, 2007; Inklaar and Timmer, 2007; Arnold and Javorcik, 2009; Elliott et al., 2013).

[31] Please note that value added is calculated as deflated production value net of deflated material input, and electricity and fuel expenditures.

Table 4.5 Production Characteristics of Motor Vehicle Assemblers

	Time	International		Local		Share of
	Period	Obs	Mean	Obs	Mean	International Enterprises
Inputs	2003-11					
Labour						
Employment (number)		91	3193.86	253	251.47	82
ln(employment) (lnEMP)		91	7.49	249	3.81	
Female worker share		91	6.88	253	9.46	
Total hours worked (million)		91	6.82	253	0.54	82
ln(total hours worked) (lnL)		91	15.14	250	11.46	
Labour cost (million of constant TL)		91	112.55	253	7.25	85
Labour cost per employee (thousand of constant TL)		91	34.83	249	15.22	
ln(labour cost per employee) (lnWAGE)		91	10.39	249	9.35	
Capital						
Capital stock (million of constant TL)		90	472.99	280	17.8	90
ln(capital stock) (lnK15)		90	18.9	280	14.14	
Capital stock per employee (thousand of constant TL)		90	146.47	253	78.32	
Total investment (million of constant TL)		91	79.81	253	3.8	88
Total investment per employee (thousand of constant TL)		91	23.2	249	12.19	
ln(total investment per employee) (lnTINV)		85	9.42	189	8.49	
Capital machines or equipment investment (million of constant TL)		91	55.05	253	1.01	95
Capital machines or equipment investment per employee (thousand of constant TL)		91	15.91	249	3.77	
ln(capital machines or equipment investment per employee) (lnMAC)		83	8.96	183	7.6	
Material						
Material net (million of constant TL)		91	1129.37	249	37.38	92

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Production Characteristics of Motor Vehicle Assemblers (Continued)

	Time Period	International		Local		Share of International Enterprises
		Obs	Mean	Obs	Mean	
ln(material net) (lnM)		91	19.97	242	14.85	
Material net per employee (thousand of constant TL)		91	353.61	249	146.31	
Energy						
Electricity (million of constant TL)		91	4.05	249	0.2	88
Electricity per employee (thousand of constant TL)		91	1.27	249	0.79	
Fuel (million of constant TL)		91	2.58	249	0.17	85
Fuel per employee (thousand of constant TL)		91	0.81	249	0.67	
Energy (million of constant TL)		91	6.63	249	0.37	87
ln(energy) (lnE)		91	14.87	239	10.48	
Energy per employee (thousand of constant TL)		91	2.07	249	1.47	
Output	2003-11					
Production value (million of constant TL)		91	1860.76	253	71.49	90
ln(production value) (lnY)		91	20.46	252	15.46	
Labour productivity (thousand of constant TL)		91	501.57	249	185.84	
ln(labour productivity) (lnLP)		91	12.97	248	11.75	
Value added (million of constant TL)		91	724.76	249	34.2	89
ln(value added) (lnVA)		89	19.64	238	14.65	
Value added per employee (thousand of constant TL)		91	226.92	249	133.85	

Notes: Monetary values are in constant 2003 Turkish lira (TL). Means and shares are rounded. Capital stock is based on a depreciation rate of 15%.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.2 International and Local Automotive Parts Suppliers

This subsection reports key findings on general economic characteristics, characteristics of certified R&D centres, characteristics of channels of international technology transfer, international trade characteristics and production characteristics of automotive parts supplying enterprises in Turkey by ownership, respectively. This subsection also compares characteristics of motor vehicle assembling enterprises reported in subsection 4.3.1 with corresponding characteristics of automotive parts supplying enterprises presented in this subsection.[32]

4.3.2.1 General Economic Characteristics

Table 4.6 presents general economic characteristics of international and local automotive parts supplying enterprises in Turkey by ownership. On average, about 8% of all observations of automotive parts supplying enterprises in Turkey have at least 10% international ownership, while this share is 21% for the assembly section of the Turkish automotive industry as reported in subsubsection 4.3.1.1 during the period 2003-2011. As stated earlier, these observations include enterprises which are on full-enumeration or have at least 20 employees. As Table 4.6 indicates, on average, international ownership intensity amongst international automotive parts supplying enterprises in Turkey is 75%, 11 percentage points higher than its motor vehicle assembling counterpart. This pattern of high international ownership is reflected in the distribution of international ownership amongst different categories, and the distribution is concentrated in higher international ownership categories. 45% of all international observations correspond to full international ownership and 16% of all international observations refer to international ownership shares of equal or more than 70% but less than full international ownership. On the other hand, as reported in subsubsection 4.3.1.1 distribution of ownership of international motor vehicle assembling enterprises across different categories are not highly different for higher categories. As a result, international motor vehicle assembling enterprises share more ownership with their local partners, while international automotive parts supplying enterprises prefer more ownership in their businesses. This pattern of high international ownership amongst international automotive parts supplying enterprises is also confirmed by the origin of controlling stake of international automotive parts supplying enterprises, around 24% of international observations' controlling origin are German followed by Italian with 13%, French with 12%, Turkish with 12% and Japanese with 9%. The most significant decrease in shares of origin of controlling stake of international automotive parts supplying enterprises compared to its motor vehicle assembling counterpart is for Turkey, it decreases

[32] Please note data on automotive parts supplying enterprises on full-enumeration is reported in this subsection, so data on automotive parts supplying enterprises on random sampling basis is not considered. Therefore, the whole automotive parts industry is larger than the one reported in this subsection. Nevertheless, as indicated in section 4.2 that more than 90% of the Turkish automotive industry are accounted by automotive enterprises having 20 or more employees, and hence automotive enterprises on full-enumeration represent more than 90% of the Turkish automotive industry.

by 19 percentage points to 12% reflecting the increase in international ownership intensity of international automotive parts supplying enterprises. There are also large decreases in overall shares of origin of controlling stake of Asian automotive parts supplying enterprises compared to Asian motor vehicle assembling enterprises' corresponding shares. Therefore, European automotive parts supplying enterprises gain more prominence in controlling the supply section compared to the assembly section of the industry. As a result, this pattern of origin of controlling stake of international automotive parts supplying enterprises is, to some extent, in line with origin of controlling stake of international motor vehicle assembling enterprises called follow source (Humphrey, 2003; Ivarsson and Alvstam, 2004). This is the case when international motor vehicle assembling enterprises encourage their supply bases at their origins to invest in their international investment locations. On the other hand, by definition, origin of controlling stake of local automotive parts supplying enterprises are Turkish.

Table 4.6 also reports age related characteristics of automotive parts supplying enterprises in Turkey by ownership. There is not any difference between the operational experience of international and local automotive parts supplying enterprises in Turkey. On the other hand, as reported earlier, international motor vehicle assembling enterprises are more experienced than their local equivalents. Compared to motor vehicle assembling enterprises, automotive parts supplying enterprises are also far less experienced. Therefore, on average a wide spread of the automotive parts supply section of the industry is recently established. This is confirmed by related age categories of the automotive parts supply section. Approximately 70% of all observations of automotive parts supplying enterprises have fewer than 20 years of operational experience, irrespective of ownership structure.

In addition, Table 4.6 presents size related characteristics of automotive parts supplying enterprises in Turkey by ownership. There is a large difference between enterprise size distribution of international and local automotive parts supplying enterprises in Turkey. Around 70% of all observations of local automotive parts supplying enterprises have fewer than 50 employees, whereas about 69% of all observations of international automotive parts supplying enterprises have 100 or more employees. On the other hand, as noted above around 89% of all observations of international motor vehicle assembling enterprises have at least 500 employees, whereas approximately 75% of all observations of local motor vehicle assembling enterprises have fewer than 50 employees. Therefore, on average irrespective of operating in the assembly or supply section of the Turkish automotive industry, the vast majority of local automotive enterprises employ fewer than 50 workers. On the other hand, the vast majority of international automotive enterprises employ at least 100 workers. Nevertheless, the majority of international automotive parts supplying enterprises have more than 100 but fewer than 1000 employees, while the majority of international motor vehicle assembling enterprises employ more than 1000 workers. There is not also any difference between the number of local units of international and local automotive parts supplying enterprises including the headquarters of enterprise if it is based in Turkey. The number of local units of automotive parts supplying enterprises is, on average, around 1.2, independent of ownership structure.

Furthermore, Table 4.6 reports locations of centres of automotive parts supplying enterprises in Turkey by ownership. As stated earlier, these locations can be headquarters of enterprises or locations of plants of enterprises. Despite differences, both motor vehicle assembling and automotive parts supplying enterprises are generally located in the western regions of Turkey.[33] Nevertheless, automotive parts supplying enterprises in Turkey are more geographically dispersed than motor vehicle assembling enterprises. This location pattern points out to clustering of automotive parts supplying enterprises around motor vehicle assembling enterprises (Klier and Rubenstein, 2008; R. C. Johnson and Noguera, 2012). As stated earlier, these automotive industry regions of concentration are in close geographic proximity to each other, on the major route to Europe and these regions constitute the economic hub of Turkey. Despite hosting motor vehicle assembling enterprises, Ankara appears to have fewer than expected automotive parts supplying enterprises. Nevertheless, Konya a neighbour of Ankara appears to host a number of automotive parts supplying enterprises in spite of not being a host of major motor vehicle assembling enterprises. As a result, motor vehicle assembling enterprises are located in regions in close geographic proximity to Europe and automotive parts supplying enterprises cluster around them (Sturgeon et al., 2008; Zeddies, 2011).

Table 4.6 General Characteristics of Automotive Parts Suppliers

	Time	International		Local	
	Period	Obs	Share	Obs	Share
International Direct Investment (FDI)	2003-11	935	100	11475	0
International Direct Investment Intensity (FDIS)	2003-11	935	75	11475	0
FDIS Categories (I)	2003-11	935		11475	
FDIS=0%		37	4	11446	100
1%<=FDIS<=49%		118	13	29	0
50%<=FDIS<=100%		780	83	0	0
FDIS Categories (II)	2003-11	935		11475	
FDIS<10%		42	4	11475	100
10%<=FDIS<=39%		34	4	0	0
40%<=FDIS<=69%		292	31	0	0
70%<=FDIS<=99%		147	16	0	0
FDIS=100%		420	45	0	0
Origin of Controlling Stake (ORIGIN)	2003-11	935		11475	
Germany		227	24	0	0

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[33] Please see footnote 20.

General Characteristics of Automotive Parts Suppliers (Continued)

	Time	International		Local	
	Period	Obs	Share	Obs	Share
Italy		124	13	0	0
France		112	12	0	0
Turkey		109	12	11475	100
Japan		83	9	0	0
United States		70	7	0	0
Spain		69	7	0	0
Netherlands		29	3	0	0
South Korea		24	3	0	0
United Kingdom		20	2	0	0
Others		68	7	0	0
Age (AGE)	2005-11	759	17	9578	18
Age Square (AGE2)	2005-11	759	394	9578	392
Age Categories	2005-11	759		9578	
<=4		4	1	174	2
5-10		238	31	2204	23
11-15		147	19	1663	17
16-20		148	19	2665	28
21-25		95	13	1094	11
26-30		26	3	886	9
31-35		25	3	576	6
36-40		48	6	189	2
41<=		28	4	127	1
Size Categories (SIZE)	2003-11	821		7951	
SMALL (<50)		138	17	5526	70
MEDIUM (50-99)		113	14	1105	14
LARGE (100<=)		570	69	1320	17
Size Categories (II)	2003-11	821		7951	
<=49		138	17	5526	70
50-99		113	14	1105	14
100-249		250	30	987	12
250-499		180	22	248	3
500-999		83	10	62	1
1000-4999		51	6	23	0
5000<=		6	1	0	0
Number of Local Units (UNIT)	2003-11	935	1.22	11475	1.23
Location of Centre (LOCATION)	2003-11	935		11475	
Bursa (TR41)		343	37	2326	20

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General Characteristics of Automotive Parts Suppliers (Continued)

	Time	International		Local	
	Period	Obs	Share	Obs	Share
Istanbul (TR10)		200	21	3458	30
Kocaeli (TR42)		196	21	1265	11
Izmir (TR31)		52	6	1217	11
Tekirdag (TR21)		35	4	70	1
Ankara (TR51)		24	3	606	5
Manisa (TR33)		24	3	190	2
Kirikkale (TR71)		18	2	132	1
Aydin (TR32)		15	2	90	1
Samsun (TR83)		8	1	170	1
Konya (TR52)		7	1	1102	10
Kayseri (TR72)		4	0	125	1
Adana (TR62)		0	0	309	3
Hatay (TR63)		0	0	119	1
Others		9	1	296	3

Notes: Shares are rounded, so they may not add up to 100%.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.2.2 Automotive Parts Suppliers of the Status of Certified R&D Centre

Table 4.7 presents ownership and location characteristics of automotive parts supplying enterprises in Turkey under the status of certified R&D centres by ownership.[34] About 79% of certified R&D centres in the Turkish automotive industry operate in the automotive parts supply section of the industry. Automotive parts supplying enterprises with at least 10% international ownership constitute around 39% of certified R&D centres of the supply section of the Turkish automotive industry. On the other hand, this figure is 63% for the assembly section of the Turkish automotive industry. Nevertheless, this higher figure of the assembly section is due to greater number of joint ventures of local motor vehicle assembling enterprises with international motor vehicle assembling enterprises. Overall international ownership intensity of certified R&D centres of international automotive parts supplying enterprises is higher than its international motor vehicle assembling counterpart, 20 out of 61 automotive parts supplying enterprises have 50% or more international ownership making up 33% of all automotive parts supplying enterprises. On the other hand, this figure is around 19% for motor vehicle assembling enterprises. Therefore, compared to international ownership intensity of certified R&D centres of international motor vehicle assembling enterprises, international ownership intensity of certified R&D

[34] Please see subsubsection 4.3.1.2 for explanation of certified R&D centres and access to data on this.

centres of international automotive parts supplying enterprises is higher. This pattern of greater ownership preference by international automotive parts supplying enterprises in comparison with their motor vehicle assembling counterparts is also confirmed in general ownership characteristics reported earlier. This pattern of ownership differential is also evident in the origin of controlling stake of certified R&D centres of automotive parts supplying enterprises, around 67% of origin of controlling stake of certified R&D centres of motor vehicle assembling enterprises are Turkish, while it is 81% for motor vehicle assembling enterprises. Automotive enterprises of German origin as both motor vehicle assemblers and automotive parts suppliers and as both origins of controlling stake and certified R&D centres rank first compared to automotive enterprises of international origin.

Table 4.7 also reports locations of certified R&D centres of automotive parts supplying enterprises in Turkey by ownership.[35] These certified R&D centres are located in the western regions of Turkey that is, to some extent, consistent with locations of automotive parts supplying enterprises reported earlier (Kirat and Lung, 1999).[36] Bursa, Kocaeli and Istanbul regions are consistently preferred by international motor vehicle assembling and automotive parts supplying enterprises as location of centres and certified R&D centres. Despite being less popular amongst international automotive enterprises, Izmir is consistently preferred by local motor vehicle assembling and automotive parts supplying enterprises as location of centres and certified R&D centres.

Table 4.7 Automotive Parts Suppliers of the Status of Certified R&D Centre

	All		International	Local	International in relation to All
	Number	Share	Number	Number	
Automotive Parts Suppliers	61	79	24	37	39
FDIS Categories (I)	61				
FDIS=0%	36	59			
1%<=FDIS<=49%	5	8			
50%<=FDIS<=100%	20	33			
FDIS Categories (II)	61				
FDIS<10%	37	61			
10%<=FDIS<=39%	0	0			
40%<=FDIS<=69%	11	18			
70%<=FDIS<=99%	2	3			
FDIS=100%	11	18			
Origin of Controlling Stake	61				
Turkey	41	67			

Continued on the next page

[35] Please see footnote 22.
[36] Please see footnote 20.

Automotive Parts Suppliers of the Status of Certified R&D Centre (Continued)

	All		International	Local	International in relation to All
	Number	Share	Number	Number	
Germany	4	7			
France	2	3			
Japan	3	5			
Others	11	18			
Location of R&D Centre	61				
Bursa (TR41)	25	41	13	12	52
Kocaeli (TR42)	14	23	6	8	43
Istanbul (TR10)	6	10	3	3	50
Izmir (TR31)	6	10	1	5	17
Manisa (TR33)	4	7	1	3	25
Ankara (TR51)	2	3	0	2	0
Others	4	7	0	4	0

Notes: This table includes R&D centres certified by the Ministry of Science, Industry and Technology of the Republic of Turkey under the law of "Number 5746 Research and Development Activities Support" as of 30 June 2016. Shares are rounded, so they may not add up to 100%.

Source: Ministry of Science, Industry and Technology of the Republic of Turkey, Directorate General for Science and Technology. Ownership related data is compiled from websites and reports of relevant enterprises.

4.3.2.3 Characteristics of Channels of International Technology Transfer

Table 4.8 reports characteristics of international technology transfer channels, namely international ownership, import and export for automotive parts supplying enterprises in Turkey by ownership during 2003-2011. As Table 4.8 reveals, about 87% of all observations of automotive parts supplying enterprises with at least 10% international ownership get involved in all three kinds of international technology transfer channels, around 11 percentage points down compared to their motor vehicle assembling counterpart. On the other hand, about 33% of all observations of local automotive parts supplying enterprises, as they by definition do not get involved in international ownership, get involved in both import and export activities, around 19 percentage points lower than their motor vehicle assembling equivalent. About 44% of all observations of local automotive parts supplying enterprises do not get engaged in any international economic activities at all, around 11 percentage points greater than their motor vehicle assembling counterpart.

Table 4.8 also presents that around 93% of all observations of international automotive parts supplying enterprises are related to import, while about 88% of all observations of international automotive parts supplying enterprises are associated with export. These figures are far lower for local automotive parts supplying enterprises, around 43% and 46%

of all observations of local automotive parts supplying enterprises are related to import and export, respectively. This lower level of involvement of local automotive parts supplying enterprises in international trade is also confirmed by about 44% of non-involvement in any international economic activities reported earlier.

As also reported in Table 4.6, on average, international ownership intensity of international automotive parts supplying enterprises is around 75% that is about 11 percentage points larger than their motor vehicle assembly counterpart.[37] On average, import and export intensities of international automotive parts supplying enterprises are about 31% and 26%, respectively that is down by about 26 and 24 percentage points in comparison with their motor vehicle assembly counterparts. On the contrary, import and export intensities of local automotive parts supplying enterprises are, on average, about 5% and 12%, respectively that is smaller by around 12 and 3 percentage points, respectively compared their motor vehicle assembly counterparts. Therefore, import intensity is 26 percentage points lower, while export intensity is 14 percentage points smaller in the case of local automotive parts supplying enterprises compared to their international automotive parts supplying equivalents.

There are three major patterns arising from Table 4.8 in comparison with Table 4.3. First, it is more likely for international automotive parts supplying enterprises to engage in import than export as seen from relative engagement, existence and intensity of import and export data of international automotive parts supplying enterprises. On the other hand, the opposite holds for local automotive parts supplying enterprises, so it is more likely for local automotive parts supplying enterprises to engage in export than import as revealed by international trade data of local automotive parts supplying enterprises. It should be noted that this pattern of international trade only holds for automotive parts supplying enterprises since both international and local motor vehicle assembling enterprises are more import intensive than being export intensive. Therefore, it is only the local automotive parts suppliers that have export intensity that is larger than import intensity. Second, comparing with engagement, existence and intensity of import and export of international and local motor vehicle assembling enterprises with their automotive parts supply counterparts, both international and local automotive parts supplying enterprises appear to get less engaged in export and import. Third, international motor vehicle assembling and automotive parts supplying enterprises get more involved in international trade than local motor vehicle assembling and automotive parts supplying enterprises.

As a result, international automotive parts supplying enterprises highly engage in international trade activities than their local counterparts, so that they can obtain more international technology transfer as in the case of the assembly section of the Turkish automotive industry (Grossman and Helpman, 1995; Eaton and Kortum, 2002; Saggi, 2002; Keller, 2010).

[37] Please see subsubsection 4.3.2.1 for more explanation on international ownership.

Table 4.8 Characteristics of Channels of International Technology Transfer for Suppliers

	Time	International		Local	
	Period	Obs	Share	Obs	Share
Channels of International Technology Transfer	2003-11	935		11475	
All Channels		815	87	0	0
FDI (Only)		57	6	0	0
FDI and Import (Only)		56	6	0	0
FDI and Export (Only)		7	1	0	0
Import (Only)		0	0	1129	10
Import and Export (Only)		0	0	3777	33
Export (Only)		0	0	1489	13
No involvement		0	0	5080	44
Existence Measures of Channels		935		11475	
International Direct Investment (FDI)	2003-11	935	100	0	0
Import (IMP)	2003-11	871	93	4906	43
Export (EXP)	2003-11	822	88	5266	46
Intensity Measures of Channels					
International Direct Investment Intensity (FDIS)	2003-11	935	75	11475	0
Import Intensity (IMPS)	2003-11	821	31	7951	5
Export Intensity (EXPS)	2003-11	821	26	7951	12

Notes: Shares are rounded, so they may not add up to 100%.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.2.4 International Trade Characteristics

Table 4.9 presents both import and export related characteristics of international and local automotive parts supplying enterprises in Turkey during 2003-2011. On average, international automotive parts supplying enterprises import around TL 26 million, while local automotive parts supplying enterprises import around TL 1.4 million during the period 2003-2011. This large differential of import value between international and local automotive parts supplying enterprises is due the fact that international automotive parts supplying enterprises are large in size and they are also extensively involved in import. This pattern is also reflected in far larger import intensity of international automotive parts suppliers reported in Table 4.8. Around 72% of all import of the automotive parts supply section of the Turkish automotive industry are made by international automotive parts supplying enterprises. Even after controlling for enterprise size, international automotive parts supplying enterprises import less than TL 74 thousand per employee, whilst local automotive parts supplying enterprises import less than TL 17 thousand per employee. Hence, international automotive parts supplying enterprises import about 4.4 times per employee more than their local counterparts reflecting lower import intensity of local automotive parts supplying enterprises reported in Table 4.8. Import of automotive parts supplying enterprises is also less than one third of import of motor vehicle assembling enterprises as motor vehicle assembling enterprises extensively source imported automotive parts for their motor vehicle assembly reflected by high import intensity of motor vehicle assembling enterprises presented in Table 4.3. Unit value of import of international automotive parts supplying enterprises is less than twice as much large as its local counterpart. Therefore, international automotive parts supplying enterprises import much more valuable items than their local equivalents. On the other hand, as reported in Table 4.4 local motor vehicle assembling enterprises import more valuable items than their international counterparts. On average, international automotive parts supplying enterprises import around 6 kinds of automotive items[38] and these items are imported from more than 6 different countries, while local automotive parts supplying enterprises import around one item from around one country during the period. As a result, on average international automotive parts supplying enterprises are engaged in a large value of import in both overall and per employee basis with higher import unit value and import of a larger number of related automotive items from more diverse countries compared to their local counterparts. Both international and local automotive parts supplying enterprises also display less engagement and diversity in import compared to motor vehicle assembling enterprises. This pattern is due mainly to the fact that automotive parts supplying enterprises do not get much engaged in assembly, are more involved in production and more oriented towards the local industry in comparison with motor vehicle assembling enterprises.

Table 4.9 also reports export related characteristics of international and local automotive parts supplying enterprises. On average, international automotive parts supplying enterprises export less than TL 24 million, whilst local automotive parts supplying enterprises export less than TL 2 million during the period 2003-2011. This large differential of export value between international and local automotive parts supplying enterprises is due the fact that international automotive parts supplying enterprises are large in size and they are also extensively involved in export. This pattern is also reflected in larger export intensity of international automotive parts suppliers reported in Table 4.8. Around 62% of all export of the automotive parts supply section of the Turkish automotive industry are made by international automotive parts supplying enterprises. Even after adjusting for enterprise size, international automotive parts supplying enterprises export around TL 67 thousand per employee, while local automotive parts supplying enterprises export more than TL 23 thousand per employee. Therefore, international automotive parts supplying enterprises export about 2.9 times per employee more than their local counterparts reflecting smaller export intensity of local automotive parts supplying enterprises presented in Table 4.8. Export of automotive parts supplying enterprises is also less than one third of

[38] Please see footnote 26.

export of motor vehicle assembling enterprises as motor vehicle assembling enterprises extensively export their output reflected by high export intensity of motor vehicle assembling enterprises reported in Table 4.3. Unit value of export of international automotive parts supplying enterprises is around 2.2 times as much large as its local counterpart. Therefore, international automotive parts supplying enterprises export much more valuable items than their local equivalents. On the other hand, as reported in Table 4.4 local motor vehicle assembling enterprises export more valuable items than their international counterparts. On average, international automotive parts supplying enterprises export around 3 kinds of automotive items[39] and these items are exported to around 6 different countries, whilst local automotive parts supplying enterprises export about 2 kinds of items to more than 3 countries during the period. As a result, on average international automotive parts supplying enterprises are engaged in a large value of export in both overall and per employee basis with higher export unit value and export of a larger number of related automotive items to more diverse countries compared to their local counterparts. Both international and local automotive parts supplying enterprises also display less engagement and diversity in export compared to motor vehicle assembling enterprises. This pattern is due mainly to the fact that automotive parts supplying enterprises are more oriented towards the local market in comparison with motor vehicle assembling enterprises.

There are three main points arising from comparison of Table 4.9 with Table 4.4. First, both international and local automotive parts supplying enterprises are less outward oriented than both international and local motor vehicle assembling enterprises. This is evident from the comparison of the extent, intensity and diversity of import and export activities of motor vehicle assembling enterprises with automotive parts supplying enterprises'. In addition to this, motor vehicle assembling enterprises undertake around 77% of all import and export of the Turkish automotive industry. This pattern of higher engagement of motor vehicle assembling enterprises in international trade is due mainly to the fact that motor vehicle assembling enterprises operate in the final section of the automotive industry: suppliers are mainly engaged in production and supply of automotive parts, while assemblers are involved in production and assembly of motor vehicles, and assemblers have more ability to obtain inputs from more sources and ship their output to more markets. Second, local automotive parts supplying enterprises constitute a more prominent place in their share of international trade in the automotive parts supply section of the Turkish automotive industry than local motor vehicle assembling enterprises' international trade shares in the assembly section of the Turkish automotive industry. This stems from that on average, local automotive parts supplying enterprises make up about 28% and 38% of all import and export of the automotive parts supply section of the Turkish automotive industry, respectively; while local motor vehicle assembling enterprises make up about 8% and 3% of all import and export of the motor vehicle assembly section of the Turkish automotive industry, respectively. These larger shares of international trade

[39] Please see footnote 26.

of local automotive parts supplying enterprises in the supply section of the industry are despite of low international trade intensities of local automotive parts supplying enterprises. This results from that local automotive parts supplying enterprises account for a larger part of the Turkish automotive industry than local motor vehicle assembling enterprises. It is also noticeable that while local automotive parts supplying enterprises' share in export of the supply section of the industry is around 10 percentage points larger than their share in import of the supply section of the industry, local motor vehicle assembling enterprises' share in export of the assembly section of the industry is around 5 percentage points smaller than their share in import of the assembly section of the industry. This is due to smaller overall export of international automotive parts supplying enterprises compared to their overall import and larger overall export of local automotive parts supplying enterprises compared to their overall import. The opposite is the case for the motor vehicle assembly section of the automotive industry. Last, both international and local automotive parts supplying enterprises import less valuable items and export more valuable items and this even holds by larger degree for international automotive parts supplying enterprises in both absolute and relative terms. Hence, international automotive parts supplying enterprises concentrate, to a large extent, on production and export of the high value added items. This pattern is also the case for local motor vehicle assembling enterprises but this pattern does not hold for international motor vehicle assembling enterprises as unit import and export values of items international motor vehicle assembling enterprises engage with are almost identical.

Table 4.9 International Trade Characteristics of Automotive Parts Suppliers

	Time	International		Local		Share of International Enterprises	Share of Suppliers
	Period	Obs	Mean	Obs	Mean		
Import (million of constant TL)	2003-11	878	26.09	6395	1.41	72	23
Import per employee (thousand of constant TL)	2003-11	821	73.64	6395	16.75		
Unit value of import (TL/kg)	2003-11	878	8.84	6395	4.67		
Number of related products imported	2003-11	878	6.13	6395	1.27		
Number of import origin engaged with	2003-11	878	6.41	6395	1.27		
Export (million of constant TL)	2003-11	878	23.79	6395	1.97	62	23
Export per employee (thousand of constant TL)	2003-11	821	67.13	6395	23.46		
Unit value of export (TL/kg)	2003-11	878	12.22	6395	5.47		
Number of related products exported	2003-11	878	3.22	6395	1.94		
Number of export destination engaged with	2003-11	878	6.06	6395	3.6		

Notes: Monetary values are in constant 2003 Turkish lira (TL). Means and shares are rounded.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.3.2.5 Production Characteristics

Table 4.10 reports input and output characteristics of international and local automotive parts supplying enterprises in Turkey during the period 2003-2011. On the labour input side, on average international automotive parts supplying enterprises employ about 379 workers, while local automotive parts supplying enterprises have, on average, about 68 workers. Hence, international automotive parts supplying enterprises are about 5.6 times larger in size than local automotive parts supplying enterprises. This employment differential between international and local automotive parts supplying enterprises is much smaller than the employment differential between international and local motor vehicle assembling enterprises. This results in international automotive parts supplying enterprises employing about 37% of all labour force in the supply section. While average enterprise size of automotive parts supplying enterprises are much smaller than motor vehicle assembling enterprises, automotive parts supplying enterprises overall employ about 2.4 times more workers than motor vehicle assembling enterprises. Total hours worked display similar patterns as employment just explained. It should be noted that there is not any major variation in total hours worked per employee whether it is the difference between international and local automotive enterprises or assemblers and suppliers.

Table 4.10 also reveals female worker shares and labour costs in the supply section of the Turkish automotive industry by ownership during the period 2003-2011. On average, around 17% of all labour force of international automotive parts supplying enterprises are female, whilst this figure is around 12% for local automotive parts supplying enterprises. Therefore, international automotive parts supplying enterprises, on average, employ more female workers than their local counterparts. On the other hand, international motor vehicle assembling enterprises, on average, employ fewer female workers than their local counterparts. Both international and local automotive parts supplying enterprises also have larger female worker shares than both international and local motor vehicle assembling enterprises. Since international automotive parts supplying enterprises are, on average, much larger in employment size than their local counterparts, overall labour costs of international automotive parts supplying enterprises are also much larger than their local counterparts by about 9.4 times. International automotive parts supplying enterprises account for 49% of all labour costs incurred in the supply section. On the other hand, average yearly labour cost per employee is less than TL 22 thousand for international automotive parts supplying enterprises, whereas it is less than TL 11 thousand for local automotive parts supplying enterprises. Therefore, international automotive parts supplying enterprises' spending on labour per employee is around 2 times larger than their local equivalents. Despite employing about 71% all workers in the Turkish automotive industry, automotive parts supplying enterprises incur about 54% of all labour cost paid in the Turkish automotive industry. This is due to the fact that wage payments or labour costs per employee are much higher in the assembly section. As a result, on average international automotive parts supplying enterprises employ more, pay more or incur more unit labour costs than their local counterparts.

On the capital input side[40], on average international automotive parts supplying enterprises have a capital stock of about TL 32 million, while local automotive parts supplying enterprises have a capital stock of less than TL 4 million during the period 2003-2011. This gives rise international automotive parts supplying enterprises to account for about 46% of all capital stock in the supply section of the Turkish automotive industry. When controlling for employment size, international automotive parts supplying enterprises' capital stock per employee is around 1.5 times greater than their local counterparts. International automotive parts supplying enterprises invest about TL 6 million, whereas local automotive parts supplying enterprises invest around TL 620 thousand. This leads international automotive parts supplying enterprises to make up about 50% of all investment in the supply section. When controlling for employment size, international automotive parts supplying enterprises' investment per employee is around 2.2 times larger than their local counterparts. Therefore, this differential is larger than its motor vehicle assembly counterpart. Table 4.10 also reveals investment on capital machines or equipment. On average, international automotive parts supplying enterprises invest around TL 4.3 million on capital machines or equipment, while local automotive parts supplying enterprises invest approximately TL 370 thousand on capital machines or equipment. This results in international automotive parts supplying enterprises accounting for approximately 54% of all capital machines or equipment investment in the supply section that is even a larger share compared to corresponding shares of capital stock and total investment. This figure translates into that on average, around 74% of all investments of international automotive parts supplying enterprises are channelled to investment on capital machines or equipment, while this figure is about 61% for local automotive parts supplying enterprises. This differential is more significant for the assembly section. On the other hand, when adjusting for employment size, international automotive parts supplying enterprises' investment on capital machines or equipment per employee is about 2.5 times larger than their local equivalents. Automotive parts supplying enterprises constitute around 53% to 55% of all capital stock, total investment and capital machines or equipment investment in the Turkish automotive industry. As a result, international automotive parts supplying enterprises are more capital intensive, more investment intensive and in particular more capital machines or equipment investment intensive than their local counterparts.

On the material input[41] side, on average international automotive parts supplying enterprises spend less than TL 34 million on material, while local automotive parts supplying enterprises spend more than TL 3 million on material during the period 2003-2011. This results in international automotive parts supplying enterprises accounting for about 52% of all material used in the supply section of the Turkish automotive industry. When accounting

[40] Please see footnote 28.

[41] Please see footnote 29.

for employment differential, material used per employee is, on average, more than TL 87 thousand for international automotive parts supplying enterprises, whereas it is more than TL 47 thousand for local automotive parts supplying enterprises. Hence, international automotive parts supplying enterprises' spending on material per employee is around 1.9 times greater than their local equivalents. Automotive parts supplying enterprises use about 32% of all material in the Turkish automotive industry. Therefore, the majority of all materials in the Turkish automotive industry are utilised by motor vehicle assembling enterprises. As a result, international automotive parts supplying enterprises are more material intensive than their local counterparts on overall, average and per employee basis.

On the energy input side, on average international automotive parts supplying enterprises spend around TL 450 thousand on electricity, while local automotive parts supplying enterprises spend about TL 80 thousand on electricity during the period 2003-2011. This leads international automotive parts supplying enterprises to account for about 38% of all electricity used in the supply section of the Turkish automotive industry. When adjusting for employment size, international automotive parts supplying enterprises' electricity use per employee becomes almost the same as their local counterparts. On average, international automotive parts supplying enterprises utilise approximately TL 140 thousand worth of fuel, while local automotive parts supplying enterprises utilise around TL 40 thousand worth of fuel. This leads international automotive parts supplying enterprises to account for about 29% of all fuel utilised in the supply section. When controlling for employment size, international automotive parts supplying enterprises' fuel use per employee becomes about 0.7 times as much as their local counterparts. Therefore, on average local automotive parts supplying enterprises' fuel use per employee is larger than their international counterparts. This pattern indicates that in comparison with electricity use there is a larger decrease in preference for fuel by international automotive parts supplying enterprises than local automotive parts supplying enterprises. Therefore, there is a change in the composition of energy mix between international and local automotive parts supplying enterprises by about 9 percentage points. On average, international automotive parts supplying enterprises use less than TL 600 thousand worth of energy[42], while local automotive parts supplying enterprises utilise less than TL 110 thousand worth of energy. This leads international automotive parts supplying enterprises to account for about 36% of all energy utilised in the supply section. When adjusting for employment size, international automotive parts supplying enterprises' energy use per employee is smaller than their local counterparts. On the other hand, as reported in Table 4.5 that international motor vehicle assembling enterprises' energy use per employee is around 1.4 times larger than their local counterparts. Therefore, the differential becomes very small and turns positively towards local automotive parts supplying enterprises. This energy input per employee differential between international and local automotive parts supplying enterprises is the lowest differential followed by capital, material and labour differentials, respectively. Table 4.10 also indicates

[42] Please footnote 30.

that automotive parts supplying enterprises use around 70% of all electricity in the Turkish automotive industry, while automotive parts supplying enterprises utilise around 59% of all fuel in the automotive industry. Therefore, there is a change in the composition of energy mix between motor vehicle assembling and automotive parts supplying enterprises. There is a tendency for motor vehicle assembling enterprises to use a larger share of their energy as fuel than automotive parts supplying enterprises but electricity is still the first choice for both motor vehicle assembling and automotive parts supplying enterprises, irrespective of their origins. On the other hand, automotive parts supplying enterprises use around 66% of all energy in the Turkish automotive industry.

Table 4.10 also reports output characteristics of international and local automotive parts supplying enterprises in Turkey during the period 2003-2011. On average, international automotive parts supplying enterprises produce around TL 68 million worth of output, while local automotive parts supplying enterprises produce around TL 6.5 million worth of output. This gives rise international automotive parts supplying enterprises to produce about 52% of all output of the supply section of the Turkish automotive industry. On the other hand, labour productivity or output per employee is, on average, less than TL 227 thousand for international automotive parts supplying enterprises, whilst it is around TL 83 thousand for local automotive parts supplying enterprises. Therefore, international automotive parts supplying enterprises' average labour productivity or output per employee is around 2.7 times larger than their local equivalents. This differential is almost the same as its motor vehicle assembly counterpart. On the other hand, the output differential between international and local automotive parts supplying enterprises is smaller in value added terms.[43] On average, international automotive parts supplying enterprises create value added of around TL 34 million, while local automotive parts supplying enterprises generate value added of more than TL 3 million. This results in international automotive parts supplying enterprises generating about 53% of all value added of the supply section. When controlling for employment size, average value added per employee is about TL 89 thousand for international automotive parts supplying enterprises, while it is more than TL 46 thousand for local automotive parts supplying enterprises. Hence, international automotive parts supplying enterprises' value added per employee is around 1.9 times greater than their local counterparts. This figure corresponds to that the value added differential is larger compared to its motor vehicle assembly counterpart by around 0.2 times. Table 4.10 also indicates that automotive parts supplying enterprises generate around 37% of all output in the Turkish automotive industry, while creating around 41% of all value added in the Turkish automotive industry. Furthermore, Table 4.10 reports average total factor productivity differential between international and local automotive parts supplying enterprises.[44] On average, international automotive parts supplying enterprises' total factor productivity is around 1.68 times that of local automotive parts supplying

[43] Please see footnote 31.
[44] Please see Appendix C: Estimation of Production Function at Enterprise Level for lnTFP.

enterprises. As a result, international automotive parts supplying enterprises generate more output and value added, and are more productive than their local counterparts in overall, average and per employee terms.

Three major points can be inferred from Table 4.5 and Table 4.10. First, local automotive parts supplying enterprises constitute a larger place in the supply section of the Turkish automotive industry compared to the place of local motor vehicle assembling enterprises in the assembly section. This pattern is reflected in larger labour, capital, material and energy use, and output and value added generation by local automotive parts supplying enterprises in the supply section compared to use of inputs and output creation by local motor vehicle assembling enterprises in the assembly section. On the other hand, the opposite to this pattern holds for comparison of international automotive parts supplying enterprises with international motor vehicle assembling enterprises. Another related pattern is that even if international automotive parts supplying enterprises are, on average, larger according to almost all indicators than their local counterparts, local automotive parts supplying enterprises overall constitute about half or more of the supply section. This is due to the fact that despite being smaller in size, local automotive parts supplying enterprises are much larger in overall terms than their international equivalents. On the other hand, international motor vehicle assembling enterprises constitute more than 80% of the assembly section in all economic measures. Therefore, while there is not dominant ownership in the supply section, it is enterprises with at least 10% international ownership clearly dominates the assembly section in all economic measures. A second related pattern is that the differentials between international and local automotive parts suppliers are smaller compared to the differentials between international and local motor vehicle assembling enterprises except female worker share, total investment per employee, fuel per employee and value added per employee. Therefore, there is less heterogeneity amongst international and local automotive parts supplying enterprises than the heterogeneity amongst international and local motor vehicle assembling enterprises.

The second major point on Table 4.5 and Table 4.10 is that use of material input and capital machines or equipment by international automotive parts supplying enterprises as proportions in the supply section of the Turkish automotive industry are larger compared to use of labour and energy inputs by local automotive parts supplying enterprises as proportions in the supply section by at least 8 percentage points. Therefore, international automotive parts supplying enterprises are, on average, more material and capital intensive, while local automotive parts supplying enterprises are more labour and energy intensive. This pattern of more use of material inputs and capital machines or equipment by international automotive parts supplying enterprises means that production technology and sourcing structure of international automotive parts supplying enterprises are based more on material inputs and capital machines or equipment compared their local counterparts. In other words, to a certain extent, local automotive parts supplying enterprises relatively rely more on labour and energy in their production structures. This pattern is also observed in the assembly section. On the other hand, in production value terms 52% of all output of the supply section are created by international automotive parts supplying enterprises or in value added terms 53% of all output of the supply section are produced by international automotive parts supplying enterprises. In production value terms, 90% of all output of the assembly section are created by international motor vehicle assembling enterprises or in value added terms 89% of all output of the assembly section are created by international motor vehicle assembling enterprises. Therefore, international and local automotive parts supplying enterprises play almost equal roles in production in the supply section, while production of the assembly section is clearly dominated by enterprises with at least 10% international ownership. Another related pattern to the second point is that the largest item of expenditure is material by a large margin that is followed by labour, capital and energy, respectively in overall, average and per employee terms holding for both automotive parts supplying and motor vehicle assembling enterprises, irrespective of ownership.

The third major point on Table 4.5 and Table 4.10 is that around 71% of all workers in the Turkish automotive industry are employed in the supply section, while the remaining are employed in the assembly section. This pattern is also confirmed in terms of total hours worked. Despite employing around 71% of all workers, automotive parts supplying enterprises incur around 54% of all wages paid in the Turkish automotive industry. Around 53% to 55% of capital stock, total investment and capital machines or equipment investment in the automotive industry are undertaken by the supply section, so less than half of the remaining are made in the assembly section. Around 32% of all material spending in the automotive industry are made in the supply section, while the remaining are made in the assembly section. Therefore, the majority of all material in the automotive industry is used by motor vehicle assembling enterprises. Around 70% of all electricity used in the automotive industry are utilised in the supply section, while the remaining are utilised in the assembly section. Around 59% of all fuel in the automotive industry are also utilised in the supply section, while the remaining are utilised in the assembly section. Therefore, overall electricity use of automotive parts supplying enterprises is smaller by about 11 percentage points compared to overall fuel use of automotive parts supplying enterprises. Nevertheless, around 66% of all energy in the automotive industry are utilised in the supply section, while the remaining are utilised in the assembly section. As a result, it is clear from Table 4.5 and Table 4.10 that motor vehicle assembling enterprises are more material intensive than automotive parts supplying enterprises, while automotive parts supplying enterprises are more labour and energy intensive than motor vehicle assembling enterprises. In addition to this, as capital stock, total investment and capital machines or equipment investment are, to some extent, split half amongst assembly and supply sections of the industry. Therefore, neither sections of the Turkish automotive industry is dominant in capital stock, total investment and capital machines or equipment investment in Turkish automotive industry. Putting these patterns together reveals that the assembly section concentrates on high value added activities in the Turkish automotive industry as motor vehicle assembling enterprises, on average, create much higher value added per employee than automotive parts supplying enterprises and account for around 59% of all value added in the Turkish automotive industry.

Table 4.5 and Table 4.10 also enable comparing international automotive enterprises operating in the assembly section with international enterprises operating in the supply section, and local enterprises operating in the assembly section with local enterprises operating in the supply section. On overall, average and per employee terms, international motor vehicle assembling enterprises spend more on labour, have more capital stock, invest more, make more capital or equipment investment, spend more on material, electricity, fuel and energy, and hence produce more output and create more value added than international automotive parts supplying enterprises despite the fact that international automotive parts supplying enterprises overall employ about 1.1 times more workers than international motor vehicle assembling enterprises. On the other hand, local automotive parts supplying enterprises spend more on labour, have more capital stock, invest more, make more capital or equipment investment, spend more on material, electricity, fuel and energy, and so produce more output and create more value added than local motor vehicle assembling enterprises on overall basis. This pattern is due mainly to the fact that local automotive parts supplying enterprises overall employ around 8.4 times more workers than local motor vehicle assembling enterprises. Nevertheless, on average local motor vehicle assembling enterprises employ more, spend more on labour, have more capital stock, invest more, make more capital or equipment investment, spend more on material, electricity, fuel and energy, and so produce more output and create more value added than local automotive parts supplying enterprises. On per employee terms, local motor vehicle assembling enterprises spend more on labour, have more capital stock, invest more, spend more on material and fuel, and so produce more output and create more value added than local automotive parts supplying enterprises but local motor vehicle assembling enterprises make less capital or equipment investment, electricity and energy expenditures than local automotive parts supplying enterprises. These differentials between local motor vehicle assembling and automotive parts supplying enterprises are much smaller than the differentials between international motor vehicle assembling and automotive parts supplying enterprises (Blalock and Veloso, 2007; Inklaar and Timmer, 2007; Arnold and Javorcik, 2009; Elliott et al., 2013).

Table 4.10 Production Characteristics of Automotive Parts Suppliers

	Time	International		Local		Share of International Enterprises	Share of Suppliers
	Period	Obs	Mean	Obs	Mean		
Inputs	2003-11						
Labour							
Employment (number)		821	378.95	7951	67.55	37	71
ln(employment) (lnEMP)		820	5.16	7859	3.66		
Female worker share		821	17.18	7951	12.07		
Total hours worked (million)		821	0.82	7951	0.15	37	71
ln(total hours worked) (lnL)		820	12.83	7869	11.32		
Labour cost (million of constant TL)		821	8.66	7951	0.92	49	54
Labour cost per employee (thousand of constant TL)		820	21.65	7859	10.69		
ln(labour cost per employee) (lnWAGE)		820	9.89	7859	9.14		
Capital							
Capital stock (million of constant TL)		792	31.75	8112	3.64	46	53
ln(capital stock) (lnK15)		788	16.03	8057	13.57		
Capital stock per employee (thousand of constant TL)		792	80.81	7951	55.02		
Total investment (million of constant TL)		821	5.85	7951	0.62	50	54
Total investment per employee (thousand of constant TL)		820	16.24	7859	7.3		
ln(total investment per employee) (lnTINV)		753	8.7	5756	8.11		
Capital machines or equipment investment (million of constant TL)		821	4.34	7951	0.37	54	55
Capital machines or equipment investment per employee (thousand of constant TL)		820	10.74	7859	4.34		
ln(capital machines or equipment investment per employee) (lnMAC)		736	8.28	5574	7.66		
Material							
Material net (million of constant TL)		810	33.52	7837	3.23	52	32

Continued on the next page

Production Characteristics of Automotive Parts Suppliers (Continued)

	Time Period	International Obs	International Mean	Local Obs	Local Mean	Share of International Enterprises	Share of Suppliers
ln(material net) (lnM)		800	16.45	7219	13.87		
Material net per employee (thousand of constant TL)		810	87.28	7837	47.09		
Energy							
Electricity (million of constant TL)		810	0.45	7837	0.08	38	70
Electricity per employee (thousand of constant TL)		810	1.18	7837	1.1		
Fuel (million of constant TL)		810	0.14	7837	0.04	29	59
Fuel per employee (thousand of constant TL)		810	0.37	7837	0.53		
Energy (million of constant TL)		810	0.6	7837	0.11	36	66
ln(energy) (lnE)		805	12.24	7251	10.42		
Energy per employee (thousand of constant TL)		810	1.56	7837	1.63		
Output	2003-11						
Production value (million of constant TL)		821	68.29	7951	6.54	52	37
ln(production value) (lnY)		821	17.12	7947	14.59		
Labour productivity (thousand of constant TL)		820	226.61	7859	83.12		
ln(labour productivity) (lnLP)		820	11.97	7857	10.98		
Value added (million of constant TL)		810	34.1	7837	3.19	53	41
ln(value added) (lnVA)		796	16.36	7581	13.89		
Value added per employee (thousand of constant TL)		810	88.79	7837	46.49		
ln(total factor productivity) (lnTFP)		727	7.52	6043	7		

Notes: Monetary values are in constant 2003 Turkish lira (TL). Means and shares are rounded. Capital stock is based on a depreciation rate of 15%. Please see Appendix C: Estimation of Production Function at Enterprise Level for lnTFP.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

4.4 Summary

This chapter determined the significance of the Turkish automotive industry in the Turkish manufacturing sector in terms of major economic indicators. This chapter also analysed key economic characteristics of the Turkish automotive industry at motor vehicle assembling and automotive parts supplying enterprise level, whilst considering ownership characteristics of enterprises.

This chapter identified seven particular points on economic characteristics of the Turkish automotive industry and the significance of the Turkish automotive industry in the Turkish manufacturing sector. First, small scaled enterprises of the size of fewer than 20 employees comprise about three quarters of all enterprises in the Turkish automotive industry. Nevertheless, more than 90% of the employment, labour spending, investment and output of the Turkish automotive industry are generated by automotive enterprises having more than 20 employees. Second, the average size of automotive enterprises is much larger than the average size of manufacturing enterprises in Turkey. Third, international ownership in the Turkish automotive industry is one of the highest amongst the Turkish manufacturing industries. Fourth, the Turkish automotive industry is one of the largest importing and exporting manufacturing industries in Turkey and automotive imports and exports form a significant part of Turkey's total imports and exports as presented in section 3.3. Fifth, the Turkish automotive industry is the largest R&D intensive manufacturing industry. It makes up around one third of the Turkish manufacturing sector R&D expenditure and employs around one fifth of the Turkish manufacturing sector R&D workers. Sixth, the Turkish automotive industry is the largest investment intensive manufacturing industry and even this rate becomes larger if only machinery and equipment investment is taken into account. Last, the Turkish automotive industry has a significant place in the Turkish manufacturing sector in terms of employment, labour expenditure and output. The Turkish automotive industry's R&D and labour expenditures per employee, investment and output per employee are also well larger than manufacturing sector average.

There were also five particular points on economic characteristics of automotive enterprises in Turkey during the period 2003-2011. First, international automotive parts supplying enterprises exhibit a higher level of integration into the global automotive industry when import and export characteristics of both international and local automotive parts suppliers are compared (Bernard, Jensen, Redding, et al., 2007; Manova and Zhang, 2009; Bernard, Jensen, Redding, et al., 2012). International motor vehicle assembling enterprises even display a higher level of integration into the global automotive industry compared to international automotive parts supplying enterprises. Second, while none of ownership kinds are clearly dominant in the supply section of the Turkish automotive industry, it is enterprises with at least 10% international ownership clearly prevails over the assembly section of the Turkish automotive industry in all economic terms. Third, international automotive parts supplying enterprises are inclined to utilise, on average, more material and capital machines or equipment, whilst local automotive parts supplying enterprises tend to use more labour and energy in their input mix (Blalock and Veloso, 2007; Inklaar and Timmer, 2007; Arnold and Javorcik, 2009; Elliott et al., 2013). This pattern also holds for the assembly section of the Turkish automotive industry. Fourth, motor vehicle assembling enterprises use the majority of the material, while automotive parts supplying enterprises utilise the majority of the labour and energy. Capital stock, total investment and capital machines or equipment investment are, to some extent, also split half amongst assembly and supply sections of the industry. Furthermore, automotive parts supplying enterprises generate around 41% of all value added created in the Turkish automotive industry. Last, on average international automotive parts supplying enterprises employ more, pay more, have more capital, invest more and in particular on capital machines or equipment, utilise more material and electricity inputs, and so produce more output, generate more value added, and are more productive in both relative and employment size adjusted terms than local automotive parts supplying enterprises, which is also well established in the general literature (Keller, 2004) and case studies (e.g., Yasar and Morrison Paul, 2007). A similar pattern is also observed for the comparison of international and local motor vehicle assembling enterprises. Chapter 6 also conducts econometric analysis on similar considerations.

Chapter 5

Measuring Technological Intensity of Import, Export and Production at Disaggregated Level in the Turkish Automotive Parts Industry

5.1 Introduction

Cross-border trade increasingly becomes larger, while production becomes more fragmented across borders. In this respect, international trade in intermediate goods increases substantially (Feenstra, 1998). This results in more need accurately measuring the extent and sustainability of this increasing cross-border trade in intermediate goods that enables precise assessment of its economic impacts on local economies. One of the ways to assess economic impacts of this increasing cross-border trade in intermediate goods on a specific local economy is to examine the technological intensity of this trade. Being at industry level, current measures of technological intensity cannot capture technological variations amongst items or intermediate goods cross-border traded within an industry. Hence, this creates demand for a measure that accurately gauges technological intensity of various items or intermediate goods within an industry. In this respect, this study develops a more accurate measure of technological intensity for well-defined items within an industry. It proposes patent counts for a well-defined item within an industry as a measure of this item's technological intensity since patent counts for a particular item naturally signal innovations made on that item or intermediate good.

The use of patent counts this study makes is different from previous uses of patent counts as this study utilises patent counts at more disaggregated level, 6-digit HS[1] level. This study tests this patent measure of technological intensity in the Turkish automotive parts industry, one of the most international trade involved industries in Turkey as reported

[1] Please see footnote 11 in chapter 2.

and analysed in chapter 2 and chapter 3. This chapter, in particular, examines the technological intensity of Turkey's automotive parts import, export and production. Being at industry level, previous automotive studies (e.g., Ansal, 1990) appear to be imprecise in their analyses on technological characteristics of the Turkish automotive industry, whereas this study examines the industry at automotive parts level that can provide more precise insights into the technological and economic characteristics of the Turkish automotive parts industry.

Section 3.3 has already examined general economic characteristics of Turkey's cross-border automotive parts trade at "industry" level by utilising UN Comtrade. On the other hand, this chapter investigates technological intensity of Turkey's automotive parts import, export and production at "individual" automotive parts level by using TurkStat's international trade and production datasets.

With the work of Acemoglu, S. Johnson, and Robinson (2001), the level of institutional quality as the determinant of economic performance has recently been paid a great deal of attention. The relation of this literature to this study lies in the amount of significance attached to institutions, namely property rights and contract enforcement institutions. The mechanism through which institutional quality determines production or trade specialisation field is that when investment is relationship-specific, meaning that investment made by a supplier is tailored according to the needs of a buyer. Because this investment is irreversible, the buyer gains ex post bargaining power, then the supplier makes under investment ex ante, which is called hold-up problem (Nunn, 2007). In addition to this, at the presence of low quality institutions, contracts cannot be efficiently enforced, meaning that they are incomplete (Levchenko, 2007). Therefore, inefficient institutions further render hold-up problem deteriorate. As a result, countries with inefficient institutions specialise in the production or trade field where the relationship-specific investment is less intensified. Put it differently, relation-specific investments are under made. Antras (2005) models this setting in an international environment and shows that due to wide-spread incomplete contracts in less developed countries, international transactions of relationship-specific investments are not made in less developed environments until these investments are standardised enough. Nunn (2007) conducts a study on this by creating a variable, which measures the proportion of a good that is based on relationship-specific investment. The author finds evidence that countries with efficient institutions export goods abundantly embodying relationship-specific investments after controlling for both physical capital and skilled labour[2], which Levchenko (2007) terms as "institutional content of trade." Despite approaching from different settings, these studies show the significance of institutional quality for determining why economies specialise in "particular" tasks (Grossman and Rossi-Hansberg, 2008), and hence particular technological fields that is of relevance to this study.

[2]The author also finds automobile and light truck manufacturing industry the most contract intensive one.

By using patent measure of technological intensity, this study finds that higher the technological intensity of an automotive part, larger the import of that automotive part becomes; whereas lower the export of that automotive part becomes in Turkey during the period 2002-2013, while controlling for modularity and macroeconomic shocks. These findings are also robust to cross-section regressions. On the other hand, there is not clear technological intensity concentration on automotive parts produced in Turkey during the period 2005-2012. These findings are, to some extent, consistent with the view that economies with relatively inefficient contract enforcement and property rights institutions specialise in the export and production of items that require less "institutional content" or have lower technological intensity. This study also investigates associations between automotive parts' import, export and production in Turkey and finds that export structure of automotive parts is in line with both import and production structures of automotive parts. In addition to this, production structure of automotive parts is unexpectedly consistent with import structure of automotive parts. This might reflect the recent R&D efforts pursued by motor vehicle assembling and automotive parts supplying enterprises in Turkey that has resulted in technology acquisitions and spillovers as stressed in section 4.2, subsubsection 4.3.1.2 and subsubsection 4.3.2.2. This finding is also to be further investigated in chapter 6.

Section 5.2 develops a measure of technological intensity for automotive parts, namely patent counts, while section 5.3 considers modularisation in the automotive industry. Then, section 5.4 utilises this patent measure of technological intensity along with "engineering cost rating" (ECR) (Monteverde and Teece, 1982) to estimate technological intensity of import, export and production of automotive parts as well as associations between import, export and production of automotive parts in Turkey. Section 5.5 summarises main findings on technological and economic characteristics of Turkey's automotive parts import, export and production.

5.2 Developing a Technological Intensity Measure at Automotive Parts Level

5.2.1 Literature on Measures of Technological Intensity

There appear four main types of approaches to identify technological intensity of automotive parts. The first approach is based on R&D spending (Hatzichronoglou, 1997). The second approach uses export value weighted with gross domestic product (GDP) per capita (Basu and Das, 2011). The third approach is to specify various parts of a product in terms of being under a technological threshold or being over a technological threshold (Foreman-Peck, 1986). The fourth approach is based on ECR (Monteverde and Teece, 1982). This subsection evaluates these four approaches and proposes a new approach measuring technological intensity of automotive parts.

The first type of approach to measure technological intensity is that of Hatzichronoglou (1997). This study uses direct R&D spending made by the sector and indirect R&D spending made on the intermediate and capital goods acquired by the sector from other sectors as a measure of calculating technological intensity. This methodology has been used in subsequent science and technology studies of the OECD (see, for example, OECD, 2005). This calculation is based on data from ten OECD countries[3] for sector level technological intensity and from six OECD countries[4] for product level technological intensity. Hatzichronoglou (1997)'s study determines technological intensity for both sectors and products. The main difference between two categories is the level of aggregation; at sector level it uses 2 to 4-digit industry classification codes, whereas at product level it focuses on 4 to 5-digit industry classification codes. After identifying technological intensity based on R&D spending, Hatzichronoglou (1997) classifies sectors into four categories namely, high-technology, medium-high-technology, medium-low-technology and low-technology. This method provides a global picture of relative technological intensities amongst various sectors. Specifically, Hatzichronoglou (1997) finds the automotive industry overall to be high-technological one when using product approach; however, Hatzichronoglou (1997) finds this industry to be medium-high-technological one when considering sector approach. The source of this inconsistency is not explained in the study. As a result, given the significance of the automotive industry in international trade to determine technological position of an economy, Hatzichronoglou (1997) decides to assess this industry just with the sector approach which means that Hatzichronoglou (1997) excludes the automotive industry from high technology product list.

However, there appear a number of points on the study of Hatzichronoglou (1997). First, not all technological developments are the result of formal R&D activities; some are unsystematically created by SMEs. Hence, these technological developments are not reflected in the R&D spending data on which Hatzichronoglou (1997)'s study is based. Second, the technological intensity measure of Hatzichronoglou (1997)'s study reflects a particular point in time or a period of time since it uses that specific point or period's R&D spending data. Therefore, it does not reflect changes over time. Third, Hatzichronoglou (1997)'s study is based on average R&D expenditure data from ten OECD countries due to availability of relevant data. It is the case that these ten countries are leading economies in R&D activities, and so average R&D expenditure of these countries are not likely to represent R&D expenditure of an average economy that might produce and use technology in different proportions. Hence, there arise questions on validity of technological classifications based on R&D spending of ten OECD countries created by Hatzichronoglou (1997) for technologically diverse economies around the world. Fourth, due to decreases in restrictions on international trade and rises in innovations, an increasing international division of labour has been realizing (Casson, 2012). This results in share

[3]These countries are Australia, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, the UK and the USA, only members of the OECD those having complete data and input-output tables.

[4]These countries are Germany, Italy, Japan, Sweden, the Netherlands and the USA.

of intermediate goods in international trade becoming larger (Feenstra, 1998). Therefore, technological intensity at product level, not at parts level that Hatzichronoglou (1997) proposes does not enable an accurate analysis of this increasing cross-border trade in intermediate goods. As a result, there is a need to go beyond product level and measure technological intensity at intermediate goods level. In contrast to measuring technological intensity at 4 or 5-digit classification level as in the study of Hatzichronoglou (1997), the efforts should be focused on 6-digit classification level at which data increasingly becomes available. Nevertheless, this level of classification is more demanding since there are a great number of items to consider but development of a technological intensity measure at 6-digit level is more accurate in capturing technological variations amongst items that can result in more precise economic analyses of increasing cross-border trade in intermediate goods.

The second type of approach to measure technological intensity is that of Basu and Das (2011). This method is based on export value of products that is weighted with GDP per capita to obtain a ranking of products based on skill and technological intensity. After that, this ranking is divided into six categories namely, non-fuel primary commodities, resource-intensive manufactures, low skill- and technology-intensive manufactures, medium skill- and technology-intensive manufactures, high skill- and technology-intensive manufactures and mineral fuels. This classification has been, to some extent, used by the United Nations Conference on Trade and Development (UNCTAD) (see, for example, UNCTAD, 2013). Basu and Das (2011) refer to Basu (n.d.) for the list of items.[5] This list provides items at 4-digit as well as 6-digit HS level. Skill and technological intensity of just 75 automotive parts related items are provided in the list. 83% of these items are identified as medium skill- and technology-intensive. This appears to be consistent with the findings of Hatzichronoglou (1997), even if Basu and Das (2011)'s study is at more disaggregate level. Basu and Das (2011), for example, find engines and transmissions as much skill and technological intensive as wheels and mufflers, which seems unconvincing. As Basu and Das (2011) report 83% of automotive parts related items to be medium skill- and technology-intensive, their study appears not to capture technological variations across automotive parts related items.

The third type of approach to calculate technological intensity is that of Foreman-Peck (1986). This method classifies automotive parts according to a technological threshold. Automotive parts being over the threshold are technologically intensive, while others below the threshold are less technologically intensive. There appear a number of issues concerning this study. First, it does not provide explicit explanations on how it determines technological or labour intensity of automotive parts. Second, it does not list all automotive parts, it just lists major ones. Last, Foreman-Peck (1986) does not consider automotive parts at disaggregated level, considers it at system level and also categorizes technological

[5] Please see http://www.unctad.info/en/Trade-Analysis-Branch/Data-And-Statistics/Other-Databases/ for a complete list of items.

intensity of automotive parts into two technological classifications, which leads to capturing less technological variations amongst automotive parts. As a result, this method seems to be simple, but not a precise one.

The last type of approach to measure technological intensity is that of Monteverde and Teece (1982). This method is based on engineering cost of developing a particular automotive part for a new automobile. This method relies on rating of 133 automotive parts by a design engineer on a 1 to 10-point scale, with rating 10 being the highest engineering cost to assess the extent of vertical integration in the automotive industry. This method differs from previous methods in a number of ways. First, being on a 10-point scale, this method can capture more technological variations amongst automotive parts than previous three methodologies. Second, former methodologies' technological intensity measures are based on country and sector level data, whereas this methodology's technological intensity measure is based on a design engineer's rating. Third, automotive parts list of this study includes more automotive parts, and hence provides more technological intensity data on automotive parts than previous methods. Fourth, previous methods are based on 2 to 5-digit level classifications; whilst this method is based on a more disaggregated and well defined level, automotive parts level. Last, former methods utilise country level data, which tends to reveal those countries' technological and economic structures rather than technological intensity of automotive parts. However, the design engineer directly assessed technological intensity of automotive parts in Monteverde and Teece (1982)'s method. On the other hand, Monteverde and Teece (1982) do not provide ECR data in their paper. However, Head et al. (2004) present Monteverde and Teece (1982)'s ECR data in their paper in a somewhat different way. Head et al. (2004) have a list of 53 automotive parts. Head et al. (2004) match Monteverde and Teece (1982)'s list of 133 automotive parts with their list of 53 automotive parts meaning that Head et al. (2004) aggregate Monteverde and Teece (1982)'s automotive parts list. After that, Head et al. (2004) average corresponding ECR for a given automotive part when there are multiple parts corresponding to one of the automotive parts listed in their own list.

On the other hand, there might be a few number of issues arising from Monteverde and Teece (1982)'s study. First, since Monteverde and Teece (1982)'s study conducted in early 1980s. It reflects that period's technology, so particular automotive parts have been undergone significant changes, for example airbag or been standard parts, for example climate control, even been redundant, for example carburetor. As a result, the list of Monteverde and Teece (1982) includes particular obsolete automotive parts and excludes currently widely used automotive parts. Second, as noted earlier that Monteverde and Teece (1982)'s technological intensity measure is based on a design engineer's view on engineering cost of developing a particular automotive part for a new automobile for the purpose of investigating vertical integration. This rating might not be widely consistent with another expert's view, so reflects a particular expert's views rather than underlying technological intensity of automotive parts. Therefore, Monteverde and Teece (1982)'s

ECR might not be highly accurate to provide a measure of technological intensity of automotive parts. Third, Head et al. (2004) aggregate Monteverde and Teece (1982)'s automotive parts list, then they average different automotive parts' ECR, which might mean combining different technologies together. Averaging different technologies is likely to result in aggregating technological variations of respective automotive parts, thereby losing accuracy. Last, around 40% of ECR data on automotive parts is missing, which might create biases.

There are a number of general points arising from these four approaches. First, these four approaches do not clearly explain their data generating processes and sources of their data. Second, being at sector level and confined to narrow technological classifications, these approaches appear not to capture technological variations amongst automotive parts, and hence become imprecise in their measurement of technological intensity of automotive parts. Third, confined to an expert opinion or based on data from particular OECD countries for particular time periods because of availability of relevant data, these approaches might not provide accurate analyses of technological sophistication of automotive parts. When one considers the highly fragmented nature of global production system, and hence increasing number of intermediate goods and expanding international trade in intermediate goods, the demand for a measure of technological intensity at disaggregated level, 6-digit HS level appears. As explained earlier, current approaches seem not to meet this demand. Therefore, there should be an accurate measure that reveals how much various parts of a product embodies technology resulting in more precise economic analyses of increasing cross-border trade in intermediate goods.

Patent statistics can, to a large extent, circumvent the above-mentioned problems of the four approaches. Number of total patents for a particular automotive part can be a good proxy to measure technological or knowledge intensity of that automotive part since it seems to signal the amount of innovations made on that automotive part, in other words it might reveal frequency of innovations made on that automotive part. As a result, patent counts for automotive parts can, to a large extent, capture technological variations amongst automotive parts, which would provide one to accurately demonstrate technological intensity of automotive parts. For example, linking patent statistics of automotive parts with international trade and production statistics of automotive parts can enable one to precisely analyse the technological concentration fields of an economy in the automotive industry that is to be investigated in section 5.4 for the Turkish automotive parts industry.

There is a growing literature that uses patent statistics as economic indicators for technological change across various countries as well as sectors over time (Griliches, 1998). There are also studies that use patent statistics for different purposes other than technological change: use of patent statistics to show the internationalization of R&D activities of multinational enterprises (Cantwell, 1995), university patenting trends (Henderson et al., 1998) and particular gravity models utilising patent statistics to explain the trade flows between countries (Lybbert and Zolas, 2014). As a result, there are diverse uses of patent statistics. These studies mainly concern across countries and industries. They are highly aggregated, at 2 to 4-digit level and so they disregard variations within industries and between economies. Therefore, these studies cannot, in a great extent, capture technological variations within industries and across economies. On the other hand, this study focuses on a major developing country's one of the most significant industries, the Turkish automotive parts industry at 6-digit HS level enabling more accurate economic analyses.

On the other hand, patent statistics has drawbacks. First, not all inventions are patented; some are kept secret (J. Acs and Audretsch, 1989). Hence, patent statistics might not represent all innovations in a particular filed. Second, not all patented inventions are used, so they might not represent the practice. Third, patents differ in value. Some patents have little or no value, while others have very high value (J. Acs and Audretsch, 1989). However, there are measures developed to tackle a large extent of these drawbacks. First, using number of technical claims and number of citations made by a patent reveal how original the invention is, compared to previous inventions in the same field (Pottelsberghe et al., 2001). Second, number of citations received by a patent indicates how general this invention is (Pottelsberghe et al., 2001). Third, measure is to use "patent family." Patents provide protection in a specific country or region where they are applied. In order to extend this protection in other locations, invention owners are required to apply to the countries, which shows the marketability of their inventions in these countries, and so are the value of these inventions. In particular, patent family is the case when a patent applicant files applications to at least three patent offices that are the United States Patent and Trademark Office (USPTO), the Japan Patent Office (JPO) and one of the members of the European Patent Office (EPO) or the EPO itself to extend the protection for its invention (Pottelsberghe et al., 2001). As a result, number of claims, number of citations made, number of citations received and patent family are important measures to surmount the drawbacks of patent statistics.

This study is different from previous patent statistics related studies using flows of patents at "industry" level. This stems from that this study utilises patent stocks or patent counts for a particular period of time within an industry at "automotive parts" level. This approach enables a finer level of disaggregation that can provide more precise insights into an industry. Another difference of this study is that it uses patent counts capturing more technological variations amongst automotive parts to identify technological intensity of automotive parts, which seems to be a more accurate and disaggregated measure compared to other four measures, namely R&D spending, export value weighted with GDP per capita, technological threshold and ECR explained earlier.

As a result, patent counts for automotive parts might enable one to more accurately document variations in technological intensity amongst automotive parts, which can be combined with international trade and production statistics to precisely analyse the automotive industry at disaggregated or automotive parts level that this study is to undertake in section 5.4.

5.2.2 Data Sources of Measures of Technological Intensity

This study uses ECR of Monteverde and Teece (1982) as a benchmark to assess the extent of patent counts to qualify for a measure of technological or knowledge intensity of automotive parts. As noted earlier that Monteverde and Teece (1982) do not report ECR data in their paper. However, a modified version of ECR data is reported in Head et al. (2004)'s paper. This modification is because of the fact that Monteverde and Teece (1982)'s list of automotive parts contains 133 automotive items, whereas Head et al. (2004)'s list of automotive parts contains 53 automotive items. Therefore, Head et al. (2004) adjust Monteverde and Teece (1982)'s ECR data according to their list of automotive parts. Head et al. (2004) combine some automotive parts in the list of Monteverde and Teece (1982) into one category as their list includes fewer automotive parts than Monteverde and Teece (1982)'s list, and then they average these multiple automotive parts' ECR data to obtain a single ECR data for a particular automotive part category. Therefore, in contrast to original data of Monteverde and Teece (1982), Head et al. (2004)'s data additionally includes one decimal place. As a result, this study follows ECR data, and hence classification of automotive parts of Head et al. (2004), which closely follow structure of 6-digit HS.

This study constructs a list of automotive items from three sources, namely European Commission (2009), Office of Transportation and Machinery U.S. Department of Commerce (2011) and Republic of Turkey Ministry of Economy (2012). These sources reflect their local considerations, so there are variations on the number of digits employed by these three sources but at 6-digit HS level, they are highly similar. After obtaining automotive lists from these three sources, this study thoroughly examines and harmonises these three lists to establish a comprehensive and accurate list of automotive items.[6] During the process of establishing this list of automotive items, special attention was paid to obtain HS codes which are directly related to the automotive industry. In cases where HS items are of general use, in other words use in the automotive industry cannot be distinguished from uses in other industries, then these HS items were not considered in this study, for example CD-cassette players. However, these cases were extreme. Appendix D: Table D.4 includes 6-digit HS codes and their descriptions, and corresponding Prodcom[7] codes specific to

[6] Please see Appendix D: Table D.4 for a list of automotive items with classification codes and their descriptions.

[7] The Community Production, abbreviated as Prodcom, "is a survey for the collection and dissemination of statistics on the production of industrial (mainly manufactured) goods, in both value and quantity terms, in the EU."

the automotive industry. There are 108 6-digit HS codes on automotive parts in this list excluding motor vehicles.[8]

Head et al. (2004)'s classification of automotive parts overall comply with HS codes but there are differences. First, Head et al. (2004) combine a number of HS codes under the same category. They, for example, aggregate HS codes of tires of motor cars, buses, lorries, agricultural or forestry vehicles, and of different sizes to create a category called "tires." Second, there are nine categories of automotive parts (inner tubes, compressors for refrigeration equipment, bearings and their parts, magnetos, electrical ignition or starting equipment, sealed beam lamp units, tungsten halogen filament lamps, airbag, speed indicators and their parts) presented in the HS codes list but not reported in Head et al. (2004). Third, ECR data on eight categories of automotive parts is missing in Head et al. (2004)'s list. Fourth, there are eleven categories of automotive parts, for example distributors and ignition coils which are listed separately in Head et al. (2004) but they are not separated in the list of HS codes. Fifth, there are seven categories of automotive parts with ten 6-digit HS codes[9] those are described as parts, other parts, not elsewhere classified (n.e.c.), not elsewhere specified (n.e.s.) or in general use. Therefore, HS descriptions of these automotive parts categories do not provide specific information about the characteristics of automotive parts or they are highly in general use. Hence, it is not possible to construct patent search terms for these automotive parts categories, and so these categories are not considered for patent statistics. Similarly, there is not also ECR data on these automotive parts categories reported by Head et al. (2004). As a result, the automotive items list of HS codes on which this study is based does not exactly match the automotive items list of Head et al. (2004).

With some variations, a typical patent document[10] includes a title, abstract, designated state(s), description, inventor's name(s) and address(es) and patent owner's name(s) and address(es), application date, application number, previous applications to other patent offices, publication date, claim(s), citation(s), technological classification codes... (OECD, 2009b). All of this information can be exploited to gain insights into technological and economic characteristics of automotive parts. As proposed earlier, patent counts for a particular automotive part might be a good proxy for measuring technological intensity or complexity/sophistication of that particular automotive part. In addition to this, patent counts for a particular automotive part can be linked with international trade and production statistics of that particular automotive part to thoroughly study the automotive industry at automotive parts level. This exercise is not directly possible because of the fact that classification codes of patents are based on technological concepts, whereas international trade and production statistics are based on economic product concepts (B. H. Hall et al.,

[8]Please note that there are also 28 6-digit HS codes in Appendix D: Table D.4 specific to motor vehicles resulting in 136 6-digit HS codes related to the automotive industry.

[9]These codes are 851190, 851290, 860900, 870829, 870899, 871610, 871631, 871639, 871640 and 871690. Please see Appendix D: Table D.4 for description of these codes.

[10]Please see Appendix F: Figure F.2 for a typical patent document for tire.

2001). Therefore, there is not a direct concordance table linking patent classification codes to international trade and production classification codes despite the fact that concordance table between international trade and production classification codes are available at highly disaggregated level.

On the other hand, there are a number of studies trying to create a concordance table between economic activity and patent classification codes (Lybbert and Zolas, 2014). First, the USPTO established a concordance table between its own patent classification codes and the US Standard Industrial Classification Codes at 3 and 4-digit level but this concordance is aggregate, providing conversion at industry level. Therefore, this concordance is not particularly relevant for within industry or disaggregated level studies since it aggregates technologically highly different automotive parts. Second, the Canadian Intellectual Property Office (CIPO) initiated a project to establish a concordance table for patents. This project focused on a sample of patents those are assigned individually to a particular Canadian Standard Industrial Classification code by patent experts. Hence, the CIPO created a concordance table for patents but it is a one-time exercise and again it is highly aggregate, at industry level. There are also studies on technology concordance that departed from the same idea as the USPTO and CIPO: Merit (Verspagen et al., 1994), Yale (Kortum and Putnam, 1997), the OECD (D. K. N. Johnson, 2002) and the European Commission (Schmoch et al., 2003). As a result, these studies have attempted to establish concordance tables between economic activity and patent classification codes but these studies' concordance tables are at industry level, so they are not particularly useful to capture technological variations within an industry. In contrast to previous studies, Lybbert and Zolas (2014) devised a different method to establish a concordance table between economic activity and patent classification codes.

The underlying idea of the study of Lybbert and Zolas (2014) is that they leverage descriptions of economic activity codes to extract keywords, and then expand these keywords and search these obtained keywords in the title and abstract of patent documents to retrieve relevant patents, and hence relevant patent classification codes. In this way, they construct a concordance table between economic activity and patent classification codes. However, their concordance tables are not at disaggregated level. They mainly use SITC[11] Rev. 4 codes, which are very aggregated compared to 6-digit HS codes. For example, 7843 (STIC Rev. 4 code) other parts and accessories of the motor vehicles of groups 722, 781, 782 and 783 (corresponding STIC Rev. 4 description) corresponds to twelve different 6-digit HS codes those are technologically highly varied automotive parts (transmissions, safety belts, wheels...). Therefore, STIC Rev. 4 that Lybbert and Zolas (2014) use neutralises the technological variations amongst automotive parts. In other words, STIC codes that Lybbert and Zolas (2014) use to construct a concordance table for

[11]The Standard International Trade Classification, abbreviated as STIC, "is a product classification of the UN used for external trade (export and import values and volumes of goods), allowing for international comparisons of commodities and manufactured goods."

IPC[12] codes cover highly varied HS codes. As a result, using more disaggregated level, 6-digit HS codes can capture more technological variations than using 4-digit STIC Rev. 4 codes. This study will make use of Lybbert and Zolas (2014)'s method but it will use more disaggregated level, 6-digit HS codes and additional restricting search terms to obtain more relevant patents resulting in capturing more technological variations amongst automotive parts, and hence more accurate analyses of technological and economic characteristics of the automotive parts industry.

Patent statistics will be obtained from WIPO's publicly available PATENTSCOPE database. The WIPO is one of agencies' of the UN working on the protection and promotion of intellectual property around the world. PATENTSCOPE is a search interface and database proving search and access to 32.5 million patent documents that includes 2.2 million published International Patent Applications under the Patent Cooperation Treaty (PCT).

5.2.3 Methodology of a New Technological Intensity Measure

Patent classification codes are constructed in terms of technological considerations and they are at disaggregated level, whereas HS codes are constructed more in terms of functional and physical considerations and they are at less disaggregated level. Therefore, patent classification codes do not directly correspond to HS codes or vice versa, and so it is challenging to match patent classification codes with HS codes as explained earlier. This study attempts to match these two different classifications by constructing patent search terms similar to that of constructing search terms for literature reviews but patent search terms additionally incorporate patent classification codes.

Similar to the study of Lybbert and Zolas (2014), this study firstly extracts keywords from descriptions of relevant 6-digit HS codes and from descriptions of corresponding Prodcom codes. After extracting keywords from HS and Prodcom descriptions, this study secondly benefits from technical automotive literature, mostly automotive dictionaries, technical automotive books and encyclopaedia (Lane, 2002; Hillier and Coombes, 2004; Erjavec, 2009; Encyclopaedia Britannica, 2013), which provides a thorough knowledge of automotive parts that enables one to conduct better searches. Then, this study thirdly obtains synonyms of the keywords from WIPO's PATENTSCOPE Cross Lingual Expansion Tool,[13] then it inserts the underlying relevant keyword(s) for the corresponding HS and Prodcom codes to WIPO's IPC Terms Search Tool,[14] which enables one to lastly find

[12]The International Patent Classification, abbreviated as IPC, "provides for a hierarchical system of language independent symbols for the classification of patents and utility models according to the different areas of technology to which they pertain." IPC is maintained by the WIPO.

[13]This tool retrieves synonyms directly from patent documents. Please see http://patentscope.wipo.int/search/clir/clir.jsp?interfaceLanguage=en to access the tool.

[14]Please see http://web2.wipo.int/ipcpub/#version=20130101&lang=en&refresh=page&notion=scheme to access the IPC Terms Search Tool.

relevant IPC codes and further examination of descriptions of retrieved IPC codes are also made since not all of the retrieved IPC codes are relevant.

Relevant IPC codes for a particular automotive part obtained from WIPO's IPC Terms Search Tool are compared with IPC codes suggested by three sources namely, The Thomson Corporation (2006), Lybbert and Zolas (2014) and WIPO's directory of vehicle parts[15] to confirm that any relevant IPC codes are not left out. The Thomson Corporation (2006) proposes a classification called Derwent World Patents Index (DWPI) suggesting IPC codes for various industries including the automotive industry. Despite being aggregate and so imprecise for the automotive industry, The Thomson Corporation (2006)'s suggestions for IPC code(s) for automotive parts are consistent with this study's IPC code(s) for automotive parts. Lybbert and Zolas (2014)'s study is based on aggregated economic classifications, so is their concordance table between economic activity and patent classification codes. Therefore, Lybbert and Zolas (2014)'s suggestions of IPC code(s) for the automotive industry become aggregate, their IPC code(s) suggestions cannot capture technological variations amongst automotive parts. However, a general comparison between this study's IPC code(s) and Lybbert and Zolas (2014)'s IPC code(s) were made for the automotive industry. They are consistent with each other at aggregated classification levels but Lybbert and Zolas (2014)'s suggested IPC code(s) cannot distinguish between technologically highly varied automotive parts. The WIPO has a directory of vehicle parts which lists various automotive parts and their corresponding IPC codes. Comparisons between IPC codes derived from WIPO's directory of vehicle parts and this study's IPC codes were carried out, which revealed the consistency between IPC codes of WIPO's directory of vehicle parts and this study. As a result, IPC code(s) for a particular automotive part incorporated in patent search are confirmed by these three sources.

As a result, descriptions and codes of relevant IPC, HS and Prodcom, and hence keywords and their synonyms for automotive parts are obtained. Alternative spellings, plural forms, root words are also obtained. Furthermore, terms having general and multiple meaning, and irrelevant terms are excluded. These steps would ensure retrieval of patents that is relevant to the individual HS and Prodcom code, so is the individual automotive part category. However, this approach has limitations since there is not an exact match between HS codes and IPC[16] codes since HS corresponds to economic activities, whereas IPC corresponds to technological activities. However, additional keywords can, to a large extent, circumvent limitations.

After conducting the steps explained earlier to obtain patent counts for a particular automotive part, there appear nine components of a patent search specification.[17] The first component (e.g., ALL:("Motor* Vehic*" OR Motorvehicle* OR "Road* Vehic*" OR

[15] Please see http://web2.wipo.int/ipcpub/#&notion=cw&initial=V&cw=VEHICLE&refresh=page/ to access this directory.

[16] This study uses IPC's 2013.01 version but there are minor differences between versions of IPC.

[17] Please see, for example, ALL:("Motor* Vehic*" OR Motorvehicle* OR "Road* Vehic*" OR Roadvehicle* OR Automotiv* OR Automobil* OR Car OR Cars OR "Motor* Car*" OR Motorcar* OR "Auto* car*" OR Autocar*) AND IC:("B60C" OR "B29D 30/00") AND CL:(Tire OR Tires OR Tyre OR Tyres) AND

Roadvehicle* OR Automotiv* OR Automobil* OR Car OR Cars OR "Motor* Car*" OR Motorcar* OR "Auto* car*" OR Autocar*)) restricts the search to the automotive industry and disregards irrelevant industries. This component is standard for every patent search executed.

The second component (e.g., AND IC:("B60C" OR "B29D 30/00")) constrains the search to relevant IPC codes, which is obtained via the IPC Terms Search Tool as explained earlier. This ensures hitting relevant patent codes, and hence obtaining relevant patents for a particular automotive part. This component depends on the specific automotive part, so it varies across automotive parts.

The third, fourth and fifth components (e.g., AND CL:(Tire OR Tires OR Tyre OR Tyres) AND AB:(Tire OR Tires OR Tyre OR Tyres) AND TI:(Tire OR Tires OR Tyre OR Tyres)) specifically describes the automotive part that is obtained from the corresponding HS and Prodcom descriptions. These components simultaneously search keywords in claims (CL:(Tire OR Tires OR Tyre OR Tyres)), abstract (AB:(Tire OR Tires OR Tyre OR Tyres)) and title (TI:(Tire OR Tires OR Tyre OR Tyres)) sections of patent documents, which results in focusing more on relevant patents, thereby increasing accuracy of patent searches. These components involve alternative spellings, plural forms and root words obtained from technical automotive literature and WIPO's PATENTSCOPE Cross Lingual Expansion Tool, and they also exclude terms having general and multiple meaning to avoid hitting irrelevant patents. These components are specific to each individual automotive part.

The sixth component (e.g., AND PD:[01.01.2002 TO 31.12.2002]) restricts the search to a particular time period which is one year in this case. In particular, this term restricts the patent search to patent rights' commencement period e.g., from 01.01.2002 to 31.12.2002, which looks for patents whose protection rights commenced within 2002. This component changes according to the time period considered. As a result, this component enables the search to select innovations made on a particular automotive part during a particular time period.

The seventh component (Office(s):all) enables one to restrict the search to specific patent office(s) to which a patent application is made. This office can be a national office or regional office. Alternatively, all offices can be selected. This study selects all offices option to access the largest possible patent pool, thereby having a wide coverage. This term is the same for all searches.

The eighth component (Language:EN) specifies the language that is used throughout all search components. The language of patent search components is English. This component is standard for each patent search.

AB:(Tire OR Tires OR Tyre OR Tyres) AND TI:(Tire OR Tires OR Tyre OR Tyres) AND PD:[01.01.2002 TO 31.12.2002] Office(s):all Language:EN Stemming:true.

The last component (Stemming: true) asks whether to use root forms of search terms or not. This study uses root forms of search terms to have a wide coverage of patents. This component is the same for each patent search.

There appear a number of points arising. First, not all innovations are patented meaning that they are not disclosed, so they do not appear in patent statistics. Second, not all patents have the same value, some patents are more valuable than others, and even some patents might have no use or value at all. Therefore, patent statistics might not, to some extent, reflect the practice. Third, some parts (e.g., magnetos) are not in use or not in extensive use but they are still listed in HS, so HS itself does not accurately reflect economic transactions. Fourth, despite high level of innovation for a particular automotive part, the latest technologies might not be currently used in the production of that specific automotive part, so does that specific automotive part not embody the latest technology; old technologies might be still in use. For example, seats of some car models or car brands might not include the latest innovations. Fifth, there are high variations between segments, brands and models as to what kind of specifications to include in design and production of motor vehicles. These specifications are based mainly on engine types (gasoline engines vs. diesel engines), engine volumes, transmission types (automatic gears vs. manual gears), and climate control types. Therefore, there is a high level of specification varieties amongst motor vehicles, and so do the technology they use. Sixth, it is the case that motor vehicles are increasingly becoming more computerized. They involve control management systems, in particular, sensors in various automotive parts to increase security, comfort, efficiency and performance of motor vehicles, which has implications for automotive parts' technologies, and hence classifications of automotive parts. Last, examination of some patent documents shows that patents tend to have more than one classification code meaning that they are attached to various technologies simultaneously, and hence they have extensive uses in various industries other than just in one industry. For example, an innovation on diesel engine might be applied not only in the automotive industry but also in other industries. Therefore, this study used the restriction term, namely ALL:("Motor* Vehic*" OR Motorvehicle* OR "Road* Vehic*" OR Roadvehicle* OR Automotiv* OR Automobil* OR Car OR Cars OR "Motor* Car*" OR Motorcar* OR "Auto* car*" OR Autocar*), to a large extent, to retrieve innovations directly used in the automotive industry.

5.2.4 Comparison of Different Measures of Technological Intensity

Having all information related to an individual automotive item enables one to construct patent search terms and obtain patent statistics on this particular automotive item. This study used WIPO's publicly available PATENTSCOPE database.[18] All information ob-

[18]Please see http://patentscope.wipo.int/search/en/structuredSearch.jsf to access WIPO's PATENTSCOPE database.

tained related to an individual 6-digit HS code item is inserted to PATENTSCOPE's Advanced Search Tool[19] to obtain relevant patent statistics.[20]

There are fifty-six categories of automotive parts for which patent search terms are constructed. These automotive parts' categorizations are based on HS and Prodcom, and Head et al. (2004). Patent hits for automotive parts vary from no hits to 3-digit number hits. Automotive parts having the most patent hits are engines, transmissions, engine parts and diesel fuel injectors, brakes, airbag, tires, steering, and seats and seat parts and furniture parts, respectively with varying hits. On the other hand, automotive parts having the least patent counts are magnetos, wiring sets, sealed beam lamp units, inner tubes, rubber mechanical articles, electrical ignition or starting equipment, meters, and compressors for refrigeration equipment, respectively.

As seen from Table 5.1, correlations between different patent search specifications[21] and ECR are all positive and significant at 1% level and the magnitude of these correlations vary from 0.3737 to 0.4635. Correlations are moderate in magnitude. In this respect, the correlation between patent counts and ECR appears not to be strong. Despite being the most appropriate benchmark in the sense that it is the only measure at automotive parts level, ECR of Monteverde and Teece (1982) is devised to measure the extent of vertical integration in the automotive industry. On the other hand, patent counts for a particular automotive part signal the level of innovations carried on that particular automotive part. It is also very likely that developing a particular automotive part from scratch might be high in cost once it is standardised meaning it is not subject to significant innovations, thereby having fewer number of patents, whereas an automotive part having a low development cost meaning it has small engineering cost might have undergone significant innovations corresponding to higher number of patents.

As Table 5.1 suggests moderate correlations between ECR and patent counts, ECR measure of technological intensity constructed by Monteverde and Teece (1982) appears not to be very compatible with patent counts measure of technological intensity proposed by this study. This is mainly because of the fact that this study uses a highly different method and departs from a highly different idea claiming that patent counts can be a proxy for measuring technological intensity of a particular automotive part. There are a number of methodological differences between ECR and patent counts. First, ECR is based on a design expert's view, while technological intensity measure of this study is based on patent counts of a particular automotive part. Second, ECR ranges from one to ten, whereas patent counts vary between no hits to 3-digit number hits, so the scales of these measurements are significantly different from one another. Third, there are high variations amongst patent counts for automotive parts; on the other hand, there are not high variations amongst ECR of automotive parts. Last, ECR was constructed in early 1980s; hence, it might not reflect

[19]Please see http://patentscope.wipo.int/search/en/advancedSearch.jsf to access PATENTSCOPE's Advanced Search Tool.

[20]Please see Appendix F: Figure F.3 for an example patent search for tires.

[21]These patent search specifications are ordered from the least selective to the most selective in Table 5.1.

the current technological situation, when constant innovations in the automotive industry is considered. On the other hand, time period of patent searches for automotive parts can be adjusted according a specific purpose.

Table 5.1 Correlations amongst Different Measures of Technological Intensity

Patent Count Search Specifications	ECR (Engineering Cost Rating)
No Restriction	0.4383*** [408]
All Patents: 01.01.00-31.12.12	0.4204*** [408]
Searched Title, Abstract and Claims	0.4058*** [408]
Searched Title, Abstract and Claims: 01.01.00-31.12.12	0.4635*** [408]
Searched Title, Abstract and Claims: 01.01.02-31.12.13	0.4199*** [408]
Searched Title, Abstract and Claims by Year (PATCOSTAC)	0.3737*** [408]

Notes: (1) First rows are correlation coefficients and number of observations are indicated in brackets. (2) *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.

Source: The WIPO and Monteverde and Teece (1982)

The main difference between the ideas of ECR and patent counts can be based on the fact that a particular automotive part might be simple or less in engineering cost having low ECR but it may be still undergo continuous innovation because of the following reasons: rules and regulations related to health, safety and environment in particular emissions reductions, fuel efficiency, developments on comfort related automotive parts e.g., seats, design of model or brand specific parts e.g., bumpers, improving performance, gaining cost efficiency in production, functionality, reliability, simplification and durability. Therefore, even if a particular automotive part is simple or less in engineering cost having low ECR, it might involve a significant amount of innovation depending on reasons specific to the individual automotive part. Therefore, there is not a strong correlation between the intensity of innovation for a particular automotive part measured as patent hits and engineering cost of that particular automotive part corresponding ECR. As a result, the intensity of innovation for a particular automotive part might not be merely driven by the engineering cost of that part.

5.3 Modularisation in the Automotive Industry

Motor vehicles consist of assembly of interrelated and complementary automotive parts which is called "system" (Monteverde and Teece, 1982) or "module" (C. Y. Baldwin and Clark, 1997). It is the recent trend that motor vehicle assembling enterprises have heavily involved in the procurement of modular systems rather than the procurement of individual automotive parts (Doran, 2004; Doran et al., 2007). It would be misleading not to consider this increasingly widespread trend. Hence, this study takes into account this trend. However, there is not a standard categorization of automotive parts by systems or modules since modularization is a dynamic process, so it evolves over time. The literature on modularization is also mostly based on case studies focusing on particular modules mostly the cockpit module and seating (Doran, 2004; Doran et al., 2007; Kane and Trimble, 2009; M. D. Johnson and Kirchain, 2011). As a result, practices of categorization of automotive parts by systems or modules vary, so there is not a standard list of modules of motor vehicles and corresponding specific automotive parts that modules embody. Nevertheless, Monteverde and Teece (1982) provide a system categorization. This study adapts this list and creates seven individual categories[22]: first, body, fuel tank or cap including fourteen categories of automotive parts; second, engine or emissions consisting of sixteen categories of automotive parts; third, chassis, transmission and steering including twelve categories of automotive parts; fourth, ventilation consisting of two categories of automotive parts; fifth, electrical including nine categories of automotive parts; sixth, rubber consisting of four categories of automotive parts; seventh, other parts including six categories of automotive parts. Hence, there are sixty-three categories of automotive parts in total which are assigned to seven individual modules or groups.

There are a number of points that should be made on modularisation. First, system or module categorizations appear not to be very definite, one part can be included in more than one categorization, for example transmission can be categorized in chassis or engine systems, so there is not a clear boundary between systems or modules. Second, HS and Prodcom already reflect, to some degree, system or modularization since automotive parts are ordered and then coded according to their "relatedness." Third, each system categorization can incorporate automotive parts those are highly varied in terms of technology, so it does not have an absolute control over technological variations amongst systems or modules. Last, certain automotive parts are already aggregated, for example engine incorporates several distinct parts including cam/crankshafts that is also separately listed as an individual automotive part. Therefore, a patent search for engine includes other engine parts as well as cam/crankshafts, whereas a patent search for cam/crankshaft retrieves cam/crankshaft related patents.

[22] Please see footnote 25.

5.4 Automotive Parts Level Technological and Economic Analyses

5.4.1 Automotive Parts Level Specifications

This subsection attempts to measure the technological intensity of automotive parts' import, export and production in Turkey during the period 2002-2013 by employing the technological intensity measure developed in section 5.2. This subsection also investigates associations between import, export and production of automotive parts in Turkey during the same period, which the following four sets of equations will enable this study to investigate.

Appendix D: Table D.3 lists automotive parts level variables, their descriptions and sources. It should be noted first that when production value is used in the regressions, values of import and export are employed in TL since production value is only reported in TL. Second, international trade data covers the period 2002-2013, while production data is only for the period 2005-2012.

$$\begin{aligned} ln(IMPV)_{it} = \lambda_0 + \beta_{patentc} PATENTC_{it} + \beta_{ecr} ECR_i + \beta_{expv} ln(EXPV)_{it} \\ + \sum_{gr=1}^{GR-1} \beta_{gr} GROUP_{gr} + \sum_{q=1}^{Q-1} \beta_q YEAR_q + \alpha_i + \varepsilon_{it} \end{aligned} \tag{5.1}$$

$$\begin{aligned} ln(EXPV)_{it} = \eta_0 + \beta_{patentc} PATENTC_{it} + \beta_{ecr} ECR_i + \beta_{impv} ln(IMPV)_{it} \\ + \sum_{gr=1}^{GR-1} \beta_{gr} GROUP_{gr} + \sum_{q=1}^{Q-1} \beta_q YEAR_q + \alpha_i + \varepsilon_{it} \end{aligned} \tag{5.2}$$

$$\begin{aligned} ln(PRODV)_{it} = \omega_0 + \beta_{patentc} PATENTC_{it} + \beta_{ecr} ECR_i + \beta_{impv} ln(IMPV)_{it} \\ + \sum_{gr=1}^{GR-1} \beta_{gr} GROUP_{gr} + \sum_{q=1}^{Q-1} \beta_q YEAR_q + \alpha_i + \varepsilon_{it} \end{aligned} \tag{5.3}$$

$$\begin{aligned} ln(PRODV)_{it} = \varphi_0 + \beta_{patentc} PATENTC_{it} + \beta_{ecr} ECR_i + \beta_{expv} ln(EXPV)_{it} \\ + \sum_{gr=1}^{GR-1} \beta_{gr} GROUP_{gr} + \sum_{q=1}^{Q-1} \beta_q YEAR_q + \alpha_i + \varepsilon_{it} \end{aligned} \tag{5.4}$$

$ln(IMPV)_{it}$ and $ln(EXPV)_{it}$ are respectively natural logarithms of import and export values[23] for automotive part i at time t and they are obtained by aggregation of international

[23] Data on international trade is based on the Foreign Trade Statistics Dataset of the TurkStat. Please see Appendix A: Data Sources for detail.

trade transactions data of automotive part i at time t. $ln(PRODV)_{it}$ is the natural logarithm of production value[24] for automotive part i at time t and it is obtained by summing up enterprise level Prodcom data of automotive part i at time t. $PATENTC_{it}$ indicates patent counts for automotive part i at time t developed by this study and data for this measure of technological intensity is obtained from WIPO's publicly available PATENTSCOPE database. Section 5.2 explains how this measure is obtained in detail. Another measure of technological intensity is ECR_i that is the engineering cost rating for automotive part i developed by Monteverde and Teece (1982). Engineering cost rating is engineering cost of developing a particular automotive part for a new automobile that is rated by a design engineer on a 1 to 10-point scale with rating 10 being the highest engineering cost. Section 5.2 explains this measure in detail. $GROUP_{gr}$ indicates group dummies[25] that unite "interrelated" automotive parts together and is included to take into account modularity adapted from Monteverde and Teece (1982). Section 5.3 explains modularisation in detail. $YEAR_q$ represents year dummies included to control for macroeconomic shocks. The first year of the respective data is the base. α_i captures the unobserved, time-invariant characteristics of automotive part i, and ε_{it} is a random error term. Estimating Equation 5.1, Equation 5.2, Equation 5.3 and Equation 5.4 by pooled ordinary least squares (OLS) implicitly assumes that α_i is zero, and hence is uncorrelated with explanatory variables. Therefore, this unobserved individual effect would enter into the error term. Coefficients would be biased, in particular upward biased. Hence, the use of a fixed effects (FE) model would overcome this issue since a FE model assumes correlation between the explanatory variables and the unobserved individual effect. This study also estimates these equations with a random effects (RE) model that assumes that none of the explanatory variables are correlated with the unobserved individual effect, so the individual effect is involved in the error term, which is the same as the pooled OLS model. However, the difference is that an RE model uses generalized least squares (GLS), and hence it will be more efficient than the pooled OLS model (Hausman and Taylor, 1981; Baltagi, 2005; Wooldridge, 2010).

Due to inefficient contract enforcement and property rights institutions (Acemoglu and S. Johnson, 2005), it is expected that lower the technological intensity of a particular automotive part, higher the production and export of that automotive part becomes in Turkey, meaning that $PATENTC$'s sign in export and production specifications is expected to be negative. While, higher the technological intensity of a particular automotive part, greater the import of that automotive part becomes in Turkey, meaning that $PATENTC$'s sign in import specification is expected to be positive.

[24]Data on production is based on the Annual Industrial Products (Prodcom) Statistics Dataset of the TurkStat. Please see Appendix A: Data Sources for detail.

[25]There are seven groups in total but there are six dummy variables created, and hence "body, fuel tank or cap" is the base group. Please see Appendix D: Table D.4 for a list of automotive parts and automotive parts' corresponding modules or groups.

On the other hand, production structure of automotive parts is expected to be similar to that of export structure of automotive parts, whereas production structure of automotive parts should be negatively related to import structure of automotive parts. Therefore, higher the production or export of a particular automotive part, lower the import of that automotive part becomes. As a result, there should be substitutions between production or export of automotive parts and import of automotive parts in Turkey.

5.4.2 Data and Summary Statistics

Subsection 5.2.2, in detail, describes how an accurate list of automotive parts is obtained. In addition to this, Appendix A: Data Sources explains how data is accessed. Data used for analysis in this subsection is based on merge of three different datasets, namely the Foreign Trade Statistics Dataset, the Annual Industrial Products (Prodcom) Statistics Dataset and Technological Intensity Measures. The merge of these datasets is based on the unique ids of automotive items and year.

Appendix E: Table E.1 reports summary statistics of automotive items. Appendix E: Table E.1 reveals that automotive parts have an average ECR of around 5, while automotive parts have average patent counts of around 61 during the period 2002-2013. Appendix E: Table E.1 also reports means of natural logarithms of import and export values in both the US dollar and TL during the period 2002-2013, and mean of natural logarithm of production value only in TL during the period 2005-2012. As Appendix E: Table E.1 indicates, mean of natural logarithm of production value of automotive items is larger than both means of natural logarithms of import and export values of automotive items, while mean of natural logarithm of import value of automotive items is larger than mean of natural logarithm of export value of automotive items, irrespective of the unit of currency.

5.4.3 Findings on Automotive Parts Level Specifications

This subsection reports estimation results of specifications introduced in subsection 5.4.1. It should be noted that variable *PATENTC* specified in subsection 5.4.1 is a generic name for any patent search specification listed in Table 5.1. Amongst six patent search specifications in Table 5.1, PATCOSTAC search specification obtaining number of relevant patents for a particular automotive part for a particular year based on simultaneous hitting of the same keywords in titles, abstracts and claims of patents is preferred since PATCOSTAC search specification is highly fussy compared to other specifications. Therefore, PATCOSTAC search specification retrieves the most relevant patents for a particular automotive part, so is the number of patents for a particular automotive part for a particular year.

Table 5.2 reports estimation results of technological intensity of import and association of import with export at automotive parts level based on pooled OLS, FE and RE models in Turkey during 2002-2013. Table 5.2 reveals that PATCOSTAC is statistically significant and has a positive sign across models but it is very low in magnitude in the FE model meaning that higher the technological intensity of a particular automotive part is, greater the import of that automotive part becomes supporting the expectation expressed in subsection 5.4.1, while controlling for modularity (group dummies), macroeconomic shocks (year dummies) and ECR measure of technological intensity. This finding on technological intensity of import is also robust to cross-section regressions[26] where patent counts measure of technological intensity (PATCOSTAC) outperforms ECR measure of technological intensity in terms of statistical significance. Table 5.2 also presents that ln(EXPVDOLLAR) is statistically significant and has a positive sign across models corresponding to that higher the export of a particular automotive part is, greater the import of that automotive part becomes being inconsistent with the expectation stated in subsection 5.4.1, whilst controlling for modularity, macroeconomic shocks and technological intensity. Therefore, export structure of automotive parts is similar to import structure of automotive parts in Turkey during the period 2002-2013. This finding on the association between import and export of automotive parts is also robust to cross-section regressions[27], while controlling for modularity and technological intensity.

Table 5.2 Technological Intensity of Import and Association of Import with Export at Automotive Parts Level: Panel 2002-13 (Dependent Variable: ln(IMPVDOLLAR))

	Pooled OLS	FE	RE
PATCOSTAC	0.005***	0	0.001**
	[0.001]	[0.000]	[0.000]
ECR	0.079*	0	0.139**
	[0.046]	[0.000]	[0.055]
ln(EXPVDOLLAR)	0.484***	0.142***	0.194***
	[0.086]	[0.051]	[0.054]
GROUP Dummies	yes	yes	yes
YEAR Dummies	yes	yes	yes
Constant	7.946***	14.270***	12.469***
	[1.358]	[0.786]	[0.859]
Observations	408	408	408
R-squared	0.725	0.704	
Number of IDs		34	34
R-Squared Within		0.704	0.7
R-Squared Between		0.516	0.535
R-Squared Overall		0.344	0.552
Rho		0.922	0.806

Notes: Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

[26] Please see Appendix E: Table E.2 and Table E.3.

[27] Please see Appendix E: Table E.2 and Table E.3.

Table 5.3 reports estimation results of technological intensity of export and association of export with import at automotive parts level based on pooled OLS, FE and RE models in Turkey during 2002-2013. Table 5.3 indicates that PATCOSTAC is statistically significant and has a negative sign across models meaning that higher the technological intensity of a particular automotive part is, smaller the export of that automotive part becomes confirming the expectation expressed in subsection 5.4.1, while controlling for modularity (group dummies), macroeconomic shocks (year dummies) and ECR measure of technological intensity. This finding on technological intensity of export is also robust to cross-section regressions in most years[28] where patent counts measure of technological intensity (PATCOSTAC), in most years, outweighs ECR measure of technological intensity in terms of statistical significance. Table 5.3 also reveals that ln(IMPVDOLLAR) is statistically significant and has a positive sign across models corresponding to that higher the import of a particular automotive part is, greater the export of that automotive part becomes being different from the expectation expressed in subsection 5.4.1, whilst controlling for modularity, macroeconomic shocks and technological intensity. Therefore, import structure of automotive parts is similar to export structure of automotive parts in Turkey during the period 2002-2013. This finding on the association between import of automotive parts and export of automotive parts is also confirmed by the previous finding in Table 5.2. This finding on the association between export and import of automotive parts is also robust to cross-section regressions[29], while controlling for modularity and technological intensity.

Table 5.4 reports estimation results of technological intensity of production and association of production with import at automotive parts level based on pooled OLS, FE and RE models in Turkey during 2005-2012. In contrast to Table 5.2, natural logarithm of import value (ln(IMPVTL)) in Table 5.4 is in TL since natural logarithm of production value (ln(PRODVTL)) in Table 5.4 is in TL. Table 5.4 for panel regressions, and Appendix E: Table E.6 and Table E.7 for cross-section regressions present that PATCOSTAC has a negative sign in OLS regressions in most cases but it is not statistically significant in most cases. Therefore, there is a highly weak and sometimes inconsistent support for the expectation expressed in subsection 5.4.1 that higher the technological intensity of a particular automotive part is, smaller the production of that automotive part becomes, while controlling for modularity (group dummies), macroeconomic shocks (year dummies) and ECR measure of technological intensity. This finding is, to some extent, also reflected in negative coefficients of ECR measure of technological intensity but this measure of technological intensity is statistically more significant in panel regressions. As a result, there is not clear technological intensity concentration on automotive parts' production in Turkey during the period 2005-2012. Table 5.4 also indicates that ln(IMPVTL) is statistically significant and has a positive sign across models corresponding to that higher the import of a particular automotive part is, greater the production of that automotive

[28] Please see Appendix E: Table E.4 and Table E.5.
[29] Please see Appendix E: Table E.4 and Table E.5.

Table 5.3 Technological Intensity of Export and Association of Export with Import at Automotive Parts Level: Panel 2002-13 (Dependent Variable: ln(EXPVDOLLAR))

	Pooled OLS	FE	RE
PATCOSTAC	-0.004**	-0.002***	-0.002***
	[0.001]	[0.001]	[0.001]
ECR	-0.116	0	-0.085
	[0.079]	[0.000]	[0.066]
ln(IMPVDOLLAR)	0.997***	0.411***	0.542***
	[0.153]	[0.139]	[0.103]
GROUP Dummies	yes	yes	yes
YEAR Dummies	yes	yes	yes
Constant	0.245	8.780***	7.322***
	[2.646]	[2.323]	[1.633]
Observations	408	408	408
R-squared	0.628	0.555	
Number of IDs		34	34
R-Squared Within		0.555	0.552
R-Squared Between		0.514	0.597
R-Squared Overall		0.429	0.576
Rho		0.835	0.752

Notes: Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

part becomes being inconsistent with the expectation stated in subsection 5.4.1, whilst controlling for modularity, macroeconomic shocks and technological intensity. Therefore, import structure of automotive parts is similar to production structure of automotive parts in Turkey during the period 2005-2012, there is not rivalry between import and production of automotive parts. This finding on the association between import and production of automotive parts is also robust to cross-section regressions[30], while controlling for modularity and technological intensity.

Table 5.5 reports estimation results of technological intensity of production and association of production with export at automotive parts level based on pooled OLS, FE and RE models in Turkey during 2005-2012. Compared to Table 5.3, natural logarithm of export value (ln(EXPVTL)) in Table 5.5 is in TL since natural logarithm of production value (ln(PRODVTL)) in Table 5.5 is in TL. Table 5.5 for panel regressions, and Appendix E: Table E.8 and Table E.9 for cross-section regressions present that PATCOSTAC tends to have a negative sign in OLS regressions in most cases but it is not statistically significant in most cases, which is also confirmed in Table 5.4 and Appendix E: Table E.6 and Table E.7. Therefore, there is a highly weak and sometimes inconsistent support for

[30]Please see Appendix E: Table E.6 and Table E.7.

Table 5.4 Technological Intensity of Production and Association of Production with Import at Automotive Parts Level: Panel 2005-12 (Dependent Variable: ln(PRODVTL))

	Pooled OLS	FE	RE
PATCOSTAC	-0.007***	0	-0.001
	[0.002]	[0.001]	[0.001]
ECR	-0.219***	0	-0.251***
	[0.069]	[0.000]	[0.089]
ln(IMPVTL)	1.059***	0.331**	0.477***
	[0.185]	[0.166]	[0.176]
GROUP Dummies	yes	yes	yes
YEAR Dummies	yes	yes	yes
Constant	0.159	11.712***	11.103***
	[3.443]	[2.961]	[3.098]
Observations	254	254	254
R-squared	0.617	0.357	
Number of IDs		34	34
R-Squared Within		0.357	0.349
R-Squared Between		0.187	0.498
R-Squared Overall		0.245	0.5
Rho		0.936	0.829

Notes: Robust standard errors are in brackets and *** *p<0.01*, ** *p<0.05*, * *p<0.1* indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

the expectation expressed in subsection 5.4.1 that higher the technological intensity of a particular automotive part is, smaller the production of that automotive part becomes, while controlling for modularity (group dummies), macroeconomic shocks (year dummies) and ECR measure of technological intensity. This finding is, to some extent, also reflected in negative coefficients of ECR measure of technological intensity but this measure of technological intensity is statistically more significant in panel regressions. Therefore, there is not clear technological intensity concentration on automotive parts produced in Turkey during the period 2005-2012 as also indicated in Table 5.4 and Appendix E: Table E.6 and Table E.7. Table 5.5 also reveals that ln(EXPVTL) is statistically significant and has a positive sign meaning that higher the export of a particular automotive part is, greater the production of that automotive part becomes being in line with the expectation stated in subsection 5.4.1, whilst controlling for modularity, macroeconomic shocks and technological intensity. Thus, export structure of automotive parts is similar to production structure of automotive parts in Turkey during the period 2005-2012, what automotive part is produced is also exported. This finding on the association between export and production of automotive parts is also robust to cross-section regressions[31], while controlling for modularity and technological intensity.

[31] Please see Appendix E: Table E.8 and Table E.9.

Table 5.5 Technological Intensity of Production and Association of Production with Export at Automotive Parts Level: Panel 2005-12 (Dependent Variable: ln(PRODVTL))

	Pooled OLS	FE	RE
PATCOSTAC	-0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]
ECR	-0.104**	0	-0.172***
	[0.051]	[0.000]	[0.060]
ln(EXPVTL)	0.915***	0.218	0.552***
	[0.091]	[0.144]	[0.128]
GROUP Dummies	yes	yes	yes
YEAR Dummies	yes	yes	yes
Constant	3.260**	13.955***	9.556***
	[1.588]	[2.429]	[2.315]
Observations	254	254	254
R-squared	0.79	0.343	
Number of IDs		34	34
R-Squared Within		0.343	0.302
R-Squared Between		0.711	0.788
R-Squared Overall		0.541	0.729
Rho		0.923	0.709

Notes: Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

As a result, findings on technological intensity of automotive parts' import and export in Turkey are consistent with the literature of institutional quality (Acemoglu and S. Johnson, 2005). During the period 2002-2013, the Turkish automotive parts industry exports more automotive parts those have lower technological intensity or whose technological structure do not require efficient contract enforcement and property rights institutions, whereas importing automotive parts those have higher technological intensity or whose technological structure require efficient contract enforcement and property rights institutions. On the other hand, there is not clear technological intensity concentration on automotive parts produced in Turkey during the period 2005-2012. This study also found that export structure of automotive parts is consistent with both import and production structures of automotive parts meaning that what automotive parts are imported and produced are also exported in Turkey. In addition to this, import structure of automotive parts is unexpectedly in line with production structure of automotive parts corresponding to that what automotive parts are imported are also produced in Turkey during the period 2005-2012. This last finding is also to be further investigated in chapter 6.

5.5 Summary

The automotive industry is one of the most international trade involved industries in Turkey as presented and analysed in chapter 2 and chapter 3. Nevertheless, there is a question of how “wide” and “sustainable” the economic contribution of this industry is to the Turkish economy. This chapter focused on this issue by investigating technological intensity of Turkey’s automotive parts import, export and production at “individual” automotive parts level, in contrast to chapter 3 that examined general economic characteristics of Turkey’s automotive parts import and export at “industry” level. Current measures of technological intensity in the literature are at industry level, and the automotive industry is generally classified as medium-high technology. Hence, technological intensity measures in the literature cannot capture technological variations amongst various automotive parts, and so the identification of economic contribution of this industry to the economy becomes inaccurate at the existence of substantially growing cross-border trade in intermediate goods or automotive parts (Feenstra, 1998). Therefore, this study developed an alternative technological intensity measure at automotive parts level; it exploited patent counts for a particular automotive part as a measure of technological intensity of that automotive part. It utilised this patent measure of technological intensity to identify technological intensity of Turkey’s automotive parts import, export and production. This study also analysed relationships between Turkey’s automotive parts import, export and production.

This chapter found that higher the technological intensity of an automotive part, larger the import of that automotive part becomes; whereas higher the technological intensity of an automotive part, lower the export of that automotive part becomes in Turkey during the period 2002-2013, while controlling for modularity, macroeconomic shocks and ECR measure of technological intensity. These findings are also robust to cross-section regressions. Nevertheless, there is not clear technological intensity concentration on automotive parts produced in Turkey during the period 2005-2012. These findings are, to some extent, in line with the view that economies with relatively inefficient contract enforcement and property rights institutions specialise in the export and production of items that require less “institutional content” or have lower technological intensity. This chapter also examined associations between automotive parts’ import, export and production in Turkey and revealed that export structure of automotive parts is consistent with both import and production structures of automotive parts. In addition to this, production structure of automotive parts is unexpectedly similar to import structure of automotive parts. This, to some extent, reflects the recent R&D efforts carried out by motor vehicle assembling and automotive parts supplying enterprises in Turkey that has given rise to technology acquisitions and spillovers in the industry as underlined in section 4.2, subsubsection 4.3.1.2 and subsubsection 4.3.2.2. This finding is also to be further investigated in chapter 6.

Chapter 6

International Technology Transfer and Productivity in the Turkish Automotive Parts Industry

6.1 Introduction

Productivity differentials can explain high income level variations across economies (R. E. Hall and Jones, 1999). In return, productivity is widely argued to be driven by technological innovations that is, to a large extent, determined by investment in R&D (Romer, 1990; Grossman and Helpman, 1991a; Grossman and Helpman, 1991b; Grossman and Helpman, 1991c; Grossman and Helpman, 1994; Jones, 1995; Castellani and Zanfei, 2006; Grossman and Helpman, 2015). Developing economies have scarce resources to devote to R&D investment, and hence they cannot create sufficient innovations and improve their productivity. Nevertheless, it is widely suggested that these economies can benefit from productivity effects through international technology transfer. Hence, this chapter focuses on associations between international technology transfer channels[1] and productivity, wage, employment, and investment. This chapter also attempts to establish the link between international technology transfer channels and productivity by estimating a flexible model of translog production function. Findings will extend the understanding on the extent of performance and productivity effects of international technology transfer channels particularly in the global automotive industry on a developing country economy, namely the Turkish economy.

Previous studies on the international technology transfer generally concentrate on developed OECD countries by investigating specific channels of international technology transfer, one channel at a time across sectors (Keller, 2004). Hence, such studies cannot fully account for simultaneously major channels of international technology transfer in

[1] These channels are international ownership, import and export.

the context of major developing countries and specific sectors, thereby failing to consider simultaneously major channels, and address developing country and sector specific factors.

Previous studies (please see Ansal, 1990; Karabag et al., 2011; Turker, 2012) on the Turkish automotive industry also focus mainly on the motor vehicle assembly section of the automotive industry, so they do not pay proper attention to the automotive parts supply section of the industry that is due mainly to the lack of data in this field and restrictions on access to relevant data. Therefore, such studies cannot accurately analyse the supply section of the industry that increasingly accounts for a larger section of the automotive industry. Such studies are also mostly qualitative and based on small samples with a limited set of variables raising questions on representativeness of their findings. On the other hand, Sonmez (2013) deals with automotive parts supplying enterprises in Turkey and has a relatively larger sample of around 150 compared to similar studies' (e.g., Ekmekci, 2010). Nevertheless, when the number of automotive parts supplying enterprises of around one thousand of the size of more than 20 employees is considered in Turkey, Sonmez (2013) cannot reach fairly representative and conclusive findings due to its research methodology adopted. On the other hand, this study employs TurkStat's enterprise level datasets covering all automotive parts supplying enterprises of the size of more than 20 workers representing more than 90% of the automotive parts supply section of the industry. In addition to this, this study has already made an extensive descriptive economic analysis of motor vehicle assembling and automotive parts supplying enterprises in Turkey in subsection 4.3.1 and subsection 4.3.2, respectively. Furthermore, this study has already examined the Turkish automotive industry at automotive parts level in chapter 2, chapter 3 and chapter 5.

Furthermore, this study differs from previous automotive industry studies in the sense that first in contrast to previous studies (e.g., Yasar and Morrison Paul, 2007), this study does not consider motor vehicle assembling enterprises in regression analysis to control for more heterogeneities between motor vehicle assembling and automotive parts supplying enterprises. Second, this study considers a relatively long period of time and focuses on the recent period (Yasar and Morrison Paul, 2007). Third, Sonmez (2013) looks particularly at knowledge and technology transfer from motor vehicle assemblers to automotive parts suppliers in Turkey, while considering variations in absorptive capacity between international and local automotive parts suppliers by surveying automotive enterprises in Turkey. On the other hand, this study investigates international technology transfer and its subsequent productivity impacts, thanks to involvement of automotive parts supplying enterprises in Turkey in international ownership, import and export activities. Fourth, this study investigates major channels of international technology transfer in a large developing country's one of the most internationally involved industries, namely the Turkish automotive parts industry during the recent period. Hence, in addition to technological characteristics of the Turkish automotive parts industry at automotive parts level investigated in chapter 5, this chapter captures complementary and confirming insights into international technology transfer characteristics of the Turkish automotive parts industry at automotive parts supplying enterprise level.

As stated in section 3.2, almost all motor vehicle assemblers in Turkey are joint ventures with European, Asian and American assemblers. There are local motor vehicle assemblers, as well. Largest automotive parts suppliers in Turkey tend be joint ventures with international automotive parts suppliers or fully international owned as reported in subsubsection 4.3.2.1. In this respect, the Turkish automotive industry is highly international. On the other hand, the vast majority of automotive parts supplying enterprises are locally owned and small in size as reported in section 4.2. As a result, there are large variations and heterogeneity in ownership and enterprise size amongst motor vehicle assembling and automotive parts supplying enterprises in Turkey as reported in section 4.3. This industry is also heavily engaged in international trade. More than two thirds of motor vehicle output of the Turkish automotive industry are exported as presented in subsection 2.3.3. In addition to providing motor vehicle assemblers in Turkey with automotive parts, automotive parts supplying enterprises also heavily export their output. Imported automotive parts constitute a large proportion of inputs of the assembly industry. Therefore, in terms of both international investment and trade, this industry is well integrated with the global automotive industry as extensively explained in chapter 2, chapter 3 and section 4.3. This chapter employs a number of unique enterprise level datasets of the TurkStat to comparatively investigate these relationships of international linkages with economic performance indicators, and in particular the link between international technology transfer channels and productivity by focusing on automotive parts supplying enterprises in Turkey during the period 2003-2011. Concentrating on one industry and specifically automotive parts supplying enterprises enables findings to be more robust to heterogeneities across industries and within the industry, respectively.

This chapter finds that during the period 2003-2011 automotive parts supplying enterprises in Turkey with international linkages are more productive, pay more and employ more in line with the descriptive analysis in subsection 4.3.2, which is also well established in the literature of international linkages (Keller, 2004) and similar to that of Yasar and Morrison Paul (2007). Nevertheless, relationships between international ownership intensity and investment, and export intensity and investment are in reverse direction but statistically insignificant which is contrary to the literature. This stems mainly from the high level of minimum capital investment requirement of the industry, irrespective of the extent of international linkages. This chapter also estimates a flexible model of translog production function based on quantitative and qualitative measures of international linkages by both OLS and quantile regression methods and finds that all international linkages result in productivity increases as revealed in quantitative specifications and all international technology transfer channels also have positive productivity premiums as indicated in qualitative specifications, which is in line with the literature (Keller, 2004) and studies on Turkey (Aslanoglu, 2000; Ozcelik and Taymaz, 2004; Yasar and Morrison Paul, 2007;

Taymaz and Yilmaz, 2008a; Maggioni, 2010; Fatima, 2016). Nevertheless, productivity rankings of individual international technology transfer channels are not consistent with the literature: in place of international ownership intensity as argued in the literature to have the largest productivity effect, import intensity is identified as having the largest productivity effect but international ownership still has the largest productivity premium. This might result from that import transactions directly embody technology transfers reflected by the finding in chapter 5 on high technological intensity of Turkey's automotive parts import, and hence import can result in larger productivity effects in short period of time, whereas productivity effects of technology transfer from international ownership can require larger period of time to realise that is what this study is likely to be capturing.

Section 6.2 introduces the related literature on channels of international technology transfer. Section 6.3 suggests a model for investigation of associations between international technology transfer channels and economic performance indicators of automotive parts supplying enterprises in Turkey, and subsection 6.3.1 presents the findings on these associations. Section 6.4 introduces a flexible model of translog production function on the link between international linkages and productivity, and subsection 6.4.1 presents findings on this link. Section 6.5 summarises main findings of this chapter.

6.2 Literature on Channels of International Technology Transfer

There are immense income variations, and hence standard of living disparities amongst economies. Once stock of labour and capital controlled, variations in the extent to which these two factors are efficiently used or productivity can explain high income level variations across economies (R. E. Hall and Jones, 1999). In return, productivity is extensively argued to be driven by technological innovations that is, to a large extent, determined by investment in R&D (Romer, 1990; Grossman and Helpman, 1991a; Grossman and Helpman, 1991b; Grossman and Helpman, 1991c; Grossman and Helpman, 1994; Jones, 1995; Castellani and Zanfei, 2006; Grossman and Helpman, 2015). Developing economies have scarce resources to devote to R&D investment, and hence they cannot create sufficient innovations and enhance their productivity. Nevertheless, it is widely suggested that these economies can benefit from productivity effects through international technology transfer. International direct investment, import and export are widely put forward as channels[2]

[2]Direct R&D activities of subsidiaries of multinational enterprises are another channel of international technology transfer. Data on R&D in Turkey is collected through Annual Industry and Service Statistics questionnaires. Nevertheless, R&D data of this dataset is not revealed since it is not edited by the TurkStat. Instead, this dataset is utilised to identify enterprises engaging in R&D activities, and then to compile a comprehensive dataset namely, the Research and Development Activities Survey of Industry and Service Enterprises Dataset that contains data on R&D activities, R&D personnel characteristics and payments, R&D investment, sources of R&D spending, and outsourced and offshored R&D activities of manufacturing and service enterprises. Nevertheless, the sample size of this dataset is highly small due to small number of enterprises conducting formal R&D in Turkey, and the sample size of this dataset fluctuates throughout

of international technology transfer but there are other linkages, as well e.g., overseas education and studies including publications, conferences and training programmes, person to person contacts, technical assistance, direct recruitment of international labour and skills, government initiatives and programmes to directly obtain technology, and knowledge and technology obtained from descriptions and drawings in patents. Despite the existence of various transmission channels of international technology transfer, this study focuses on three major linkages namely, international direct investment, import and export since other linkages are hard to quantify and they are also more of subject of qualitative studies.

International direct investment is the first channel of international technology transfer investigated in this study. Compared to import and export, international direct investment is regarded as the most efficient conduit for international technology transfer (Keller, 2004), so it is widely promoted across economies (Haskel et al., 2007). There are various ways through which international direct investment disseminates technology to host enterprises (Blomstrom and Kokko, 1998). Through interacting with upstream and downstream enterprises in various ways, multinational enterprises can pass their best practices and technologies to their local partners (Javorcik, 2004). Local rivals of multinational enterprises can also benefit from these practices and technologies. In addition to passing best practices and technologies to their local partners, multinational enterprises can assist their local partners to get involved in international trade that can result in additional technology transfer. Multinational enterprises are also more active in promoting technical, practical and managerial skills of their employees by providing them with various training programmes. In addition to training programmes, multinational enterprises can enable their employees to work in their headquarters or other subsidiaries, so their employees can have international work experience. It is argued that due to labour mobility, local enterprises can recruit multinational enterprises' employees (Poole, 2013). Therefore, local enterprises can have access to skills of multinational enterprises' workers. Furthermore, multinational enterprises have more ability to source or import more variety of high quality and cost competitive intermediate inputs to their host economy that enable multinational enterprises to produce higher quality and more competitive output, so that multinational enterprises can extensively serve both local and international markets. Last, successfully initiated

available years. Merging the R&D dataset with the main dataset of this study significantly shrinks the number of observations. Therefore, for the sake of using a larger dataset of automotive parts supplying enterprises in Turkey, the R&D dataset is not considered, neither is R&D channel of international technology transfer in the analysis. Nevertheless, investment data reported by an enterprise in the Annual Industry and Service Statistics Dataset also includes investment in R&D amongst other kinds of investment, so R&D channel is indirectly considered in this study. In addition to this, the automotive industry related descriptive statistics on R&D has already been reported in section 4.2, subsubsection 4.3.1.2 and subsubsection 4.3.2.2. Spending on international licenses is also another channel of international technology transfer, there is not precise data on this but there is a variable; investment in concession, patents, licenses, brand and similar rights in the Annual Industry and Service Statistics Dataset but this variable is highly broad and encompasses almost all intangible investment, and it also includes investment in both local and international patents. In addition to this, this variable is not edited by the TurkStat, and hence it includes a large number of missing observations and zero values. As a result, international licenses as a channel of international technology transfer is not considered in the analysis, as well.

international investment serves as signal for other international investments. Multinational enterprises also bring their supply base with themselves. Therefore, international investment encourages other multinational enterprises to access the host economy, thereby creating additional investment (Keller, 2004). It should be noted that this list is rather limited in ways through which international direct investment diffuses technology to host economies, thereby improving productivity of host economies.

There are a number of factors having implications for efficiency of technology transfer from international direct investment (Sonmez, 2013). The first factor is kind of motivation of multinational enterprises. There can be various kinds of motivations for investing in the host economy: seeking new markets or locating themselves in key geographies, seeking efficiency by restructuring their activities across economies, diversification of their markets and resources, benefiting from low labour costs, natural resources or local government incentives, and accessing local skills and innovations. For example, compared to international investment in extracting just natural resources, international investment in R&D activities to benefit from highly skilled local labour force results in more technology transfer. Therefore, kind of motivation has impacts on the efficiency and extent of technology diffusion from international investment. The second factor is mode of entry of international investment: green field or mergers and acquisitions (M&A). These main entry modes determine the extent of interaction with local enterprises, and hence technology diffusion to local enterprises. The third factor is share of international ownership: minority, joint venture, majority or full internationally owned. The extent of international ownership involvement determines the intensity of interactions with local enterprises. The fourth factor is the origin of multinational enterprises. There are variations in openness of multinational enterprises to interactions with local enterprises depending on the origin of multinational enterprises. Particular multinational enterprises of specific origin tend to be less cooperative than others. This is due mainly to multinational enterprises' high quality standards, and business practices and cultures to cooperate and rely more on home and home enterprises. A case in point is Japanese keiretsu (Spencer and Qiu, 2001) that is based on forging strong relationships with home and home enterprises, so this limits the extent, and hence efficiency of technology dissemination to local enterprises. The fifth factor is kind of activities carried out by multinational enterprises. Kind of activities conducted by multinational enterprises depend mainly on the motivation of multinational enterprises and characteristics of the host economy. There are variations in technological intensity of activities conducted by multinational enterprises in the host economy as well as degree of involvement in R&D across multinational enterprises. Therefore, higher the technological intensity of activities that multinational enterprises engage in the host economy and larger the involvement in R&D and innovation activities by multinational enterprise, greater the technology transfer to local enterprises becomes. The last factor is the extent of interaction of multinational enterprises with local enterprises. This heavily depends on characteristics of local enterprises, and hence the host economy as well as characteristics of multinational enterprises (Carr et al., 2001; Taymaz and Ozler, 2007). Higher the interaction with local enterprises, more best practices, and hence more technology are passed to local enterprises from multinational enterprises. As a result, heterogeneities in characteristics of international investment and multinational enterprises play a significant role in determining the efficiency and extent of technology transfer to local enterprises.

Import is the second channel of international technology transfer considered in this study. Import enables enterprises to utilise, learn and then imitate technology by reverse engineering, so it lays the foundation for being innovator (Keller, 2004). In addition to imitation effect of import, knowledge and technology embodied in imported intermediate inputs and capital goods lead to technology transfer to local enterprises (Xu and Wang, 1999; Eaton, Kortum, and Kramarz, 2004; Savvides and Zachariadis, 2005). Import does not only enable local producers to utilise a large variety and quantity of high quality inputs (Kasahara and Rodrigue, 2008; Goldberg et al., 2010; Halpern et al., 2015), but it also enables local producers to benefit from knowledge and technology embodied in intermediate inputs (Amiti and Konings, 2007). Along with resulting in higher productivity, imported intermediate goods can ultimately enable local enterprises to produce more variety of high quality and more cost competitive final goods for both local and international markets (Levinsohn, 1993). Technology embodied in imported capital goods is also another conduit for international technology transfer (Eaton and Kortum, 2001). In addition to improvement of productivity, imported capital goods can upgrade both products and production processes of local enterprises, and raise their production capacity. Imported capital goods appear to be comparatively more efficient than imported intermediate goods in contribution to local technological capability since the former involves more direct technical assistance and training in formal and informal forms to convey technology to local enterprises. Comparing efficiency of international direct investment with import as a channel of diffusion of international technology, it appears that international direct investment is more efficient than import in diffusing technology to local enterprises since international direct investment as an international technology conduit involves direct transfer of technology and more direct and less costly interactions with local enterprises than import (Keller, 2004).

There are a number of factors having implications for efficiency of international technology transfer from import of intermediate inputs and capital goods. First, there are large variations in technological intensity of imported intermediate inputs and capital goods. Higher the technological intensity of imported intermediate inputs and capital goods, greater the technology transfer to local enterprises becomes. Second, origin of imported intermediate inputs and capital goods plays a role in determining efficiency and extent of international technology diffusions to local enterprises as there are variations in amount of R&D and innovation activities carried out by these economies, and hence variations in technological intensity of goods produced by these economies. Therefore, higher the share of imported intermediate inputs and capital goods from economies heavily engaged in R&D and innovation activities, larger the technology transfer to local enterprises becomes. Third, share of imported intermediate inputs and capital goods in total import is significant for efficiency of technology transfer (Yasar, 2013). A larger amount of import of intermediate inputs and capital goods in relation to other imported goods result in more technology transfer. As a result, heterogeneities in characteristics of import play a role in determining the efficiency and extent of technology transfer to local enterprises.

Export is the third channel of international technology transfer investigated in this study. Since its direct contribution to economic growth, export is widely promoted by governments around the world. In particular, export enables enterprises to serve more than a market resulting in benefiting from economies of scale as well as specialization. Overall, export allows enterprises to serve a large number of markets resulting in better allocation of resources within an economy, and hence efficiency gains (Pavcnik, 2002; Melitz, 2003). Compared to import as a channel of international technology diffusion, export channel has received more attention from academic circles and international economic institutions. In particular, there is a relatively large empirical literature investigating whether exporting leads to productivity of enterprises or enterprises those are already the most productive become exporters. The first explanation is called "learning-by-exporting hypothesis," while the second explanation is called "self-selection hypothesis." Learning-by-exporting hypothesis argues that exporting enables enterprises to interact with international buyers that can provide key knowledge and technologies on both products and production processes. Therefore, according to learning-by-exporting hypothesis, exporting results in productivity of exporters. On the other hand, self-selection hypothesis asserts that since international markets are highly competitive and starting to engage in exporting involves high entry costs or sunk costs, enterprises desiring to access international markets are required to have been amongst the most productive enterprises in the economy well before starting to export. The majority of empirical studies (e.g., Aw and Hwang, 1995; Bernard, Jensen, and Lawrence, 1995; Bernard and Wagner, 1997; Roberts and Tybout, 1997; Clerides et al., 1998; Bernard and Jensen, 1999; Delgado et al., 2002; Bernard, Eaton, et al., 2003; Alvarez and Lopez, 2005) find evidence supporting self-selection hypothesis but there are studies (e.g., Castellani, 2002; Wagner, 2002; Bigsten et al., 2004; Blalock and Gertler, 2004; Girma et al., 2004; Van Biesebroeck, 2005; Kraay, 2006; De Loecker, 2007) supporting learning-by-exporting hypothesis, as well. Overall, empirical studies acknowledge the difficulty of establishing a causal link between exporting and productivity but what clearly emerges from enterprise level export-productivity empirical studies is that exporting enterprises are more productive prior to exporting, so they assume this stylised fact as a support for self-selection hypothesis.

There are a number of factors determining the extent and efficiency of international technology diffusion from export. First, kind of product exported plays a role in the extent and efficiency of international technology diffusion (Lall et al., 2006). If the product exported is related to a mature technology, agriculture products or raw materials, then it becomes less likely for exporters to receive significant knowledge and technology inputs from international customers as there is less room for innovations to be carried out on these kinds of products. Second, destination of export is of significance for determining the efficiency and extent of international technology diffusion to local enterprises. As there are heterogeneities in R&D spending and intensity of innovation activities across economies, there are variations in technology and knowledge each economy possesses, and hence respective knowledge and technology that can be transferred to exporters. Therefore, higher the share of export to economies heavily engaged in R&D and innovation activities, greater the technology transfer to exporters becomes. Third, share of export in total output is important for the extent of international technology transfer. A larger share of export in relation to total output leads to more contacts with international customers, and hence more international technology transfer. As a result, heterogeneities in characteristics of export are significant in determining the efficiency and extent of technology transfer to local enterprises.

Studies stated earlier investigate channels of international technology transfer through quantitative methods but there are also studies using qualitative methods particularly called “case studies” (e.g., Sonmez, 2013). The former approach utilises mostly secondary data collected by national statistics offices usually compiled by international economic institutions, such as the OECD. On the other hand, the latter approach is based generally on primary data gathered from questionnaires, surveys, interviews with industry representatives, plant managers, purchasing and supplier managers, production managers, and design and R&D managers, and sector specific reports. Therefore, the latter approach enables researchers to gather more specific and detailed data that can directly address research questions. Nevertheless, this results in analyses of case studies being based on smaller samples compared to quantitative studies, and conclusions of case studies drawn being highly specific, time-dependent, and hence less representative. The second comparison area is on the unit of analysis: the former approach can be across economies-sectors or enterprises across sectors in a particular economy. On the other hand, the latter approach is generally on a particular industry in a specific country or region or a set of enterprises operating in a specific sector of a particular country or region. Thus, analysis of case studies is highly specific, and hence it can better capture local experience and characteristics but at the same time rendering conclusions into a particular context. Next, case studies examine technology transfer through precise technology dissemination mechanisms by analysing characteristics, type, kind, existence, extent and efficiency of specific technology transfer via particular technological interactions amongst enterprises. They, in particular, explain technology acquisition experience of local enterprises from international interactions. In this respect, case studies analyse technology disseminated to upstream, downstream and rival enterprises as well as technology gained from multinational parents through each technology dissemination mechanism. On the other hand, quantitative studies focus on channels of international technology transfer through which various technology transfer mechanisms, despite being not individually quantified, are assumed to result in dissemination of technology, and hence productivity improvements. The main reason why quantitative studies focus on technology transfer channels rather than on each individual technology dissemination mechanism is due to data limitations. There is not generally secondary data on a specific technology transfer mechanism, e.g., existence of co-design activities with multinational enterprises but there is data on ownership structure of enterprises through which co-design activity is possible, implying existence of channel of international technology transfer. Therefore, quantitative studies cannot measure each technology dissemination mechanism but they can identify existence of international technology dissemination channels that embody all individual technology dissemination mechanisms. Hence, quantitative approach indirectly measures technology dissemination mechanisms but it cannot measure each individual mechanism. As a result, case studies can refer to and capture each individual technology transfer mechanism but quantitative studies cannot, instead quantitative studies focus on channels of international technology transfer containing all technology transfer mechanisms and their relative contribution to efficiency in impacting productivity of enterprises. Last, case studies are inherently descriptive reflecting individual account, whereas quantitative studies are inferential indicating averages. This enables analysis of quantitative studies to be more representative and robust. Nevertheless, qualitative and quantitative studies complement one another.

It is widely emphasised in the literature that the extent to which an economy can effectively benefit from international technology transfer depends on a number of factors related to characteristics of the recipient economy as well as the inherent nature of the technology transfer process (Keller, 2004).

Characteristics of the recipient economy determine the extent and efficiency of international technology transfer. First, absorptive capacity of the recipient economy is highly crucial in this process of efficient adoption of technology that is the set of skills to understand the technology, adapt and utilise it efficiently, and last develop the ability to imitate the technology (Keller, 1996). In return, absorptive capacity is determined by the extent of human capital that is directly related to education level of the workforce of the recipient economy (Nelson and Phelps, 1966). In this respect, foreign language skills are also key for efficient communication and interaction in international technology adoption process. Therefore, education level and its quality, and hence level of skilled labour of the recipient economy determines how efficiently international technology can be adopted (Meschi et al., 2011). Second, R&D investment at a threshold is required for efficient absorption of international technology. Adoption of technology is a process in which there are constant and consistent efforts are put in place to digest the technology that requires a minimum investment in complementary skills and capital equipment. Therefore, access to finance, and hence an efficient financial system is key in this process for funding required R&D investment. Third, enterprises are required to operate at a large scale for the feasibility of R&D investment demanded for efficient international technology adoption.

There are uncertainties associated with innovation efforts made, if enterprises are able to spread the risks or costs associated with R&D activities over a large volume of output, then it becomes less risky to conduct innovative activities. Therefore, enterprises seek to operate in large markets or serve multiple markets in order to diffuse the risks and costs associated with R&D activities. Fourth, efficiency of property rights and contract enforcement institutions are of significance in enabling transfer of international technology to local enterprises (Yasar, Morrison Paul, and Ward, 2011). They ensure protection of innovations made by both local and international enterprises. Hence, quality of institutional environment and efficiency of economic environment of the recipient economy are crucial for enabling and facilitating creation of innovations and technology transfer. Next, openness to international trade and investment, a flexible labour market and the level of barriers to entry and exit, which corresponds to openness and competitiveness of the recipient economy are other determinants of the efficient adoption of international technology. These factors remove obstacles hindering free movements of technology, knowledge, businesses and labourers, thereby resulting in more efficient technology transfer. Last, a comprehensive approach jointly developed and conducted by the government and enterprises is required for the efficient adoption of international technology. This approach contains consistent and determined government efforts, a good understanding of significance of technology for productivity and constant efforts in this respect made by enterprises, and collaboration and coordination between the government and enterprises to this end. Overall, international technology adoption is a dynamic process in which a large amount of effective efforts are required for its efficiency.

Inherent nature of the dissemination process is also significant for international technology transfer. Technology itself is not free, and transfer and adoption process of technology is not costless and risk-free, as well. There are also various technological levels. First, inventions are generally kept secret by inventors to capitalize on them, so access to them is limited. Inventors can also seek active protection of their inventions in their origins as well as other potential markets, so they get their inventions patented. In this process, inventors reveal their inventions in places where they file patent applications in return for active protection of their inventions, but this process is not costless, as well. By patenting, they can turn their inventions to commercial products to market them or licence their inventions to others for gaining revenue depending on economic value of the invention. As a result, technology is protected and not free (Eaton and Kortum, 1999). Second, technology cannot be fully expressed and formally communicated meaning that it cannot be fully codified since it embodies tacit knowledge (Lenger and Taymaz, 2006). Therefore, extra efforts, in this case, are needed to obtain knowledge and technology, such as more direct contacts or recruitment of international labours are required but this renders transfer of technology less efficient and raises the cost of transferring technology. Hence, international direct investment is more efficient in transfer of tacit knowledge. Third, despite innovations in communication and transportation technologies, geographic proximity to leading technology producing countries appears to matter for efficient international technology transfer (Keller, 2002). Higher the geographic distance to leading technology innovators, greater the cost of technology transfer and lower the efficiency of technology transfer become. Therefore, geographic proximity plays an important role in determining efficiency and cost of technology transfer. Fourth, existence of language barriers is significant in the process of international technology transfer (Adler and Hashai, 2007). International technology tends to be expressed in foreign languages. Grasping a good command of foreign languages is not costless and communication process is not flawless, as well. Therefore, communication process of international technology results in efficiency loss and extra costs. Next, there is an effort required to adapt international technology's suitability for local structure and needs. This adaptation process of international technology to meet local needs is not costless and risk-free. As a result, international technology itself and transfer and adaptation of it involve various costs and risks. Last, technology is not homogeneous. There are technological intensity heterogeneities amongst sectors, processes, activities and products. There are also technological intensity variations across countries as economies have different technological development levels, and hence level of technology that a particular economy diffuses to other economies varies. These technological heterogeneities affect extent and efficiency of international technology transfer. As a result, efficiency of international technology transfer is not only related to the recipient economy but it is also related to inherent nature of technology and process of diffusion of technology.

Above, there is a discussion on how international technology can disseminate across economies and determinants of efficiency of international technology transfer but there is still a question on how international technology transfer can be measured. Measurement of international technology transfer is not an easy task since it involves various transmission mechanisms and their interactions, and there are limitations on relevant data, as well. In addition to this, there are also lags in their effects. Therefore, it is highly difficult to capture international technology transfer. Nevertheless, there are various measures developed in the literature as proxy for international technology transfer: focusing on inputs, such as R&D spending or output, for example patents, or concentrating on effects on productivity (Keller, 2004). On the other hand, case studies tend to focus on analysis of general trends and various experience of international technology transfer rather than trying to quantify magnitude of transfer. The choice amongst these measures depends on the scope of the study and data limitations. Since there is not enterprise level data on R&D spending and patents[3], this study utilises effects on productivity approach. In particular, this study investigates the productivity effect of international direct investment, import and export channels of international technology transfer by focusing on the Turkish automotive parts industry, Turkey's one of the most internationally integrated industries. In the literature, productivity at enterprise level is mostly measured as total factor productivity but it is also measured as labour productivity that is output per labour. On the other hand,

[3]Please see footnote 2.

channels of international technology transfer at enterprise level are measured as binary whether enterprise has international ownership or not, whether enterprise engages in import or not and whether enterprise engages in export or not, or as the extent of involvement or intensity of engagement of enterprise in international direct investment, import and export. It should be noted that this approach widely used in the literature does not allow to quantify magnitude of individual mechanism of international technology transfer channels through which international technology disseminate to local enterprises as identified and discussed earlier, instead this study is based on overall productivity effect of each international technology transfer channel, namely international direct investment, import and export. Therefore, each channel's particular mechanism, e.g., the technology dissemination of labourers having worked in multinational enterprises is not separately regarded as data on this specific mechanism at enterprise level is not available, rather this study focuses on international investment channel as a whole. This study also investigates relative productivity effects of individual channels of international technology transfer. As widely emphasised in the literature, it is empirically hard to find evidence of causal relationship between channels of international technology transfer and productivity. For example, multinationals mainly invest in a country, sector, process or product in which there is already high productivity or a higher prospect of productivity, and hence in this specific case the causal link between investment of multinational enterprise and productivity cannot be established due to self-selection. As a result, it is important to employ techniques to surmount this issue of causality vs. correlation, and hence cautiously analyse results of productivity effects of channels of international technology transfer.

6.3 International Linkages and Economic Performance Measures

This section is on economic performance characteristics of automotive parts supplying enterprises in Turkey. In particular, it looks at the associations of productivity, wage, employment and investment measures with international technology transfer channels, namely international ownership, import and export at enterprise level.[4]

Yasar and Morrison Paul (2007) also investigate similar considerations by using close specifications as in Bernard, Jensen, and Lawrence (1995), Bernard and Wagner (1997) and Bernard and Jensen (1999) for the Turkish automotive, and apparel and textile industries based on the Annual Survey of Manufacturing Industries Dataset of the TurkStat for the period 1990-1996. There are a number of differences between this study and Yasar

[4]The TurkStat defines enterprise as: "an organizational unit that produces goods and services using decision autonomy concerning allocation of resources. An enterprise is real or legal personality that produces goods and services on the market by carrying out one or more activities at one or more locations. The relation between enterprise and legal unit is directly stated by this definition: "An enterprise corresponds to a legal unit or combination of legal units."" Therefore, according to this definition of the TurkStat, an enterprise can contain more than one plant but around 90% of enterprises are single plant enterprises.

and Morrison Paul (2007)'s study. First, Yasar and Morrison Paul (2007) pool different industries together that cannot fully account for heterogeneities between these highly distinct industries. On the other hand, this study focuses just on the Turkish automotive industry, and uses a richer, more representative and recent dataset[5] namely, the Annual Industry and Service Statistics Dataset for the period 2003-2011. As explained in Appendix A: Data Sources, the Annual Industry and Service Statistics Dataset covers all manufacturing enterprises having more than 20 employees, while it covers a representative sample of manufacturing enterprises having fewer than 20 employees. On the other hand, the dataset on which Yasar and Morrison Paul (2007)'s study is based covers all manufacturing enterprises having more than 25 employees and a sample of manufacturing enterprises having fewer than 25 employees. Therefore, sampling methodology of the dataset on which this study is based is highly different from Yasar and Morrison Paul (2007)'s. Second, this study's dataset also differs from Yasar and Morrison Paul (2007)'s dataset in the sense that enterprises are not asked about their international trade transactions any more, instead the TurkStat obtains international trade data directly from the customs declaration of enterprises. Therefore, this study merges three datasets[6], namely the Foreign Trade Statistics, Annual Industry and Service Statistics, and Annual Business Registers Frames by unique enterprise identifiers to bring more accurate and relevant variables into the model(s) so as to test more considerations and control for enterprise heterogeneities. There are also significant differences between survey structures and questions in the dataset that this study utilises and the dataset that Yasar and Morrison Paul (2007) use, and hence there are considerable differences between the data collected. Furthermore, classification systems of Yasar and Morrison Paul (2007)'s dataset and this study's datasets are not closely related, Yasar and Morrison Paul (2007)'s Annual Survey of Manufacturing Industries Dataset is based on the ISIC[7] Rev. 2 and Yasar and Morrison Paul (2007) use ISIC Rev. 2 code 3843,[8] whereas this study's Annual Industry and Service Statistics Dataset is based on NACE Rev. 1.1 and Rev. 2, and this study uses NACE Rev. 2 codes 29.10, 29.20, 29.31 and 29.32[9], and hence two classification systems cannot be matched one to one. As a result, these two datasets separately covering periods of pre-2002 and post-2002 cannot be merged because of different methodological approaches and survey structures on which these datasets are based stated earlier, and different classification systems that cannot be matched one to one. Therefore, this study focuses only on the post-2002 period. Third, Yasar and Morrison Paul (2007)'s study cannot not distinguish

[5] The TurkStat has undergone significant transformations after 2002 for the aim of harmonisation with the European Statistical System, and hence survey and sampling methodologies, and questionnaire structures of the TurkStat have significantly changed since then.

[6] Please see Appendix A: Data Sources for detail.

[7] The International Standard Industrial Classification of All Economic Activities, abbreviated as ISIC, "is the international reference classification of productive activities." ISIC is developed by the UN and 4-digit.

[8] ISIC Rev. 2 code 3843 corresponds to "manufacture of motor vehicles." This code also includes "specialized manufacture of motor vehicle parts and accessories." Therefore, ISIC Rev. 2 code 3843 jointly identifies motor vehicle assemblers and automotive parts suppliers.

[9] Please see footnote 17 in chapter 4.

between motor vehicle assemblers and automotive parts suppliers because of the limitation of the classification system on which their dataset is based, so they combine clearly distinct enterprises of motor vehicle assemblers and automotive parts suppliers together. On the other hand, this study distinguishes motor vehicle assemblers identified with NACE Rev. 2 code 29.10 from automotive parts suppliers identified with NACE Rev. 2 codes 29.20, 29.31 and 29.32.[10] Therefore, this study just regards automotive parts supplying enterprises in regression analysis to account for more heterogeneities amongst motor vehicle assembling and automotive parts supplying enterprises. Nevertheless, this study has already extensively reported descriptive statistics on motor vehicle assembling enterprises in subsection 4.3.1. Fourth, this study focuses on automotive parts supplying enterprises on full-enumeration, thereby not considering enterprises selected on random sampling basis since enterprises selected on random sampling basis are not consistently surveyed throughout the period of the dataset, they have fewer than 20 employees as stated earlier, and data on such enterprises are also poor. Last, this study additionally tests and controls for more enterprise specific characteristics that Yasar and Morrison Paul (2007) do not, i.e. number of local units of enterprise including the headquarters of enterprise if it is based in Turkey, age of enterprise, and origin of controlling stake of enterprise to account for more heterogeneities amongst automotive parts supplying enterprises in Turkey. As a result, the following model is estimated.

$$\begin{aligned} lnP_{jt} = \beta_1 + \beta_{fdis} FDIS_{jt} + \beta_{imps} IMPS_{jt} + \beta_{exps} EXPS_{jt} \\ + \beta_{emp} lnEMP_{jt} + \beta_{unit} UNIT_{jt} \\ + \beta_{age} AGE_{jt} + \beta_{age2} AGE2_{jt} + \sum_{r=1}^{R-1} \beta_r LOCATION_{rjt} \\ + \sum_{s=1}^{S-1} \beta_s ORIGIN_{sjt} + \sum_{q=1}^{Q-1} \beta_q YEAR_q + v_{jt} \end{aligned} \tag{6.1}$$

lnP_{jt} corresponds to natural logarithm of various measures of economic performance of enterprise j at time t. These measures are natural logarithm of total factor productivity ($lnTFP$)[11], natural logarithm of labour productivity ($lnLP$), natural logarithm of wage per employee ($lnWAGE$), natural logarithm of total employment ($lnEMP$), natural logarithm of capital machines or equipment investment per employee ($lnMAC$) and natural logarithm of total investment per employee ($lnTINV$). The selection of these variables is based on findings in the literature that enterprises with international linkages are more productive in terms of both total factor productivity and labour productivity, pay higher wages, employ more, are more capital machine or equipment investment intensive, and invest more than enterprises without international linkages (Bernard, Jensen, and Schott, 2009).

[10] Please see footnote 17 in chapter 4.

[11] Please see Appendix C: Estimation of Production Function at Enterprise Level for lnTFP.

Channels of international technology transfer considered in this study are $FDIS_{jt}$, $IMPS_{jt}$ and $EXPS_{jt}$ that correspond to international ownership share of enterprise j at time t, import share (import value divided by production value) of enterprise j at time t and export share (export value divided by production value) of enterprise j at time t, respectively.[12] These measures of international linkages identify the effects of varying intensities of international economic involvement on economic performance of automotive parts supplying enterprises in Turkey. As widely discussed in the literature (Keller, 2004), these intensity measures of international economic involvement are supposed to positively contribute to the economic performance of enterprises. Nevertheless, international ownership is expected to have a larger effect compared to import and export channels of international technology transfer as widely discussed in section 6.2.

$lnEMP_{jt}$ is natural logarithm of the number of paid employees in full-time equivalence for enterprise j at time t that is a measure of enterprise size and it reveals differences in production technologies of enterprises of various sizes. $lnEMP$ is only considered in the $lnTFP$ model since dependent variables of other economic performance models are either employment or a share of employee. $UNIT_{jt}$ is the number of local units including headquarters provided headquarters is based in Turkey of enterprise j at time t differentiating enterprises operating in varying number of locations. In addition to $lnEMP$, $UNIT$ is also another measure of enterprise size. AGE_{jt} is the age of enterprise j at time t controlling for the operational experience of enterprise. $AGE2$ is also included as a control in the specifications. $LOCATION_{rjt}$ includes location dummies indicating statistical region r of enterprise j at time t.[13] This set of dummy variables captures productivity disparities amongst Turkish regions due to infrastructure, rule of law, public service quality, and density. $ORIGIN_{sjt}$ including dummies of origin of controlling stake of enterprise indicates ownership origin s of enterprise j at time t.[14] As pointed out in section 6.2, international enterprises originating from various economies have differing practices of transferring technology, so that these origin dummies control for heterogeneities in technology transfer practices of international enterprises. $YEAR_q$ embodies time dummies indicating year that control for macroeconomic shocks and changes in the institutional environment.[15] v_{jt} is an error term (Yasar and Morrison Paul, 2007, p.378).[16]

[12] As suggested by Castellani (2002) that intensity measures of international economic involvement can better capture international technology transfer. Therefore, this model uses intensities rather than dummies to measure the effects of channels of international technology transfer.

[13] There are 24 subregions in the data and Istanbul (TR10), the economic hub of Turkey, is selected as the base. Please see footnote 20 in chapter 4.

[14] There are 20 origins in the data and the USA is selected as the base.

[15] 2003, the first year of the dataset, is selected as the base.

[16] Please see Appendix A: Data Sources, Appendix B: Construction of Enterprise Level Variables and Appendix D: Table D.1 for a list of enterprise level variables, their descriptions and sources.

6.3.1 Findings on International Linkages and Economic Performance Measures

Appendix A: Data Sources explains enterprise level datasets employed here and how these datasets are accessed. Subsection 4.3.2 has already extensively reported descriptive statistics on international and local automotive parts supplying enterprises in Turkey. Therefore, this subsection does not report related descriptive statistics here.

Table 6.1 reports associations between channels of international technology transfer and natural logarithm of total factor productivity ($lnTFP$) for automotive parts supplying enterprises in Turkey during 2003-2011.[17] $lnTFP$ is estimated by methods of Levinsohn and Petrin (2003), pooled OLS and Olley and Pakes (1996) to obtain more robust estimations for $lnTFP$.[18] It appears that all coefficients maintain their signs, and their magnitudes do not change substantially across three $lnTFP$ models as presented in Table 6.1, while all models control for age, location, ownership origin and year.

Table 6.1 reveals that signs of international linkage variables are in line with the expectations. Nevertheless, rankings of their magnitudes do not meet expectations. It is expected that international ownership intensity ($FDIS$) should have had the largest productivity effect amongst three channels but import intensity ($IMPS$) appears to have the largest productivity effect and its magnitude is immensely large compared to other channels. This large effect of import intensity might be due to two factors: first, import also includes importation of capital goods, and hence technology, so $IMPS$ more directly impacts productivity; second, $IMPS$ directly affects production process via input mechanism, so it can better capture direct and immediate effects on productivity. On the other hand, it might take international ownership more time to have a larger effect on productivity. The same might also hold for export intensity ($EXPS$), so the learning effect of export intensity to have a larger impact on productivity, there might be need for longer time span. In all cases, when any international linkage intensity increases by one percentage point, there is less than proportionate increase in productivity as revealed in Table 6.1.

Table 6.1 also indicates that larger the enterprise size ($lnEMP$), lower the productivity of the enterprise becomes. This finding is also supported by the number of local units of enterprise ($UNIT$): larger the number of local units of an enterprise, lower the productivity of the enterprise becomes. As a result, there is a negative relationship between enterprise size and productivity, while controlling for age, location, ownership origin and year.

Table 6.2 also presents associations between international linkages and economic performance measures for automotive parts supplying enterprises in Turkey during 2003-2011.[19] Labour productivity ($lnLP$) is also another measure of productivity in addition

[17] Please note that $FDIS$ is in percentage, whereas $IMPS$ and $EXPS$ are in decimal fractions. Therefore, when magnitudes of coefficients of international linkages are interpreted, only the coefficient of $FDIS$ should be multiplied by 100.

[18] Please see Appendix C: Estimation of Production Function at Enterprise Level for lnTFP based on these three methods and related methodological discussions.

[19] Please see footnote 17.

Table 6.1 International Linkages and Total Factor Productivity (TFP): 2003-11 Pooled OLS

	$lnTFP$ (LEVPET) (1)	$lnTFP$ (OLS) (2)	$lnTFP$ (OPREG) (3)
FDIS	0.002*	0.003**	0.003**
	[0.001]	[0.001]	[0.001]
IMPS	0.517***	0.537***	0.490***
	[0.119]	[0.120]	[0.124]
EXPS	0.228***	0.196***	0.161**
	[0.066]	[0.063]	[0.067]
lnEMP	-0.033**	-0.120***	-0.161***
	[0.017]	[0.016]	[0.017]
UNIT	-0.047*	-0.051**	-0.062**
	[0.027]	[0.026]	[0.027]
AGE	yes	yes	yes
AGE2	yes	yes	yes
LOCATION	yes	yes	yes
ORIGIN	yes	yes	yes
YEAR	yes	yes	yes
Constant	7.839***	1.178***	6.807***
	[0.202]	[0.189]	[0.215]
Observations	5674	5489	4609
R-squared	0.186	0.194	0.211

Notes: (1) Dependent variable is $lnTFP$, estimation of $lnTFP$ is based on methods of Levinsohn and Petrin (2003) in the first model, pooled OLS in the second model and Olley and Pakes (1996) in the last model, and please see Appendix C: Estimation of Production Function at Enterprise Level for lnTFP and Appendix D: Table D.1 for description of enterprise level variables. (2) Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels. (3) Energy is used as a proxy for productivity shocks in estimation of $lnTFP$ (LEVPET). (4) Capital computation assumes depreciation rate of 15% and results are also robust to 5% and 20% of depreciation rates.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

to $lnTFP$ in Table 6.1. Signs and magnitudes of labour productivity with respect to $FDIS$ and $EXPS$ reported in the first model of Table 6.2 are not highly different from their counterparts reported in Table 6.1. On the other hand, magnitude of import intensity becomes larger when productivity is expressed in terms of labour productivity as reported in the first model of Table 6.2. Therefore, when import intensity increases by one percentage point, there is more than proportionate increase in productivity, while holding other factors constant. On the other hand, $UNIT$ changes its sign and becomes insignificant. In other words, in the case of labour productivity as a measure of productivity presented in the first model of Table 6.2 compared to total factor productivity as another measure of productivity reported in Table 6.1, there is positive but statistically insignificant relationship between number of local units of enterprise and labour productivity, whilst controlling for age, location, ownership origin and year.

This study's finding on associations between international linkages and wage paid reported in the second model of Table 6.2 supports the literature (Bernard, Jensen, and Schott, 2009). Higher the intensity of involvement in international economic linkages, greater the wage per employee ($lnWAGE$) becomes. Therefore, increasing wages are associated with greater international linkage intensities. It also appears that higher the number of local units of an enterprise, lower the labour cost per employee becomes since the enterprise can adjust its operation such that it enables the enterprise to spend less on labour per employee. Signs of employment size of enterprises ($lnEMP$) with respect to international linkages are also in line with expectations. All international linkage variables have positive signs and they are also statistically significant except international ownership. It is also worth pointing out that when import rises by one percentage point, there is more than proportionate increase in employment. This is due to the fact that increase in import of capital and intermediate goods directly and immediately requires additional labour. Therefore, compared to labour cost, employment is more responsive to increases in international involvement intensities as indicated by relative coefficients of $IMPS$ and $EXPS$ for $lnWAGE$ and $lnEMP$ with the exception of international ownership intensity. Furthermore, higher the number of local units of an enterprise, larger the employment of the enterprise becomes. As a result, higher the number of operational location of an enterprise, lower the labour cost and larger the employment of the enterprise become.

Inconsistent with expectations, enterprises with higher international ownership and export intensities have lower capital machines or equipment investment per employee ($lnMAC$) and total investment per employee ($lnTINV$) as reported in the fourth and fifth models of Table 6.2.[20] The reason for this might be that currently automotive parts supplying enterprises are required to have similar capital machines or equipment to meet technical standards and customers' demand that have increasingly become high and sophisticated since the last decade. Therefore, increasingly engaging in international ownership or export does not affect capital machines or equipment structure already required to be high for enterprises to be able to operate in the automotive industry. In addition to this, enterprises with lower or no-existent international ownership and export might be highly motivated to make more investment in order to get involved in international linkages well before initiation of more international linkages. On the other hand, signs of import intensity in the fourth and fifth models of Table 6.2 are reported as expected and consistent with previous results, and their magnitudes even become larger compared to previous models. Reasons for this large effect of import intensity might be: first, import also involves importation of capital machines or equipment, other investment

[20]Please note that models 4 and 5 in Table 6.2 have much lower explanatory powers or smaller R-squares than previous models. Please see footnote 28 in chapter 4.

goods those are directly captured by $lnMAC$ and $lnTINV$; second, increases in import of intermediate inputs and raw materials can create need for extra investment, and hence additional import of capital goods translating into larger $lnMAC$ and $lnTINV$. When import intensity increases by one percentage point, capital machines or equipment investment per employee and total investment per employee increase by around two percent. Despite being statistically insignificant, enterprises with higher number of local units have greater capital machines or equipment investment per employee, and total investment per employee which confirms expectations, while controlling for age, location, ownership origin and year.

Table 6.2 International Linkages and Economic Performance Measures: 2003-11 Pooled OLS

	$lnLP$ (1)	$lnWAGE$ (2)	$lnEMP$ (3)	$lnMAC$ (4)	$lnTINV$ (5)
FDIS	0.003**	0.004***	0.003	-0.003	-0.005*
	[0.001]	[0.001]	[0.002]	[0.003]	[0.003]
IMPS	1.267***	0.601***	1.677***	1.988***	2.206***
	[0.152]	[0.085]	[0.205]	[0.277]	[0.246]
EXPS	0.219***	0.195***	0.670***	-0.15	-0.162
	[0.072]	[0.044]	[0.101]	[0.153]	[0.149]
UNIT	0.028	-0.029*	0.341***	0.019	0.041
	[0.029]	[0.015]	[0.046]	[0.053]	[0.053]
AGE	yes	yes	yes	yes	yes
AGE2	yes	yes	yes	yes	yes
LOCATION	yes	yes	yes	yes	yes
ORIGIN	yes	yes	yes	yes	yes
YEAR	yes	yes	yes	yes	yes
Constant	11.146***	9.441***	3.387***	7.411***	7.537***
	[0.214]	[0.116]	[0.466]	[0.438]	[0.397]
Observations	7186	7188	7188	5277	5432
R-squared	0.23	0.377	0.346	0.067	0.069

Notes: (1) Dependent variable is stated at the beginning of each model and please see Appendix D: Table D.1 for description of enterprise level variables. (2) Robust standard errors are in brackets and *** *p<0.01,* ** *p<0.05,* * *p<0.1* indicate significance levels.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

As a result, there are positive associations between international linkages and economic performance measures. Therefore, enterprises with higher international linkages are more productive, pay more and employ more, which is well established in the literature (Keller, 2004). Nevertheless, expectation on relationships between international ownership intensity and investment, and export intensity and investment are not met. This might be due to the special structure of the automotive industry in which high level of investment is already required, irrespective of international ownership and orientation of market, i.e. international market vs. local market.

Three points should also be considered when interpreting the results reported in Table 6.1 and Table 6.2. First, these results primarily capture short-run relationships but magnitudes and direction of relationships can change in the long-run. Second, the same or similar practices contributing to economic performance of enterprises can be transmitted via multiple international technology transfer channels. Therefore, it is not straightforward to relate a particular practice resulting in economic performance improvements with a specific international technology transfer channel. Last, these results do not capture specific practices or mechanisms of international technology transfer channels. Therefore, this study focuses on economic performance outcomes of international technology transfer channels, so it is still open question that which practices are transferred via which international technology transfer channels, and what the extent of relative contribution of particular practices or mechanisms of these channels to productivity or economic performance of enterprises is.

6.4 Link between Channels of International Technology Transfer and Productivity

This section introduces a flexible model to seek the relationship between international linkages and productivity improvements by utilising OLS and quantile regression (Koenker, 2005) methods allowing for control of enterprise size heterogeneities. As a result, this study estimates the following translog production function model that is similar to the model in Yasar and Morrison Paul (2007)[21] by both OLS and quantile regression methods.

$$
\begin{aligned}
lnY_{jt} = \beta_2 + \beta_{fdis}FDIS_{jt} + \beta_{imps}IMPS_{jt} + \beta_{exps}EXPS_{jt} \\
+\beta_l lnL_{jt} + \beta_{k15} lnK15_{jt} + \beta_m lnM_{jt} + \beta_e lnE_{jt} \\
+\beta_t t + \gamma_{lt} lnL_{jt}t + \gamma_{k15t} lnK15_{jt}t + \gamma_{mt} lnM_{jt}t + \gamma_{et} lnE_{jt}t \\
+.5(\delta_{ll} lnL_{jt} lnL_{jt} + \delta_{lk15} lnL_{jt} lnK15_{jt} + \delta_{lm} lnL_{jt} lnM_{jt} + \delta_{le} lnL_{jt} lnE_{jt} \\
+\delta_{k15k15} lnK15_{jt} lnK15_{jt} + \delta_{k15m} lnK15_{jt} lnM_{jt} + \delta_{k15e} lnK15_{jt} lnE_{jt} \\
+\delta_{mm} lnM_{jt} lnM_{jt} + \delta_{me} lnM_{jt} lnE_{jt} + \delta_{ee} lnE_{jt} lnE_{jt} + \delta_{tt} t^2) \\
+\sum_n \beta_n SIZE_{njt} + \beta_{age} AGE_{jt} + \beta_{age2} AGE2_{jt} \\
+\sum_r \beta_r LOCATION_{rjt} + \sum_s \beta_s ORIGIN_{sjt} + \phi_{jt}
\end{aligned}
\tag{6.2}
$$

[21] Please see section 6.3 for details on differences between this study and Yasar and Morrison Paul (2007)'s study.

lnY_{jt} is natural logarithm of output that is deflated aggregate production value with changes in inventory considered for enterprise j at time t. The following variables identify inputs: lnL_{jt} is natural logarithm of labour input that is directly measured as total hours worked calculated as average weekly hours worked times the number of paid employees in full-time equivalence times 48 (average number of weeks in a year) for enterprise j at time t. $lnK15_{jt}$ is natural logarithm of capital input that is measured by cumulating net investment over years which is deflated by the capital goods price index of the TurkStat and adjusted for depreciation rate of 15% (the perpetual inventory method) for enterprise j at time t.[22] lnM_{jt} is natural logarithm of material input that is deflated material input expenditure with changes in material input inventory considered for enterprise j at time t. lnE_{jt} is natural logarithm of energy input that is deflated expenditure on electricity and fuel for enterprise j at time t. t is a time trend (counter). The model also embodies interactions between inputs and time counter as well as interactions between inputs.

Channels of international technology transfer considered in this study are $FDIS_{jt}$, $IMPS_{jt}$ and $EXPS_{jt}$ that correspond to international ownership share of enterprise j at time t, import share (import value divided by production value) of enterprise j at time t and export share (export value divided by production value) of enterprise j at time t, respectively.[23] These measures of international linkages identify the effects of varying intensities of international economic engagement on productivity of automotive parts supplying enterprises in Turkey. These channels of international technology transfer are suggested to positively affect productivity of enterprises (Keller, 2004). $SIZE_{njt}$ includes enterprise size dummies indicating size n of enterprise j at time t. There are three categories on enterprise size: first is small enterprise employing fewer than 50 employees, second is medium enterprise whose number of employees are from 50 to 99, and third is large enterprise employing 100 or more employees. Enterprise size dummies are included in estimations to control for production technology differences related to enterprise size.[24,25] ϕ_{jt} is a stochastic error term.[26]

[22]Please see footnote 28 in chapter 4.

[23]Dummy measures of international linkages are also employed in the estimations. Different from intensity measures of international linkages, dummy measures of international linkages identify productivity differences between those get involved in a particular international activity and those do not. In this respect, FDI_{jt} refers to whether enterprise j at time t has an international ownership share of at least 10%, IMP_{jt} corresponds to whether enterprise j at time t engages in import, and EXP_{jt} refers to whether enterprise j at time t engages in export.

[24]Please see section 6.3 for explanation of AGE_{jt}, $AGE2_{jt}$, $LOCATION_{rjt}$ and $ORIGIN_{sjt}$ included in the estimations to control for enterprise and regional characteristics.

[25]Please note that large enterprise size is selected as the base.

[26]Please see footnote 16.

6.4.1 Findings on the Link between Channels of International Technology Transfer and Productivity

As noted earlier that Appendix A: Data Sources explains enterprise level datasets used here and how these datasets are accessed. Subsection 4.3.2 has already extensively reported descriptive statistics on international and local automotive parts supplying enterprises in Turkey. Hence, this subsection does not report related descriptive statistics here.

Table 6.3 and Table 6.4 report the productivity effects of international linkages in the Turkish automotive parts industry during 2003-2011.[27] It should be noted that Table 6.3 reports the quantitative model referring to the specifications using intensity measures of international linkages, while Table 6.4 reports the qualitative model corresponding to the specifications employing dummy measures of international linkages. It should also be noted that international linkage variables of both the quantitative model and the qualitative model lagged by one year to consider endogeneity issues, and all models reported in Table 6.3 and Table 6.4 control for size, age, location and ownership origin.

Table 6.3 supports general expectations on signs of international linkage intensity variables. The same signs have already been reported in subsection 6.3.1 but what changes is magnitudes of these international linkage intensity variables: magnitudes of these variables are now much smaller than their counterparts in Table 6.1. In particular, import intensity still has the largest productivity effect compared to international ownership intensity and export intensity. As a result, findings on the link between international technology transfer channels and productivity presented in subsection 6.3.1 are robust to estimation of a flexible model of translog production function. These findings are also robust to the quantile regression method that is stronger to outliers (Koenker, 2005).

Having much smaller effect on the productivity compared to import intensity as also presented in Table 6.1, productivity effect of international ownership intensity ($FDIS$) reported in Table 6.3 becomes almost one third of what is presented in Table 6.1. $FDIS$ also sustains its magnitude across quantiles except quantile 50. On the other hand, Yasar and Morrison Paul (2007) present $FDIS$ as having the largest effect on productivity compared to other channels of international technology transfer; there are large differences between coefficients of $FDIS$ reported in Table 6.3 and Yasar and Morrison Paul (2007)'s study. This is due mainly to the fact that this study concerns post-2002 period during which the Turkish automotive parts industry has undergone substantial transformation, whereas Yasar and Morrison Paul (2007) investigate pre-2002 period.[28]

Having the largest productivity effect as also presented in Table 6.1, productivity effect of import intensity ($IMPS$) becomes around half of what is reported in Table 6.1, and even it becomes around one fourth of what is presented in Table 6.1 in mid-quantiles of 25, 50 and 75. Therefore, $IMPS$ has larger productivity effects on small and large enterprises. When $IMPS$ increases by one percentage point, there is less than proportionate

[27] Please see footnote 17.
[28] Please see footnote 21.

increase in productivity. Yasar and Morrison Paul (2007) report *IMPS* as having the lowest productivity effect amongst other channels of international technology transfer that is in contrast to the findings of this study. Magnitude of *IMPS* reported in Yasar and Morrison Paul (2007)'s study is from around one fifth to about half of what is reported in Table 6.3. This is due mainly to the fact that import data in Yasar and Morrison Paul (2007)'s study involves just import of capital machines or equipment, and data on import comes from the Annual Survey of Manufacturing Industries Dataset of the TurkStat asking enterprises to report their import of capital machines or equipment. On the other hand, import data used in this study does not only involve import data of capital goods but it also embodies intermediate goods, raw materials and other items' import data, and data on import is directly obtained from the customs declarations of enterprises accessed from the Foreign Trade Statistics Dataset of the TurkStat.

Productivity effect of export intensity (*EXPS*) reported in Table 6.3 is much smaller than its counterpart presented in Table 6.1. Coefficient of *EXPS* increases when the model is estimated by the quantile regression method compared to the OLS method. *EXPS* maintains, to some extent, its magnitude across quantiles meaning that there are not large variations in productivity effect of *EXPS* across differing enterprise sizes. Magnitude of *EXPS* reported in Yasar and Morrison Paul (2007)'s study is the same as or up to twice of what is reported in Table 6.3. On the other hand, differences in magnitudes of *FDIS* and *IMPS* between the ones reported in Yasar and Morrison Paul (2007)'s study and the ones presented in Table 6.3 are larger compared to *EXPS* magnitude difference.[29]

Table 6.3 Channels of International Technology Transfer and Productivity: 2003-11 Quantitative

	lnY					
		Quantile Regressions				
	OLS	Quantile 10	Quantile 25	Quantile 50	Quantile 75	Quantile 90
	(1)	(2)	(3)	(4)	(5)	(6)
FDISL1	0.001**	0.001*	0.001*	0	0.001**	0.001
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]	[0.001]
IMPSL1	0.261***	0.209***	0.126***	0.120***	0.175***	0.228***
	[0.054]	[0.059]	[0.038]	[0.034]	[0.038]	[0.055]
EXPSL1	0.075**	0.131***	0.109***	0.108***	0.110***	0.107***
	[0.031]	[0.033]	[0.025]	[0.017]	[0.017]	[0.031]
lnL	0.396***	0.376*	0.558***	0.675***	0.494***	0.577***
	[0.130]	[0.225]	[0.121]	[0.097]	[0.102]	[0.136]
lnK15	0.148**	0.132	0.172***	0.164***	0.163***	0.151**

Continued on the next page

[29]Please see footnote 21.

International Technology Transfer and Productivity: 2003-11 Quantitative (Continued)

	[0.058]	[0.096]	[0.058]	[0.055]	[0.060]	[0.071]
lnM	0.515***	0.602***	0.452***	0.295***	0.331***	0.036
	[0.098]	[0.120]	[0.083]	[0.086]	[0.084]	[0.114]
lnE	0.09	0.189	0.02	0.029	0.042	0.236**
	[0.090]	[0.133]	[0.079]	[0.071]	[0.069]	[0.111]
t	0.029	-0.002	0	0.049**	0.065***	0.074*
	[0.029]	[0.042]	[0.031]	[0.025]	[0.024]	[0.039]
lnLt	0.003	0.01	0.009*	0.003	0.002	0.011*
	[0.006]	[0.008]	[0.005]	[0.004]	[0.005]	[0.006]
lnK15t	0.001	0.002	0.001	0.001	0	-0.002
	[0.002]	[0.005]	[0.003]	[0.002]	[0.003]	[0.003]
lnMt	-0.006	-0.005	-0.005	-0.005*	-0.005	-0.007*
	[0.004]	[0.007]	[0.004]	[0.003]	[0.003]	[0.004]
lnEt	0.001	-0.003	-0.003	0	0	-0.006
	[0.003]	[0.005]	[0.003]	[0.003]	[0.003]	[0.004]
lnLlnL	0.105***	0.057**	0.084***	0.121***	0.148***	0.137***
	[0.016]	[0.026]	[0.023]	[0.024]	[0.019]	[0.027]
lnLlnK15	-0.005	0.044	0.027	0.012	0.001	-0.002
	[0.021]	[0.033]	[0.019]	[0.017]	[0.016]	[0.019]
lnLlnM	-0.176***	-0.147**	-0.234***	-0.282***	-0.269***	-0.253***
	[0.044]	[0.059]	[0.045]	[0.029]	[0.021]	[0.032]
lnLlnE	-0.006	-0.009	0.035	0.02	-0.007	-0.024
	[0.028]	[0.043]	[0.030]	[0.022]	[0.019]	[0.033]
lnK15lnK15	0.013**	-0.004	0	0.009**	0.017***	0.023***
	[0.005]	[0.009]	[0.005]	[0.004]	[0.005]	[0.008]
lnK15lnM	-0.041**	-0.062***	-0.040***	-0.046***	-0.057***	-0.062***
	[0.017]	[0.023]	[0.014]	[0.013]	[0.010]	[0.017]
lnK15lnE	0.01	0.027	0.002	0.005	0.014	0.013
	[0.016]	[0.021]	[0.013]	[0.010]	[0.011]	[0.022]
lnMlnM	0.117***	0.112***	0.145***	0.181***	0.182***	0.208***
	[0.020]	[0.026]	[0.025]	[0.013]	[0.010]	[0.016]
lnMlnE	-0.054**	-0.043	-0.041*	-0.051**	-0.067***	-0.102***
	[0.021]	[0.027]	[0.024]	[0.020]	[0.016]	[0.025]
lnElnE	0.031***	0.006	0.013	0.024***	0.042***	0.062***
	[0.011]	[0.010]	[0.008]	[0.008]	[0.009]	[0.020]
t2	0.007***	0.003	0.007**	0.005**	0.006***	0.009**
	[0.002]	[0.004]	[0.003]	[0.002]	[0.002]	[0.004]
SIZE	yes	yes	yes	yes	yes	yes
AGE	yes	yes	yes	yes	yes	yes
AGE2	yes	yes	yes	yes	yes	yes
LOCATION	yes	yes	yes	yes	yes	yes

Continued on the next page

International Technology Transfer and Productivity: 2003-11 Quantitative (Continued)

ORIGIN	yes	yes	yes	yes	yes	yes
Constant	0.589	-0.957	0.008	0.579	1.566***	2.538***
	[0.744]	[1.153]	[0.607]	[0.460]	[0.596]	[0.640]
Observations	5220	5220	5220	5220	5220	5220
R-squared	0.956					

Notes: (1) Dependent variable is *lnY* and please see Appendix D: Table D.1 for description of enterprise level variables. (2) Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

As indicated earlier that Table 6.4 employs dummy measures of international linkages that reveal average productivity differences between enterprises those get engage in a specific channel of international technology transfer and those do not.[30] Therefore, this average productivity difference is due to movement from non-existence of an international linkage to existence of a specific international linkage. On the other hand, intensity measures of international linkages reveal productivity effects of varying intensities of international linkages as reported in Table 6.3.

In contrast to productivity rankings of international linkages reported in Table 6.3, international ownership engagement (FDI) now ranks as the largest productivity linkage according to the OLS estimation method as reported in Table 6.4. The first place of FDI in the ranking is consistent with the expectations but as stated earlier that this is not confirmed in Table 6.3. Holding other factors constant, enterprises having an international ownership share of at least 10% are, on average, 12.5% more productive than those having less than 10% international ownership share, based on the OLS estimation method. Nevertheless, magnitude of this differential decreases once the model is estimated by the quantile regression method, and even productivity differential of FDI gets smaller until quantile 75 that indicates productivity differential of FDI is larger in small and large enterprises. The major reason why international ownership productivity differential is relatively larger compared to import and export productivity differentials, at least according to the OLS estimation method, might be that once there is international ownership engagement of at least 10% as reported in Table 6.4, then there are not major increases in productivity in response to international ownership intensity increases as shown in Table 6.3. On the other hand, in addition to having productivity differentials as reported in Table 6.4, further increases in import and export intensities as indicated in Table 6.3 results in larger

[30] Please note that Table 6.3 and Table 6.4 appear to have highly similar explanatory powers or R-squares in three decimal digits.

productivity improvements compared to productivity effects of international ownership intensity as revealed in Table 6.3. As a result, international ownership channel is less responsive to variations in intensity after the threshold of 10%, whereas import and export channels are relatively more responsive to variations when considering estimation results in Table 6.3 and Table 6.4 together. This result somewhat disputes the findings in the literature.

Import engagement (IMP) has now the second largest productivity differential compared to its first place in Table 6.3 according to the OLS estimation method reported in the first model of Table 6.4. Holding other factors fixed, enterprises getting engaged in import are, on average, 7.5% more productive than those do not based on the OLS estimation method. This magnitude of import productivity differential being smaller than international ownership differential is consistent with the expectations. Nevertheless, once the model estimated by the quantile regression method productivity differential of import increases in quantile 10 and decreases in quantile 25 to a level reported in the OLS model and fluctuates approximately around this level throughout quantiles 50, 75 and 90.

Export engagement (EXP) reported in Table 6.4 has the smallest productivity differential, irrespective of methods employed and quantiles. Corresponding estimation results in Table 6.1 and Table 6.3 are not directly comparable since Table 6.4 reports dummy measures of international linkages, while Table 6.1 and Table 6.3 indicate intensity measures of international linkages. Holding other factors constant, enterprises getting involved in export are, on average, 3.4% more productive than those do not based on the OLS estimation method. This productivity differential does not substantially change once the model is estimated by the quantile regression method. It should be noted that the middle quantiles, namely 25, 50 and 75 have larger export productivity differentials than quantiles 25 and 90. Therefore, middle size enterprises benefit more from starting to engage in export.

Table 6.4 Channels of International Technology Transfer and Productivity: 2003-11 Qualitative

	lnY					
		Quantile Regressions				
	OLS	Quantile 10	Quantile 25	Quantile 50	Quantile 75	Quantile 90
	(1)	(2)	(3)	(4)	(5)	(6)
FDIL1	0.125***	0.074	0.071**	0.062***	0.055**	0.074**
	[0.033]	[0.050]	[0.028]	[0.024]	[0.024]	[0.035]
IMPL1	0.075***	0.106***	0.074***	0.060***	0.071***	0.068***
	[0.016]	[0.021]	[0.014]	[0.011]	[0.010]	[0.016]
EXPL1	0.034**	0.029	0.039***	0.048***	0.046***	0.026

Continued on the next page

International Technology Transfer and Productivity: 2003-11 Qualitative (Continued)

	[0.014]	[0.019]	[0.012]	[0.011]	[0.011]	[0.020]
lnL	0.389***	0.337	0.585***	0.647***	0.510***	0.524***
	[0.129]	[0.211]	[0.143]	[0.084]	[0.105]	[0.134]
lnK15	0.120**	0.03	0.129**	0.115**	0.143**	0.096
	[0.057]	[0.114]	[0.065]	[0.052]	[0.064]	[0.079]
lnM	0.495***	0.525***	0.445***	0.305***	0.251***	0.095
	[0.100]	[0.127]	[0.083]	[0.078]	[0.081]	[0.124]
lnE	0.072	0.245**	-0.01	0.029	0.053	0.2
	[0.091]	[0.123]	[0.081]	[0.072]	[0.077]	[0.131]
t	0.039	0.007	-0.016	0.052**	0.066***	0.085**
	[0.029]	[0.048]	[0.028]	[0.021]	[0.025]	[0.035]
lnLt	0.003	0.011	0.008	0.004	0.002	0.01
	[0.006]	[0.010]	[0.006]	[0.004]	[0.005]	[0.007]
lnK15t	0	0.001	0.001	0.001	0	-0.001
	[0.002]	[0.005]	[0.002]	[0.002]	[0.003]	[0.003]
lnMt	-0.005	-0.008	-0.005	-0.006**	-0.005*	-0.005
	[0.004]	[0.007]	[0.004]	[0.003]	[0.003]	[0.004]
lnEt	0.002	0	0	0	0	-0.007
	[0.003]	[0.005]	[0.003]	[0.003]	[0.003]	[0.005]
lnLlnL	0.104***	0.057**	0.074***	0.121***	0.150***	0.138***
	[0.017]	[0.025]	[0.025]	[0.023]	[0.018]	[0.024]
lnLlnK15	-0.004	0.048	0.022	0.014	-0.008	0.006
	[0.021]	[0.039]	[0.022]	[0.016]	[0.016]	[0.025]
lnLlnM	-0.175***	-0.143***	-0.221***	-0.285***	-0.267***	-0.255***
	[0.044]	[0.052]	[0.043]	[0.026]	[0.024]	[0.038]
lnLlnE	-0.004	-0.013	0.04	0.025	-0.003	-0.02
	[0.028]	[0.037]	[0.028]	[0.018]	[0.019]	[0.034]
lnK15lnK15	0.013**	-0.006	0.005	0.008**	0.016***	0.024***
	[0.005]	[0.009]	[0.005]	[0.004]	[0.005]	[0.008]
lnK15lnM	-0.038**	-0.043**	-0.042***	-0.039***	-0.047***	-0.065***
	[0.017]	[0.019]	[0.014]	[0.011]	[0.011]	[0.020]
lnK15lnE	0.01	0.022	0.004	0.002	0.014	0.015
	[0.016]	[0.022]	[0.013]	[0.011]	[0.012]	[0.024]
lnMlnM	0.117***	0.109***	0.144***	0.179***	0.183***	0.208***
	[0.020]	[0.024]	[0.023]	[0.013]	[0.009]	[0.018]
lnMlnE	-0.054**	-0.049**	-0.051**	-0.056***	-0.072***	-0.108***
	[0.021]	[0.024]	[0.021]	[0.016]	[0.015]	[0.022]
lnElnE	0.031***	0.008	0.016*	0.026***	0.042***	0.067***
	[0.011]	[0.008]	[0.009]	[0.007]	[0.009]	[0.022]
t2	0.006***	0.002	0.006**	0.004	0.006***	0.005
	[0.002]	[0.004]	[0.002]	[0.003]	[0.002]	[0.004]

Continued on the next page

International Technology Transfer and Productivity: 2003-11 Qualitative (Continued)

SIZE	yes	yes	yes	yes	yes	yes
AGE	yes	yes	yes	yes	yes	yes
AGE2	yes	yes	yes	yes	yes	yes
LOCATION	yes	yes	yes	yes	yes	yes
ORIGIN	yes	yes	yes	yes	yes	yes
Constant	1.06	0.216	0.347	1.045**	2.200***	2.973***
	[0.744]	[1.151]	[0.732]	[0.432]	[0.672]	[0.846]
Observations	5220	5220	5220	5220	5220	5220
R-squared	0.956					

Notes: (1) Dependent variable is *lnY* and please see Appendix D: Table D.1 for description of enterprise level variables. (2) Robust standard errors are in brackets and *** *p<0.01,* ** *p<0.05,* * *p<0.1* indicate significance levels.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

As a result, this subsection based on estimation of a flexible model of translog production function supports general expectations as well as findings reported in subsection 6.3.1. In addition to being estimated by the OLS estimation method, this flexible model of translog production function is estimated by the quantile regression method that is more robust to outliers. Furthermore, both quantitative and qualitative measures of international linkages are employed in estimation of this flexible model of translog production function.[31] Signs of international linkage variables in both quantitative and qualitative specifications are positive and in line with the ones reported in Table 6.1. Nevertheless, rankings of productivity effects of international linkages vary across different measures of international linkages as indicated in Table 6.3 and Table 6.4. In addition to this, in comparison with Table 6.1, the extent of productivity effect of international linkages becomes much smaller as revealed in Table 6.3 when a flexible model of translog production function is employed. On the other hand, import intensity has the largest productivity effect amongst international linkages reported in both Table 6.1 and Table 6.3.

Despite variations in magnitudes and rankings of international linkage variables presented in this study and Yasar and Morrison Paul (2007)'s study, international linkage variables have positive signs in both studies. Nevertheless, it should be noted that Yasar and Morrison Paul (2007)'s study does not just consider the automotive industry, it considers apparel and textile industries, and it does not also distinguish between highly distinct

[31] The former consideration measures changes in productivity due to changes in intensity of a particular international technology transfer channel, while the latter consideration measures productivity differentials due to existence of engagement in a particular international technology transfer channel. Therefore, these two measures are not directly comparable but they are rather complementary.

enterprises of motor vehicle assemblers and automotive parts suppliers. On the other hand, this study just considers automotive parts supplying enterprises to account for heterogeneity. Second, Yasar and Morrison Paul (2007) analyse the 1990-1996 period, while this study analyses the 2003-2011 period during which the Turkish automotive parts industry experienced substantial transformation.[32]

6.5 Summary

Developing economies can benefit from international technology transfer to raise their productivity levels, thereby sustaining their economic growth. This chapter utilised a number of unique enterprise level datasets of the TurkStat to comparatively investigate associations between international linkages and economic performance indicators, and the link between international technology transfer channels and productivity by focusing on automotive parts supplying enterprises in Turkey during the period 2003-2011.

This chapter found that during the period 2003-2011 automotive parts supplying enterprises in Turkey with international linkages are more productive, pay more and employ more confirming earlier descriptive analysis in subsection 4.3.2, which is also well established in the literature of international linkages (Keller, 2004) and in line with Yasar and Morrison Paul (2007)'s study. Nonetheless, associations between international ownership intensity and investment, and export intensity and investment are in reverse direction but statistically insignificant which is opposite to the literature. This results mainly from the high level of minimum capital investment requirement of the industry, irrespective of the extent of international linkages. This chapter also estimated a flexible model of translog production function based on intensity and dummy measures of international linkages by both OLS and quantile regression methods and found that all international linkages result in productivity increases as revealed in intensity specifications and all international technology transfer channels also have positive productivity premiums as indicated in dummy specifications, which is consistent with the literature (Keller, 2004) and studies on Turkey (Aslanoglu, 2000; Ozcelik and Taymaz, 2004; Yasar and Morrison Paul, 2007; Taymaz and Yilmaz, 2008a; Maggioni, 2010; Fatima, 2016). Nonetheless, productivity rankings of individual international technology transfer channels are not in line with the literature: in place of international ownership intensity as suggested in the literature to have the largest productivity effect, import intensity is identified as having the largest productivity effect but international ownership still has the largest productivity premium. This might stem from that import transactions inherently embody technology transfers reflected by the finding in chapter 5 on high technological intensity of Turkey's automotive parts import, so import can result in larger productivity effects in short period of time, whereas productivity effects of technology transfer from international ownership can require larger period of time to realise.

[32] Please see footnote 21.

Chapter 7

Conclusion

7.1 Introduction

This study investigates whether there is productivity effect through international technology transfer in one of the most significant and internationally involved industries of a large developing country, namely the Turkish automotive parts industry. Being at sector level, previous studies on international technology transfer cannot account for heterogeneities across sectors and within sectors. Before conducting this particular investigation of international technology transfer in the Turkish automotive parts industry, this study develops a more accurate measure of technological intensity for individual automotive parts, namely patent counts for each automotive part enabling identification of technological and economic characteristics of the Turkish automotive parts industry. Focusing mainly on the motor vehicle assembly section of the Turkish automotive industry, previous case studies have not thoroughly examined the automotive parts supply section of the industry. Therefore, this study does not only enhance the understanding of both motor vehicle assembly and automotive parts supply sections of the Turkish automotive industry, but it also provides insights into technological and economic relations of the global automotive industry with a developing economy, namely Turkey.

This study: first, developed an understanding of the global automotive sector in chapter 2 and second, advanced the understanding of the Turkish automotive sector in chapter 3 introduced in the previous chapter. Third, this study in chapter 4 established the significance of the Turkish automotive industry in the Turkish manufacturing sector and descriptively analysed key economic characteristics of both motor vehicle assembling and automotive parts supplying enterprises in Turkey, while considering ownership characteristics of enterprises. Fourth, this study in chapter 5 developed a more accurate measure of technological intensity at disaggregated level, 6-digit HS level to identify technological intensity of Turkey's automotive parts import, export and production, thereby establishing technological stand of the Turkish automotive parts industry. Last, given the technological stand of the Turkish automotive parts industry revealed in the previous chapter, this study in chapter 6 investigated economic performance differentials between automotive parts supplying enterprises in Turkey with varying intensities of international economic interactions and the link between international technology transfer channels and productivity for automotive parts supplying enterprises in Turkey to determine whether automotive parts supplying enterprises in Turkey benefit from involvement in international economic interactions.

Section 7.2 provides an overview of main findings of this study by chapter. Section 7.3 explains main recommendations of this study and policy implications. Section 7.4 underlines limitations of this study and makes recommendations for future research.

7.2 Overview of Main Findings

The Turkish automotive industry does not just simply assemble motor vehicles from imported automotive parts for its internal market, and nor does it engage in manufacture of automotive parts embodying simple technology and low value added. During the last decade, the Turkish automotive industry has transformed itself to get involved in design and R&D activities, and acquired substantial skills in design and innovation, and also created high value added due mainly to its extensive integration with the global automotive industry, especially with the European automotive value chain. Despite still having a lower motor vehicle ownership rate, the Turkish motor vehicle market has also been relatively strong and substantially expanding during the last decade. Therefore, the Turkish motor vehicle market is far away from saturated giving rise to more opportunities for the Turkish automotive industry.

Chapter 2 indicates that Turkey accounts for more than 1% of the world automotive imports, exports, motor vehicle assembly and market. The Turkish automotive sector has also displayed performance in automotive imports, exports, and motor vehicle assembly and market similar to or better than comparable countries' during the last decade. Automotive imports and exports constitute more than 10% of Turkey's total imports and exports. Import of automotive parts constitutes the majority of Turkey's automotive imports, while export of motor vehicles constitutes the majority of Turkey's automotive exports. More than 70% of Turkey's motor vehicle assembly are also exported. Imported motor vehicles account for more than 70% of Turkey's motor vehicle sales. Furthermore, motor vehicle assembly of Turkey is larger than its sales by one third. Therefore, the Turkish automotive sector is highly open and well integrated with the global automotive sector as a motor vehicle assembly hub. On the other hand, Turkey has a much lower motor vehicle ownership rate than comparable countries' resulting in potentials for the automotive industry. As result, the Turkish automotive sector is a major regional motor vehicle assembly hub and market having significant opportunities for the automotive industry.

Chapter 3 reveals that more than three quarters of automotive imports and exports of Turkey are carried out with Europe. Turkey tends to import automotive parts from and export motor vehicles to Europe consistent with Turkey's regional motor vehicle assembly hub structure as also revealed in section 2.5. Nevertheless, having a large internal motor vehicle market, Turkey has recently been importing motor vehicles as a larger share of its automotive imports from Europe. Therefore, the Turkish automotive sector is integrated well with the European automotive sector in terms of motor vehicle assembly and market. The MENA is the second largest destination of Turkey's automotive exports After Europe. Nevertheless, despite having wide cross-border trade relations with the MENA in other sectors, Turkey has not forged extensive cross-border trade relations with the MENA in the automotive sector. Asia-Pacific is the second largest source of Turkey's automotive imports after Europe. The vast majority of these automotive imports are in the form of automotive parts. On the other hand, Asia-Pacific is the fourth largest destination of Turkey's automotive exports after Europe, the MENA and Americas, and most of these automotive exports are in the form of automotive parts. The Americas are a growing partner of the Turkish automotive sector, as well.

This study in chapter 3 also determines four specific cross-border automotive trade patterns of Turkey with its individual major partners based on compositions of automotive imports and exports. The first pattern is identified with Turkey's regional motor vehicle assembly hub structure and motor vehicle market structures of Turkey's partners within this pattern e.g., Italy. Turkey's automotive trade involvement with such countries is based on sourcing automotive parts for its motor vehicle assembly and then dispatching motor vehicles assembled. The second pattern also, to some extent, is characterised by Turkey's regional motor vehicle assembly hub structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., South Africa. Turkey sources automotive parts for its motor vehicle assembly and dispatches automotive parts to supply motor vehicle assembly abroad. The third pattern characterises Turkey's motor vehicle market structure and motor vehicle assembly structures of Turkey's partners within this pattern e.g., Germany. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles, while Turkey dispatches more than 50% of its automotive exports to such countries in the form of automotive parts. The fourth pattern is identified with Turkey's motor vehicle market and regional motor vehicle assembly hub structures as well as motor vehicle market and assembly structures of Turkey's partners within this pattern e.g., Spain. Turkey sources more than 50% of its automotive imports from such countries in the form of motor vehicles and dispatches more than 50% of its automotive exports to such countries in the form of motor vehicles.

A thorough examination of Turkey's automotive parts imports and exports also reveals a significant pattern of the Turkish automotive industry that in Turkey it is more likely to import automotive parts as a system, while it is more likely to export automotive parts as unassembled. This pattern is in line with the motor vehicle assembly oriented structure of the Turkish automotive industry.

Chapter 4 identifies seven particular points on economic characteristics of the Turkish automotive industry and the significance of the Turkish automotive industry in the Turkish manufacturing sector. First, small scaled enterprises employing fewer than 20 workers comprise about three quarters of all enterprises in the Turkish automotive industry. Nevertheless, more than 90% of the employment, labour spending, investment and output of the Turkish automotive industry are generated by automotive enterprises of the size of more than 20 employees. Second, the average size of automotive enterprises is also much larger than the average size of manufacturing enterprises in Turkey. Third, international ownership in the Turkish automotive industry is one of the highest amongst the Turkish manufacturing industries. Fourth, the Turkish automotive industry is one of the largest importing and exporting manufacturing industries in Turkey and automotive imports and exports constitute a significant part of Turkey's total imports and exports as indicated in section 3.3. Fifth, the Turkish automotive industry is the largest R&D intensive manufacturing industry. It comprises around one third of the Turkish manufacturing sector R&D expenditure and employs around one fifth of the Turkish manufacturing sector R&D workers. Sixth, the Turkish automotive industry is the largest investment intensive manufacturing industry and even this rate becomes larger if only machinery and equipment investment is taken into account. Last, the Turkish automotive industry has a significant place in the Turkish manufacturing sector in terms of employment, labour expenditure and output. The Turkish automotive industry's R&D and labour expenditures per employee, investment and output per employee are also well larger than manufacturing sector average.

Chapter 4 also determines five particular points on economic characteristics of automotive enterprises in Turkey during the period 2003-2011. First, international automotive parts supplying enterprises exhibit a higher level of integration into the global automotive industry when imports and exports characteristics of both international and local automotive parts suppliers are compared (Bernard, Jensen, Redding, et al., 2007; Manova and Zhang, 2009; Bernard, Jensen, Redding, et al., 2012). International motor vehicle assembling enterprises even display a higher level of integration into the global automotive industry compared to international automotive parts supplying enterprises. Second, while none of ownership kinds are clearly dominant in the supply section of the Turkish automotive industry, it is enterprises with at least 10% international ownership clearly prevails over the assembly section of the Turkish automotive industry in all economic terms. Third, international automotive parts supplying enterprises are, on average, inclined to utilise more material and capital machines or equipment, whilst local automotive parts supplying enterprises tend to use more labour and energy in their input mix (Blalock and Veloso, 2007; Inklaar and Timmer, 2007; Arnold and Javorcik, 2009; Elliott et al., 2013). This pattern also holds for the assembly section of the Turkish automotive industry. Fourth, motor vehicle assembling enterprises use the majority of the material, while automotive parts supplying enterprises utilise the majority of the labour and energy. Capital stock, total investment and capital machines or equipment investment are, to some extent, also split half amongst assembly and supply sections of the industry. Furthermore, automotive parts supplying enterprises create around 41% of all value added generated in the

Turkish automotive industry. Last, on average, international automotive parts supplying enterprises employ more, pay more, have more capital, invest more and in particular on capital machines or equipment, utilise more material and electricity inputs, and hence produce more output, generate more value added, and are more productive in both relative and employment size adjusted terms than local automotive parts supplying enterprises, which is also well established in the general literature (Keller, 2004) and case studies (e.g., Yasar and Morrison Paul, 2007). A similar pattern is also observed for the comparison of international and local motor vehicle assembling enterprises.

Chapter 5 finds out that higher the technological intensity of an automotive part, greater the import of that automotive part becomes; whereas smaller the export of that automotive part becomes in Turkey during the period 2002-2013 based on patent measure of technological intensity developed in this study, while controlling for modularity, macroeconomic shocks and ECR measure of technological intensity. These findings are also robust to cross-section regressions. On the other hand, there is not clear technological intensity concentration on automotive parts produced in Turkey during the period 2005-2012. These findings are, to some extent, consistent with the view that economies with relatively inefficient contract enforcement and property rights institutions specialise in the export and production of items that require less “institutional content” or have lower technological intensity (Nunn, 2007). Chapter 5 also reveals that export structure of automotive parts is in line with both import and production structures of automotive parts. In addition to this, production structure of automotive parts is unexpectedly consistent with import structure of automotive parts. This might reflect the recent R&D efforts pursued by motor vehicle assembling and automotive parts supplying enterprises in Turkey that has resulted in technology acquisitions and spillovers in the industry as stressed in section 4.2, subsubsection 4.3.1.2 and subsubsection 4.3.2.2. This finding is also further investigated in chapter 6.

Chapter 6 reveals that during the period 2003-2011 automotive parts supplying enterprises in Turkey with international linkages are more productive, pay more and employ more in line with the descriptive analysis in subsection 4.3.2, which is also well established in the literature of international linkages (Keller, 2004) and similar to that of Yasar and Morrison Paul (2007). Nevertheless, relationships between international ownership intensity and investment, and export intensity and investment are in reverse direction but statistically insignificant which is contrary to the literature. This stems mainly from the high level of minimum capital investment requirement of the industry, irrespective of the extent of international linkages. Chapter 6 also estimates a flexible model of translog production function based on quantitative and qualitative measures of international linkages by both OLS and quantile regression methods and finds that all international linkages result in productivity increases as revealed in quantitative specifications and all international technology transfer channels also have positive productivity premiums as indicated in qualitative specifications, which is consistent with the literature (Keller, 2004) and studies on Turkey (Aslanoglu, 2000; Ozcelik and Taymaz, 2004; Yasar and Morrison Paul, 2007; Taymaz and Yilmaz, 2008a; Maggioni, 2010; Fatima, 2016). Nevertheless, productivity rankings of individual international technology transfer channels are not consistent with the literature: in place of international ownership intensity as argued in the literature to have the largest productivity effect, import intensity is identified as having the largest productivity effect but international ownership still has the largest productivity premium. This might result from that import transactions directly embody technology transfers reflected by the finding in chapter 5 on high technological intensity of Turkey's automotive parts import, and hence import can result in larger productivity effects in short period of time, whereas productivity effects of technology transfer from international ownership can require larger period of time to realise that is what this study is likely to be capturing.

7.3 Recommendations of the Study and Policy Implications

Electrical automotive parts increasingly gain prominence in the automotive industry that can be observed from increasing use of such automotive parts in motor vehicles and expanding cross-border trade of such automotive parts. When compositions of Turkey's automotive imports and exports by automotive group are assessed against automotive groups' world average import and export compositions, it appears that it is less likely to import electrical automotive parts from Turkey and it is also less likely for Turkey to import electrical automotive parts. As motor vehicles increasingly get smarter and environmental concerns take more effect, it is more likely that use and cross-border trade of embedded software and electronics, and hence electrical automotive parts will increasingly dominate the global automotive industry. Therefore, automotive enterprises in Turkey as appeared to be already weak in this field should put more effort into this area not to lag behind in the global automotive industry.

Another significant point appears, when composition of Turkey's automotive imports by automotive group is compared with automotive groups' shares in the world automotive imports. Turkey's automotive import composition tilts towards sourcing more automotive parts in the group of "engine or emissions" appearing to be the most technologically intensive group as found in chapter 5 than the world average composition of engine or emissions imports. Therefore, the government should support projects in this particular field more to enable the Turkish automotive industry to be more competitive in the global automotive industry.

The automotive parts supply section of the Turkish automotive industry is much less directly involved in international trade than the motor vehicle assembly section of the industry as revealed in section 4.3. As underlined in section 2.3 that international trade of automotive parts increasingly constitutes a larger part of the international automotive trade reflecting the general trend in substantially increasing cross-border trade in intermediate goods (Feenstra, 1998). Therefore, automotive parts supplying enterprises should be encouraged to get more involved directly in international trade to benefit from this growing trend, and hence international technology transfer from increased international interactions as investigated in chapter 6.

Motor vehicle assemblers increasingly forge ties with automotive parts suppliers from initial development phase of motor vehicle projects by first, co-design activities, and then supply of automotive systems, subsystems and parts. Therefore, automotive parts suppliers are required to already possess particular skills in design and innovation, and in particular have R&D capabilities to be selected by motor vehicle assemblers as partners and collaborators also argued by Sonmez (2013). Therefore, in order to benefit from positive effects of international technology transfer as widely examined in chapter 6 automotive parts suppliers are required to have a high level of awareness about positive effects of international technology transfer and possess "absorptive capacity" that is enterprises' ability to effectively internalise and absorb technology transfers (Keller, 1996). Hence, automotive parts suppliers should be supported more in their R&D capability building efforts and commercialisation of their innovations, especially patenting by the government. A relevant point to this consideration is that test facilities and certification requiring large investments and spending are necessary for development projects of motor vehicles and automotive parts and they are particularly important for power train parts, namely engine and transmission where the Turkish automotive industry lacks capability. Therefore, the government should also directly support efforts more made in establishing test facilities and obtaining certification.

As indicated in section 4.2 that local small sized automotive parts supplying enterprises of the size of fewer than 20 employees mainly manufacturing automotive parts for after-market constitute about three quarters of all enterprises in the Turkish automotive industry. Therefore, local small sized automotive parts supplying enterprises dominate the Turkish automotive industry in quantity. Nevertheless, more than 90% of the Turkish automotive industry are accounted by automotive enterprises of the size of more than 20 employees. Being in small size, such enterprises cannot widely and efficiently engage in design and R&D activities, and make capital expenditure highly required for this capital oriented industry. This results in such enterprises focusing on low value added activities and being inefficient, thereby rendering them unable to raise their productivity levels. Therefore, these enterprises are required to expand their sizes to reach efficient scale of economies, and hence become competitive. This is also to ensure these enterprises to have more international economic interactions allowing them to benefit from international technology transfers raising their productivity levels further as examined in chapter 6. As a result, the government should foster such enterprises by easing their access to finance, thereby enabling such enterprises to make R&D and capital investments key for the automotive industry.

Automotive industry is based on management of a large supply chain (Casson, 2013). Therefore, efficient management of logistics is curial for a competitive automotive industry (Gol and Catay, 2007). As underlined in chapter 2 that the Turkish automotive industry is part of the global automotive industry, especially integrated well with the European automotive value chain. In this respect, adequate transportation infrastructure is key for the industry to efficiently organise its resource flows and conduct its exchanges to be competitive in the global automotive industry. During the last decade, the government has undertaken extensive infrastructure projects, namely airports, seaports, railways and motorways. Better integration, coordination and cost-efficiency of recently built infrastructure are required to have efficiency impacts on logistics of the Turkish automotive industry.

A stable and large motor vehicle market is required for the automotive industry to thrive evident from the introduction of the industry explained in section 2.2. Hence, the automotive industry is, to a large extent, driven by characteristics of the motor vehicle market. In particular, stability and size of internal motor vehicle market are highly influential in determining characteristics of the automotive industry as revealed in section 2.5. In addition to this, stability of motor vehicle market directly determines capacity utilisation of the industry one of the most important challenges constantly tackled by the automotive industry that directly affects productivity levels of the industry. Therefore, the government should remove obstacles in front of the Turkish motor vehicle market to ensure that the market is stable and motor vehicle demand is not inhibited by any obstacles resulting in the automotive industry maintaining an efficient capacity utilisation.

Growth in the world motor vehicle demand has mainly originated from Asia-Pacific during the last decade as reported in section 2.4. Nevertheless, as stated earlier that the Turkish automotive sector is highly focused on the European automotive sector and its cross-border trade relations with Asia-Pacific are relatively weak as reported in section 3.3. Therefore, the Turkish automotive sector should also forge more cross-border trade relations with Asia-Pacific to diversify its cross-border trade relations as well as advantage from the recent substantial expansion of the Asia-Pacific automotive sector.

The MENA has also had significant growth in motor vehicle demand during the last decade as presented in section 2.4. Nevertheless, it appears that the Turkish automotive industry has not widely benefited from this growth as reported in section 3.3 due to marketing strategies of motor vehicle assembling enterprises in Turkey focusing mainly on the European motor vehicle market, and mismatch between motor vehicle models manufactured in Turkey and demanded in the MENA. As a result, the Turkish automotive industry should also consider engaging extensively with this growing market.

Quality of institutions, namely property rights and contract enforcement institutions (please see Casson, Della Giusta, et al., 2010, for a critical review of institutions both formal and informal ones) are widely argued to determine efficiency of economies (Acemoglu and S. Johnson, 2005). This has extensive implications for the automotive industry, as well. In particular, efficient institutions are key for the automotive industry being highly capital oriented and having high interactions with the global automotive industry to undertake investment and engage in R&D and innovation activities. These activities of the automotive industry require high proprietary protection, and hence efficient institutions. Therefore, having efficient institutions is key for a developed and competitive automotive industry.

Macroeconomic environment and stability, especially financial stability are curial for the automotive sector as underlined in section 3.2. Macroeconomic environment directly determines availability and efficiency of funding investments of the industry and financing motor vehicle purchases. Macroeconomic environment through foreign exchange rates and inflation levels also affects both the supply and demand sides of the automotive sector. As a result, maintaining a stable macroeconomic environment is key for the automotive sector to thrive.

As reported in section 2.4, despite displaying substantial performance in the motor vehicle market during the last decade, Turkey has still got a much lower motor vehicle ownership rate than comparable countries'. Nevertheless, there is high demand for motor vehicles in Turkey, and hence the Turkish motor vehicle market is unsaturated. There are a number of reasons for this low rate of motor vehicle ownership as discussed in section 3.2. Along with structural reasons, high taxes on purchase and ownership of motor vehicles, and oil have been cited as major deterrents in section 3.2. Therefore, the government should revise related taxes on motor vehicle purchase and ownership to stimulate and maintain strong and stable demand for motor vehicles.

As a result, the government should encourage and coordinate efforts made by automotive enterprises especially automotive parts supplying enterprises to advance the industry that will ultimately have substantial economic development effects.

7.4 Limitations of the Study and Recommendations for Future Research

This study analysed overall automotive parts imports and exports, and motor vehicle imports, exports, assembly and sales in the world, and across regions and major countries in chapter 2. On the other hand, additional dimensions can be added to this analysis. International trade flow of automotive groups or automotive parts by technological intensity between major countries can be mapped to find out not only source, destination and extent of international automotive trade across major countries but also technological specialisation fields of major countries. Considering time dimension in this exercise can also enable assessment of evolution of cross-border automotive trade and technological specialisation fields of major countries over time. Furthermore, variations in unit prices of automotive groups or automotive parts or motor vehicles between countries can shed more light on structures of automotive industries of major countries, and changes in these unit prices over time can also reveal the dynamics of structures of automotive industries of major countries.

This study mainly analysed post-2002 period due to increasing availability, consistency and accuracy of relevant data after 2002 in Turkey. Industry and product level international trade and production datasets are also available beginning from 1989. Nevertheless, changes in collection methodologies and classification systems of these pre-2002 datasets raise serious questions for their consistency and accuracy for analysis. Enterprise level datasets are also available beginning from 1980s but these datasets are of small sample size, and hence they are far away from being representative, and constantly subjected to methodological changes. Therefore, it is not possible to have accurate, consistent and representative enterprise level datasets before 2002 in Turkey. On the other hand, consistent and accurate international trade and production datasets on the Turkish automotive industry for pre-2002 period can be obtained by spending a significant amount of effort. This can bring about a better understanding of the Turkish automotive industry during the 1990s and even 1980s. This can also result in a more accurate analysis of the effects of Turkey's Customs Union with the EU on the Turkish automotive industry.

This study focused on the Turkish automotive industry to account for more heterogeneities across industries. Nevertheless, the Turkish automotive industry can be contrasted with other comparable Turkish manufacturing industries to better assess relative performance of the Turkish automotive industry.

Section 4.3 examined variations in economic characteristics amongst international and local motor vehicle assembling and automotive parts supplying enterprises in Turkey. This exercise can also be carried out for other comparable countries' automotive enterprises. Findings of this exercise can be contrasted with findings in section 4.3 resulting in assessment of economic characteristics and performance differentials between automotive enterprises in Turkey and other comparable countries. Nevertheless, this practise is bounded by availability and access possibility of relevant datasets of other comparable countries.

Patent counts as a measure of technological intensity for automotive parts developed in chapter 5 could be used for other countries to identify technological characteristics of these countries' automotive parts industries. Patent statistics could also be used to analyse location and ownership related characteristics of innovations on automotive parts. This can enable analysis of cross-country technological variations in automotive parts. Furthermore, patent counts as a measure of technological intensity at disaggregated level for other industries can also be constructed by using the method developed in chapter 5 to determine technological intensity of import, export and production at disaggregated level for other industries.

Chapter 6 just considered automotive parts supplying enterprises of the size of more than 20 employees as automotive enterprises having fewer than 20 employees were selected on random sampling basis. Nevertheless, automotive enterprises of the size of more than

20 employees accounted for more than 90% of the Turkish automotive parts industry. Therefore, findings in chapter 6 reflect automotive parts supplying enterprises of the size of more than 20 employees more. There are also large variations across industries (Melitz, 2003). Therefore, findings of this study are more reflective of the automotive industry. Furthermore, as stressed earlier that this study has mainly analysed the post-2002 period, and the automotive industry has already been subject to great transformations during this period. Hence, analyses made here reflect the current period more. As a result, conclusions drawn in this study should be regarded within this particular context.

Chapter 6 also just examined international technology transfer via channels of international ownership, import and export, and their corresponding effects on the Turkish automotive parts industry, so it did not examine specific mechanisms through which international technology transfer was disseminated to automotive parts supplying enterprises in Turkey. This is due to the characteristics of the available datasets used in this study. Therefore, qualitative surveying methods are required to research specific mechanisms of international technology transfer and their subsequent effects on the Turkish automotive parts industry.

Impact of R&D on automotive enterprises is another important avenue for future research. Nevertheless, this research is bounded by the availability of relevant data. The TurkStat compiles a dataset on innovation and R&D activities of enterprises but the sample size of this dataset is not particularly helpful for regression analysis especially for the automotive industry. On the other hand, as coverage rate of this dataset increases, it becomes possible to carry out R&D related investigations for the Turkish automotive industry.

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Appendix A

Data Sources

Technological Intensity Measures

Subsection 5.2.2, in detail, explains how data on measures of technological intensity at automotive parts level is obtained. ECR is developed by Monteverde and Teece (1982) and reported in Head et al. (2004). Patent counts are compiled from WIPO's publicly available PATENTSCOPE database. PATENTSCOPE is a search interface and database proving search and access to patent documents enabling retrieval of patent counts for automotive parts. Appendix D: Table D.4 provides a list of automotive items with corresponding patent search terms. Appendix F: Figure F.3 presents a patent search for tires. While international trade and product data at automotive parts level are yearly, ECR is time invariant. On the other hand, patent counts can be yearly or time invariant depending on the restrictions used in patent search terms.

Foreign Trade Statistics

Maintained by the TurkStat, this dataset is based on the customs declarations and covers all international trade transactions above $100. International trade transactions are recorded at 6 or 12-digit HS level. It covers the period 2002-2013. A typical row of this dataset includes enterprise identifier, year identifier, source or destination country of international trade, HS code (6 or 12-digit depending on the year), item name, measurement unit name(s) (particular items have double measurement units: kilogram or number of items but the vast majority of relevant items are in kilogram), import quantity in terms unit one, import quantity in terms of unit two (if applicable), export quantity in terms of unit one, export quantity in terms of unit two (if applicable), import value in the US dollar (CIF: cost, insurance and freight value), import value in the Euro, import value in TL, export value in the US dollar (FOB: free on board value), export value in the Euro and export value in TL. This dataset at this detail is regarded as confidential by the TurkStat, and hence access to it is allowed in the premises of the TurkStat with a special protocol.

Annual Industrial Products (Prodcom) Statistics

This dataset is based on survey of products of industrial enterprises having 20 or more employees and has a representation rate of 90%. It is recorded, at most, 10-digit ProdTR2011 product level, a TurkStat extension of Prodcom. It covers the period 2005-2012. A typical row of this dataset contains enterprise identifier, year identifier, product code (ProdTR), description of product, volume of production, measurement unit name of production, value of production in TL, volume of sales, measurement unit name of sales and value of sales in TL. This dataset at this detail is regarded as confidential by the TurkStat, and hence access to it is allowed in the premises of the TurkStat with a special protocol.

Annual Industry and Service Statistics

This dataset covers all enterprises of the size of more than 20 employees, while it covers a sample of enterprises having fewer than 20 employees. It is at enterprise level classified according to NACE Rev. 2. It is also classified according to NACE Rev. 1.1 depending on the year generally available for early years. It covers the period 2003-2011. A typical row of this dataset includes enterprise identifier, year identifier, classification code of the main industry in which enterprise operates (NACE Rev. 2 or NACE Rev. 1.1 depending on the year), employment, number of hours worked by employees, wage payments, total purchases of goods and services, cost and expenditure items, turnover, value of production, value-added at factor cost, change in stocks, fixed and tangible capital investment and sales, location of centre, number of local units including centre, ownership shares and ownership origin of the controlling stake amongst other variables. Monetary values in this dataset are expressed in TL. This dataset at this level is considered as confidential by the TurkStat, and hence access to it is allowed in the premises of the TurkStat with a special protocol.

Annual Business Registers Frames

This dataset is compiled by the TurkStat from annual business surveys and business registers of semi-official and official institutions, namely the Union of Chambers and Commodity Exchanges of Turkey and the Ministry of Finance of the Republic of Turkey, Revenue Administration Department. It is at enterprise level classified according to NACE Rev. 2. It is also classified according to NACE Rev. 1.1 depending on the year generally available for early years. It covers the period 2005-2013. A typical row of this dataset contains enterprise identifier, year identifier, classification code of the main industry in which enterprise operates (NACE Rev. 2 or NACE Rev. 1.1 depending on the year), province of enterprise, number of employees, date of incorporation and date of closure if enterprise is closed. At this level, this dataset is considered as confidential by the TurkStat, and hence access to it is allowed in the premises of the TurkStat with a special protocol.

Appendix B

Construction of Enterprise Level Variables

Appendix A: Data Sources explains datasets used in chapter 6 and variables available in these datasets. These datasets are merged via enterprise identifiers unique across datasets. Appendix D: Table D.1 also provides a list of enterprise level variables with their descriptions and sources.

Monetary values are expressed in TL otherwise indicated. Variables are deflated by 4-digit NACE Rev. 2 relevant automotive industry producer price index of the TurkStat in case there is not a special price index for a particular variable. 4-digit NACE Rev. 2 price index is the most disaggregated deflator currently available. 4-digit NACE Rev. 2 price index at this level is not publicly available and access to it requires special request from the TurkStat.

Productivity Measures

Del Gatto et al. (2011) provide a thorough review of the literature on productivity and estimation methods of productivity. This study employs two widely used measures of productivity, namely total factor productivity and labour productivity. Total factor productivity is estimated, whereas labour productivity is calculated. The following explains these two measures of productivity.

Total factor productivity ($lnTFP$): it is natural logarithm of total factor productivity of enterprise derived as residual from estimation of a Cobb-Douglas production function. Appendix C: Estimation of Production Function at Enterprise Level explains derivation of $lnTFP$.

Labour productivity ($lnLP$): it is natural logarithm of labour productivity calculated as deflated production value divided by the number of paid employees in full-time equivalence.

Economic Performance Measures

There are four kinds of economic performance measures used in chapter 6 and listed below.

Employment ($lnEMP$): it is natural logarithm of the number of paid employees in full-time equivalence.

Machine or equipment investment ($lnMAC$): it is natural logarithm of deflated (please see Appendix B: Table B.1 for the index) capital machines or equipment investment divided by the number of paid employees in full-time equivalence.

Investment ($lnTINV$): it is natural logarithm of deflated (please see Appendix B: Table B.1 for the index) total investment divided by the number of paid employees in full-time equivalence.

Wage ($lnWAGE$): it is natural logarithm of deflated total labour cost divided by the number of paid employees in full-time equivalence.

Channels of International Technology Transfer

Three main channels of international technology transfer are considered in chapter 6. These three main channels can be expressed as either intensities or dummies. The following explains these three main channels and their intensity and dummy variants.

International direct investment

International direct investment as a main channel of international technology transfer is expressed as either intensity or dummy.

International direct investment intensity ($FDIS$): it is international ownership proportion in relation to whole ownership. It is expressed as a percentage.

International direct investment dummy (FDI): it equals 1 if enterprise has an international ownership share of at least 10%, 0 otherwise.

Import

Import as a main channel of international technology transfer is expressed as either intensity or dummy.

Import intensity ($IMPS$): it is calculated as deflated import value divided by deflated production value. It is expressed as a decimal fraction.

Import dummy (IMP): it equals 1 if enterprise imports positive amount of goods and services, 0 otherwise.

Export

Export as a main channel of international technology transfer is expressed as either intensity or dummy.

Export intensity (*EXPS*)**:** it is calculated as deflated export value divided by deflated production value. It is expressed as a decimal fraction.

Export dummy (*EXP*)**:** it equals 1 if enterprise exports positive amount of goods and services, 0 otherwise.

Inputs

Four inputs employed in chapter 6 are explained below.

Labour (lnL)**:** it is natural logarithm of labour input that is directly measured as total hours worked calculated as average weekly hours worked times the number of paid employees in full-time equivalence times 48 (average number of weeks in a year).

Capital ($lnK15$)**:** it is natural logarithm of capital input that is measured by cumulating net investment over years which is deflated by the capital goods price index of the TurkStat (please see the following table for the index) and adjusted for depreciation rate of 15% (the perpetual inventory method). Alternative capital depreciation rates of 5% and 20% are also computed. OECD (2009a) explains computation of capital in detail.

Table B.1 Price Index for Capital Goods

Year	Price Index
2003	100
2004	106.83
2005	115.67
2006	123.54
2007	127.39
2008	137.89
2009	145.84
2010	145.38
2011	157.1

Notes: 2003 is the base year.

Source: The TurkStat, Producer Price Index.

Material (lnM)**:** it is natural logarithm of material input that is deflated (please see the following table for the index) material input expenditure with changes in material input inventory considered. Material input is defined in footnote 29 in chapter 4.

Table B.2 Price Index for Intermediate Goods

Year	Price Index
2003	100
2004	115.64
2005	120.2
2006	133.55
2007	142.12
2008	158.37
2009	155.52
2010	167.58
2011	196.94

Notes: 2003 is the base year.

Source: The TurkStat, Producer Price Index.

Energy (*lnE*): it is natural logarithm of energy input that is deflated (please see the following table for the index) expenditure on electricity and fuel.

Table B.3 Price Index for Energy

Year	Price Index
2003	100
2004	114.21
2005	133.59
2006	162.59
2007	171.32
2008	225.19
2009	217.85
2010	249.25
2011	283.63

Notes: 2003 is the base year.

Source: The TurkStat, Producer Price Index.

Output

Two widely used measures of output are employed in chapter 6 and explained below.

Value added (*lnVA*): it is natural logarithm of value added calculated as deflated production value net of deflated material input, and electricity and fuel expenditures.

Production value (lnY): it is natural logarithm of output that is deflated aggregate production value with changes in inventory considered.

Controls

Controls are included in estimations in chapter 6 to account mainly for enterprise heterogeneities.

Age (AGE): age of enterprise that is computed from establishment year of enterprise. Therefore, it measures number of years that enterprise is in operation.

Location of enterprise ($LOCATION$): they are regional dummies indicating NUTS 2 statistical region of enterprise's headquarters in Turkey. There are 24 subregions at NUTS 2 level in the data and Istanbul (TR10), the economic hub of Turkey, is selected as the base. NUTS is explained in footnote 20 in chapter 4 in detail. Appendix D: Table D.2 provides a list of statistical regions of Turkey with corresponding names and codes at NUTS 1, NUTS 2 and NUTS 3 levels, while Appendix F: Figure F.1 displays the map of statistical regions of Turkey with corresponding NUTS 2 codes of subregions.

Ownership origin of enterprise ($ORIGIN$): they are dummies of origin of the controlling stake of enterprise. There are 20 origins in the data and the USA is selected as the base.

Enterprise size ($SIZE$): they are enterprise size dummies: small enterprise having fewer than 50 paid employees in full-time equivalence, medium enterprise whose number of paid employees in full-time equivalence are from 50 to 99 and large enterprise having 100 or more paid employees in full-time equivalence. Large enterprises are selected as the base.

Time trend (t): it is a time counter. it starts from 2003 equalling 1 and extends until 2011 equalling 9.

Number of local units of enterprise ($UNIT$): it is the number of local units of enterprise including headquarters of enterprise if it is based in Turkey.

Year ($YEAR$): they are year dummies. 2003, the first year of the dataset, is selected as the base.

Appendix C

Estimation of Production Function at Enterprise Level

This study estimates a Cobb-Douglas production function by three different methods and their variants, namely Levinsohn and Petrin (2003)'s method, pooled-OLS method and Olley and Pakes (1996)'s method to obtain total factor productivity at automotive parts supplying enterprise level. Van Beveren (2012) presents derivation of the production function. Consistent and unbiased estimation of the production function is not possible due mainly to simultaneity and selection bias problems. The former refers to correlation between unobserved productivity shocks and inputs. The latter corresponds to that enterprises with higher stock of capital is likely not to exit, and hence they are self-selected into the dataset. Semi-parametric approaches are argued to obtain consistent estimates of the parameters of the production function (Olley and Pakes, 1996; Levinsohn and Petrin, 2003). Hence, these different estimation methods are to allow for addressing simultaneity and selection bias problems, thereby enabling results on total factor productivity being more robust.

The main difference between methods of Levinsohn and Petrin (2003) and Olley and Pakes (1996) is that the latter employs investment as a proxy for unobserved productivity shocks, while the former uses either material expenditure or energy expenditure as a proxy for unobserved productivity shocks. The first major reason why Levinsohn and Petrin (2003) use material expenditure or energy expenditure as a proxy for unobserved productivity shocks, instead of investment is that Levinsohn and Petrin (2003) argue that investment has higher adjustment costs in response to unobserved productivity shocks than material or energy inputs. Therefore, material or energy inputs are more responsive to unobserved productivity shocks, thereby being a more favourable proxy. The second major reason is that zero investment is highly reported in manufacturing enterprise surveys, in particular surveys for developing countries. This is also observed in this study as reported in Table 4.10. Therefore, Levinsohn and Petrin (2003) is more favoured. Nevertheless, estimation results of other methods are also reported below and utilised in chapter 6.

The following table reports the estimation results of these three methods by using value added (*lnVA*) as output, and the number of paid employees in full-time equivalence (*lnEMP*) and capital stock with depreciation rate of 15% (*lnK*15) as inputs for automotive parts supplying enterprises in Turkey during the period 2003-2011. When simultaneity and selection bias problems are not accounted for; labour input will be upward biased, while capital input will be downward biased depending on the extent of correlation between input factors and unobserved productivity shocks (Petrin et al., 2004; Yasar, Raciborski, et al., 2008). Estimation results of the parameters of the production function in the following table support the expectation as labour input has a smaller coefficient in the estimations of LEVPET and OPREG compared to the estimation with OLS, while capital input has a larger coefficient in the estimations of LEVPET and OPREG compared to the estimation with OLS.

Table C.1 Production Function Estimation at Enterprise Level: 2003-11

	lnVA (LEVPET) (1)	*lnVA* (OLS) (2)	*lnVA* (OPREG) (3)
lnEMP	0.774***	0.937***	0.893***
	[0.024]	[0.020]	[0.027]
lnK15	0.300***	0.238***	0.298***
	[0.043]	[0.012]	[0.040]
Observations	6532	6770	6241

Notes: (1) Dependent variable is *lnVA* and alternative output measures also provide similar coefficients, and estimations are based on methods of Levinsohn and Petrin (2003) in the first model, pooled OLS in the second model and Olley and Pakes (1996) in the last model. (2) Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels. (3) Energy is used as a proxy for productivity shocks, material as a proxy also provides similar results. (4) Labour is measured as the number of paid employees in full-time equivalence. (5) Capital computation assumes depreciation rate of 15% and estimation results are also similar in case of 5% and 20% of depreciation rates across models and their variants. (6) Please see Appendix D: Table D.1 for description and source of enterprise level variables and Appendix B: Construction of Enterprise Level Variables for detail.

Source: Calculations are based on TurkStat's datasets. Please see Appendix A: Data Sources for detail.

Appendix D

Lists

Table D.1 Enterprise Level Variables, their Descriptions and Sources

Name of Variable	Description of Variable	Source of Variable*
AGE	Age of enterprise	ABRFD
EXP	Dummy variable if enterprise gets engaged in export	FTSD
EXPS	Export share of production	FTSD and AISSD
FDI	Dummy variable if enterprise has an international ownership share of at least 10%	AISSD
FDIS	International ownership share	AISSD
IMP	Dummy variable if enterprise gets engaged in import	FTSD
IMPS	Import share of production	FTSD and AISSD
lnE	Natural logarithm of energy input that is deflated expenditure on electricity and fuel	AISSD
lnEMP	Natural logarithm of the number of paid employees in full-time equivalence	AISSD
lnK15	Natural logarithm of capital input that is measured by cumulating net investment over years which is deflated by the capital goods price index of the TurkStat and adjusted for depreciation rate of 15%	AISSD
lnL	Natural logarithm of labour input that is directly measured as total hours worked	AISSD
lnLP	Natural logarithm of labour productivity that is output per employee	AISSD

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Enterprise Level Variables, their Descriptions and Sources (Continued)

Name of Variable	Description of Variable	Source of Variable*
lnM	Natural logarithm of material input that is deflated material input expenditure with changes in material input inventory	AISSD
lnMAC	Natural logarithm of deflated capital machines or equipment investment per employee	AISSD
lnP	Natural logarithm of various economic performance measures	
lnTFP	Natural logarithm of total factor productivity of enterprise obtained as residual from estimation of a Cobb-Douglas production function	Please see Appendix C: Estimation of Production Function at Enterprise Level
lnTINV	Natural logarithm of deflated total investment per employee	AISSD
lnVA	Natural logarithm of value added	AISSD
lnWAGE	Natural logarithm of deflated total labour cost per employee	AISSD
lnY	Natural logarithm of output that is deflated aggregate production value with changes in inventory	AISSD
LOCATION	Regional dummies indicating NUTS 2 statistical region of enterprise's headquarters in Turkey	AISSD
ORIGIN	Dummies of origin of the controlling stake of enterprise	AISSD
SIZE	Enterprise size dummies (small enterprise having fewer than 50 paid employees in full-time equivalence, medium enterprise whose number of paid employees in full-time equivalence are from 50 to 99 and large enterprise having 100 or more paid employees in full-time equivalence)	AISSD
t	Time trend (counter)	
UNIT	Number of local units of enterprise including headquarters of enterprise if it is based in Turkey	AISSD
YEAR	Year dummies	

*Foreign Trade Statistics Dataset (FTSD), Annual Industry and Service Statistics Dataset (AISSD) and Annual Business Registers Frames Dataset (ABRFD) are compiled by the TurkStat. Please see Appendix A: Data Sources and Appendix B: Construction of Enterprise Level Variables for detail.

Table D.2 Statistical Regions of Turkey (NUTS 1, NUTS 2 and NUTS 3)

NUTS 1 Name and Code	NUTS 2 Name and Code	NUTS 3 Name and Code
Istanbul Region (TR1)	Istanbul Subregion (TR10)	Istanbul Province (TR100)
West Marmara Region (TR2)	Tekirdag Subregion (TR21)	Tekirdag Province (TR211)
		Edirne Province (TR212)
		Kirklareli Province (TR213)
	Balikesir Subregion (TR22)	Balikesir Province (TR221)
		Canakkale Province (TR222)
Aegean Region (TR3)	Izmir Subregion (TR31)	Izmir Province (TR310)
	Aydin Subregion (TR32)	Aydin Province (TR321)
		Denizli Province (TR322)
		Mugla Province (TR323)
	Manisa Subregion (TR33)	Manisa Province (TR331)
		Afyonkarahisar Province (TR332)
		Kutahya Province (TR333)
		Usak Province (TR334)
East Marmara Region (TR4)	Bursa Subregion (TR41)	Bursa Province (TR411)
		Eskisehir Province (TR412)
		Bilecik Province (TR413)
	Kocaeli Subregion (TR42)	Kocaeli Province (TR421)
		Sakarya Province (TR422)
		Duzce Province (TR423)
		Bolu Province (TR424)
		Yalova Province (TR425)
West Anatolia Region (TR5)	Ankara Subregion (TR51)	Ankara Province (TR510)
	Konya Subregion (TR52)	Konya Province (TR521)
		Karaman Province (TR522)
Mediterranean Region (TR6)	Antalya Subregion (TR61)	Antalya Province (TR611)
		Isparta Province (TR612)
		Burdur Province (TR613)
	Adana Subregion (TR62)	Adana Province (TR621)
		Mersin Province (TR622)
	Hatay Subregion (TR63)	Hatay Province (TR631)
		Kahramanmaras Province (TR632)
		Osmaniye Province (TR633)

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Statistical Regions of Turkey (NUTS 1, NUTS 2 and NUTS 3) (Continued)

NUTS 1 Name and Code	NUTS 2 Name and Code	NUTS 3 Name and Code
Central Anatolia Region (TR7)	Kirikkale Subregion (TR71)	Kirikkale Province (TR711) Aksaray Province (TR712) Nigde Province (TR713) Nevsehir Province (TR714) Kirsehir Province (TR715)
	Kayseri Subregion (TR72)	Kayseri Province (TR721) Sivas Province (TR722) Yozgat Province (TR723)
West Black Sea Region (TR8)	Zonguldak Subregion (TR81)	Zonguldak Province (TR811) Karabuk Province (TR812) Bartin Province (TR813)
	Kastamonu Subregion (TR82)	Kastamonu Province (TR821) Cankiri Province (TR822) Sinop Province (TR823)
	Samsun Subregion (TR83)	Samsun Province (TR831) Tokat Province (TR832) Corum Province (TR833) Amasya Province (TR834)
East Black Sea Region (TR9)	Trabzon Subregion (TR90)	Trabzon Province (TR901) Ordu Province (TR902) Giresun Province (TR903) Rize Province (TR904) Artvin Province (TR905) Gumushane Province (TR906)
Northeast Anatolia Region (TRA)	Erzurum Subregion (TRA1)	Erzurum Province (TRA11) Erzincan Province (TRA12) Bayburt Province (TRA13)
	Agri Subregion (TRA2)	Agri Province (TRA21) Kars Province (TRA22) Igdir Province (TRA23) Ardahan Province (TRA24)

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Statistical Regions of Turkey (NUTS 1, NUTS 2 and NUTS 3) (Continued)

NUTS 1 Name and Code	NUTS 2 Name and Code	NUTS 3 Name and Code
Central East Anatolia Region (TRB)	Malatya Subregion (TRB1)	Malatya Province (TRB11)
		Elazig Province (TRB12)
		Bingol Province (TRB13)
		Tunceli Province (TRB14)
	Van Subregion (TRB2)	Van Province (TRB21)
		Mus Province (TRB22)
		Bitlis Province (TRB23)
		Hakkari Province (TRB24)
Southeast Anatolia Region (TRC)	Gaziantep Subregion (TRC1)	Gaziantep Province (TRC11)
		Adiyaman Province (TRC12)
		Kilis Province (TRC13)
	Sanliurfa Subregion (TRC2)	Sanliurfa Province (TRC21)
		Diyarbakir Province (TRC22)
	Mardin Subregion (TRC3)	Mardin Province (TRC31)
		Batman Province (TRC32)
		Sirnak Province (TRC33)
		Siirt Province (TRC34)

Source: Eurostat (2008, pp.37–40)

Table D.3 Automotive Parts Level Variables, their Descriptions and Sources

Name of Variable	Description of Variable	Source of Variable*
PATENTC	(PATCOSTAC) Patent counts for automotive part	PATENTSCOPE
ECR	Engineering cost rating of automotive part	Monteverde and Teece (1982)
GROUP	Dummies for group of automotive parts (there are seven groups in total: first, body, fuel tank or cap; second, engine or emissions; third, chassis, transmission and steering; fourth, ventilation; fifth, electrical; sixth, rubber; seventh, other parts. Nevertheless, six dummy variables created, and hence body, fuel tank or cap is the base case.)	Adapted from Monteverde and Teece (1982)
ln(EXPV)	Natural logarithm of export value of automotive part	FTSD
ln(EXPVDOLLAR)	Natural logarithm of export value of automotive part in the US dollar	FTSD
ln(EXPVTL)	Natural logarithm of export value of automotive part in the Turkish lira (TL)	FTSD
ln(IMPV)	Natural logarithm of import value of automotive part	FTSD
ln(IMPVDOLLAR)	Natural logarithm of import value of automotive part in the US dollar	FTSD
ln(IMPVTL)	Natural logarithm of import value of automotive part in the Turkish lira (TL)	FTSD
ln(PRODV)	Natural logarithm of production value of automotive part	AIPSD
ln(PRODVTL)	Natural logarithm of production value of automotive part in the Turkish lira (TL)	AIPSD
YEAR	Year dummies	

*Foreign Trade Statistics Dataset (FTSD) and Annual Industrial Products (Prodcom) Statistics Dataset (AIPSD) are compiled by the TurkStat. PATENTSCOPE database is maintained by the WIPO. ECR is devised by Monteverde and Teece (1982) and reported in Head et al. (2004). Please see subsection 5.2.3 for how "PATENTC (PATCOSTAC)" is created.

Table D.4 List of Automotive Parts and Motor Vehicles

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
400912	Tubes, pipes and hoses, of vulcanised rubber (excl. hard rubber), not reinforced or otherwise combined with other materials, with fittings	Brake hose	Chassis, Transmission and Steering	Automotive part	22.19.30	25.13.30	(“F16L” OR “B60T 17/00”)	(“Brake Hoses” OR “Brake Hose” OR Brake-Hose OR Brake-Hoses OR “Braking Hoses” OR “Braking Hose”)
400922	Tubes, pipes and hoses, of vulcanised rubber (excl. hard rubber), reinforced or otherwise combined only with metal, with fittings							
400932	Tubes, pipes and hoses, of vulcanised rubber (excl. hard rubber), reinforced or otherwise combined only with textile materials, with fittings							
400942	Tubes, pipes and hoses, of vulcanised rubber (excl. hard rubber), reinforced or otherwise combined with materials other than metal or textile materials, with fittings							
401110	New pneumatic tyres, of rubber, of a kind used for motor cars, incl. station wagons and racing cars	Tires	Rubber	Automotive part	22.11.11	25.11.11	(“B60C” OR “B29D 30/00”)	(Tire OR Tires OR Tyre OR Tyres)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
401120	New pneumatic tyres, of rubber, of a kind used for buses and lorries (excl. typres with lug, corner or similar treads)				22.11.13	25.11.13		
401161	Pneumatic tyres, new, of rubber, having a “herring-bone” or similar tread, of a kind used on agricultural or forestry vehicles and machines				22.11.14	25.11.14		
401162	Pneumatic tyres, new, of rubber, having a “herring-bone” or similar tread, of a kind used on construction or industrial handling vehicles and machines and having a rim size <= 61 cm^3							
401163	Pneumatic tyres, new, of rubber, having a “herring-bone” or similar tread, of a kind used on construction or industrial handling vehicles and machines and having a rim size >61 cm^3							
401169	Pneumatic tyres, new, of rubber, having a “herring-bone” or similar tread (excl. of a kind used on agricultural or forestry and construction or industrial handling vehicles and machines)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
401192	Pneumatic tyres, of rubber, new, of a kind used on agricultural or forestry vehicles and machines (excl. having a “herring-bone” or similar tread)							
401193	Pneumatic tyres, new, of rubber, of a kind used on construction or industrial handling vehicles and machines and having a rim size <= 61 cm^3 (excl. having a “herring-bone” or similar tread)							
401194	Pneumatic tyres, new, of rubber, of a kind used on construction or industrial handling vehicles and machines and having a rim size >61 cm^3 (excl. having a “herring-bone” or similar tread)							
401199	Pneumatic tyres, new, of rubber (excl. having a “herring-bone” or similar tread and pneumatic tyres of a kind used on agricultural or forestry and construction or industrial handling vehicles and machines, on motor cars, station wagons, racing cars, buses, lorries, aircraft, motorcycles and bicycles)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
401211	Retreaded pneumatic tyres, of rubber, of a kind used on motor cars “incl. station wagons and racing cars”				22.11.20	25.12.10		
401212	Retreaded pneumatic tyres, of rubber, of a kind used on buses or lorries							
401290	Solid or cushion tyres, interchangeable tyre treads and tyre flaps, of rubber				22.11.15	25.11.15		
401310	Inner tubes, of rubber, of a kind used on motor cars, incl. station wagons and racing cars, buses and lorries	Inner Tubes	Rubber	Automotive part	22.11.15	25.11.15	(“B60C 5/00”)	(“Inner Tube*” OR Innertube*)
401693	Gaskets, washers and other seals, of vulcanised rubber (excl. hard rubber and those of cellular rubber)	Gaskets	Rubber	Automotive part	22.19.73	25.13.73	(“F16J 15/00”)	(Gasket OR Gaskets)
401699	Articles of vulcanised rubber (excl. hard rubber), n.e.s.	Rubber mechanical articles	Rubber	Automotive part	22.19.73	25.13.73	(“B29C” OR “B29D” OR “C08J” OR “D07B” OR “C08L” OR “B32B” OR “B60R”)	(“Vulcanised Rubber”)
681320	Friction material and articles thereof, e.g. sheets, rolls, strips, segments, discs, washers and pads, for clutches and the like, not mounted, containing asbestos, whether or not combined with textile or other materials	Brake linings	Chassis, Transmission and Steering	Automotive part	23.99.11	26.82.11	(“F16D 69/00”)	(“Brake Lining” OR “Brake Linings”)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
681381	Brake linings and pads, with a basis of mineral substances or cellulose, whether or not combined with textile or other materials (excl. containing asbestos)							
681389	Friction material and articles thereof, e.g. sheets, rolls, strips, segments, discs, washers and pads, for clutches and the like, with a basis of mineral substances or cellulose, whether or not combined with textile or other materials (excl. containing asbestos, and brake linings and pads)							
700711	Toughened "tempered" safety glass, of size and shape suitable for incorporation in motor vehicles, aircraft, spacecraft, vessels and other vehicles	Windows	Body, Fuel Tank or Cap	Automotive part	23.12.12	26.12.12	("B60J 1/00")	("Safety Glass*" OR Window* OR Windshield* OR "Side* Glass*" OR "Side* Window*" OR "Rear* Window*" OR "Back Window*" OR Windscreen*)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
700721	Laminated safety glass, of size and shape suitable for incorporation in motor vehicles, aircraft, spacecraft, vessels and other vehicles (excl. multiple-walled insulating units of glass)							
700910	Rear-view mirrors, whether or not framed, for vehicles	Mirrors	Body, Fuel Tank or Cap	Automotive part	23.12.13	26.12.13	("B60R 1/00")	("Rear-view Mirror*" OR "Rearview Mirror*" OR "Rear View Mirror*")
732010	Leaf-springs and leaves therefor, of iron or steel (excl. clock and watch springs and shock absorbers and torque rod or torsion bar springs of Section 17)	Coil springs	Chassis, Transmission and Steering	Automotive part	25.93.16	28.74.14	("B60G 11/00" OR "F16F 1/00" OR "F16F 3/00")	("Coil Spring*" OR "Helical Spring*" OR "Leaf Spring*")
732020	Helical springs, of iron or steel (excl. flat spiral springs, clock and watch springs, springs for sticks and handles of umbrellas or parasols, and shock absorbers of Section 17)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
830120	Locks used for motor vehicles, of base metal	Locks	Body, Fuel Tank or Cap	Automotive part	25.72.11	28.63.11	(“E05B 9/00” OR “E05B 13/00” OR “E05B 15/00” OR “E05B 17/00” OR “E05B 47/00” OR “E05B 65/00” OR “E05C 3/00” OR “E05C 19/00”)	(Lock OR Locks)
830210	Hinges of all kinds, of base metal	Hinges	Body, Fuel Tank or Cap	Automotive part	25.72.14	28.63.14	(“E05D”)	(Hinge OR Hinges)
840731	Spark-ignition reciprocating piston engine, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity <= 50 cm^3	Engines	Engine or Emissions	Automotive part	39.99.00.Z1 (coded as 29.10.11 by Turk-Stat)	34.10.11	(“F02B” OR “F02D” OR “F02F” OR “F02N” OR “F02P”)	(Engine*)
840732	Spark-ignition reciprocating piston engine, of a kind used for the propulsion of vehicles of chapter 87, of a cylinder capacity >50 cm^3 but <= 250 cm^3							
840733	Spark-ignition reciprocating piston engine, of a kind used for vehicles of chapter 87, of a cylinder capacity >250 cm^3 but <= 1.000 cm^3							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
840734	Spark-ignition reciprocating piston engine, of a kind used for vehicles of chapter 87, of a cylinder capacity >1.000 cm^3				39.99.00.Z2 (coded as 29.10.12 by TurkStat)	34.10.12		
840820	Compression-ignition internal combustion piston engine “diesel or semi-diesel engine“, for the propulsion of vehicles of chapter 87				29.10.13	34.10.13		
840991	Parts suitable for use solely or principally with spark-ignition internal combustion piston engine, n.e.s.	Engine parts and diesel fuel injectors	Engine or Emissions	Automotive part	28.11.41	34.30.11	(“F16J” OR “F02B” OR “F02F” OR “F16C 7/00” OR “F04B” OR “F02D” OR “F01L” OR “F01M”)	(“Cylinder Block*” OR “Cylinder Head*” OR Piston* OR “Connecting Rod*” OR “Valve Train” OR Valvetrain)
840999	Parts suitable for use solely or principally with compression-ignition internal combustion piston engine “diesel or semi-diesel engine“, n.e.s.				28.11.42	34.30.12		
841330	Fuel, lubricating or cooling medium pumps for internal combustion piston engine	Fuel pumps	Engine or Emissions	Automotive part	28.13.11	29.12.21	(“F16N 13/00” OR “B60K 11/00” OR “B60R 17/00” OR “F01M” OR “F01P” OR “F04F”)	(“Fuel Pump*” OR “Lubricat* Pump*” OR “Cool* Pump*”)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
841430	Compressors for refrigerating equipment	Compressors for refrigeration equipment	Ventilation	Automotive part	28.13.23	29.12.33	(“F25B” OR “C09K” OR “C10M” OR “B60H” OR “F04B” OR “F25D” OR “F04C” OR “F01M” OR “F16D”)	(“Refrigerati* Compressor*” OR “Compressor* Refrigerati*”)
841459	Fans (excl. table, floor, wall, window, ceiling or roof fans, with a self-contained electric motor of an output <= 125 W)	Fans	Engine or Emissions	Automotive part	28.25.20	29.23.20	(“B60H 1/00” OR “B60H 3/00” OR “H02K 9/00” OR “B60K 11/00” OR “F01P 1/00” OR “F01P 5/00”)	(Fan OR Fans)
841520	Air conditioning machines of a kind used for persons, in motor vehicles	Climate control	Ventilation	Automotive part	28.25.12	29.23.12	(“B60H 1/00” OR “B60H 3/00”)	(“Air Conditioning” OR “Air Conditioner*” OR Air-conditioning OR Air-conditioner* OR Airconditioning OR Airconditioner*)
842123	Oil or petrol-filters for internal combustion engines	Oil / Fuel filters	Engine or Emissions	Automotive part	28.29.13	29.24.13	(“B01D 17/00” OR “B01D 27/00” OR “B01D 29/00” OR “B01D 35/00” OR “B01D 36/00” OR “B01D 37/00” OR “B01D 39/00”)	(“Oil Filter*” OR “Fuel Filter*”)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
842131	Intake air filters for internal combustion engines	Intake air filters	Engine or Emissions	Automotive part	28.29.13	29.24.13	(“B01D 46/00”)	(“Air Filter*”)
842139	Machinery and apparatus for filtering or purifying gases (excl. isotope separators and intake air filters for internal combustion engines)	Catalytic converters	Engine or Emissions	Automotive part	28.25.14	29.23.14	(“F01N 3/00” OR “B01D 53/00” OR “B01J 23/00”)	(“Catalytic Converter*”)
848210	Ball bearings	Bearings and their parts	Other Parts	Automotive part	28.15.10	29.14.10	(“F16C”)	(Bearing OR Bearings)
848220	Tapered roller bearings, incl. cone and tapered roller assemblies							
848240	Needle roller bearings							
848250	Cylindrical roller bearings (excl. needle roller bearings)							
848280	Roller bearings, incl. combined ball-roller bearings (excl. ball bearings, tapered roller bearings, incl. cone and tapered roller assemblies, spherical roller bearings, needle and cylindrical roller bearings)							
848291	Balls, needles and rollers for bearings (excl. steel balls of heading 7326)				28.15.31	29.14.31		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
848299	Parts of ball or roller bearings (excl. balls, needles and rollers), n.e.s.							
848310	Transmission shafts, incl. cam shafts and crank shafts, and cranks	Cam / Crankshafts	Engine or Emissions	Automotive part	28.15.22	29.14.22	(“F01L 1/00” OR “F16C 3/00”)	(Camshaft? OR Crankshaft? OR “Cam Shaft?” OR “Crank Shaft?”)
848350	Flywheels and pulleys, incl. pulley blocks	Flywheels and pulleys	Engine or Emissions	Automotive part	28.15.25	29.14.25	(“F16F 15/30” OR “F16H 33/02” OR “F16H 55/00” OR “F16D 13/76”)	(Flywheel? OR Pulley?)
850710	Lead-acid accumulators of a kind used for starting piston engine “starter batteries” (excl. spent)	Batteries	Electrical	Automotive part	27.20.21	31.40.21	(“H01M 2/00” OR “H01M 4/00”)	(“Accumulator* Plate*” OR “Batter* Plate*” OR “Accumulator* Separator*” OR “Batter* Separator*”)
850720	Lead acid accumulators (excl. spent and starter batteries)				27.20.22	31.40.22		
850730	Nickel-cadmium accumulators (excl. spent)				27.20.23	31.40.23		
850740	Nickel-iron accumulators (excl. spent)							
850750	Nickel-metal hydride accumulators (excl. spent)							
850760	Lithium-ion accumulators (excl. spent)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
850780	Electric accumulators (excl. spent and lead-acid, nickel-cadmium, nickel-iron, nickel-metal hydride and lithium-ion accumulators)				27.20.23	31.40.23		
850790	Plates, separators and other parts of electric accumulators, n.e.s.				27.20.24	31.40.24		
851110	Sparking plugs of a kind used for spark-ignition or compression-ignition internal combustion engines	Spark plugs	Engine or Emissions	Automotive part	29.31.21	31.61.21	(“F02P” OR “F02M 57/06” OR “H01T 13/00”)	(“Spark* Plug*”)
851120	Ignition magnetos, magneto-dynamos and magnetic flywheels, for spark-ignition or compression-ignition internal combustion engines	Magnetos	Engine or Emissions	Automotive part	29.31.21	31.61.21	(“H02K” OR “F02P” OR “H01F” OR “F02B”)	(“Ignit* Magnet*” OR “Magnet* Dynamo*” OR “Magnet* Flywheel*” OR “Magnet* Fly Wheel*”)
851130	Distributors and ignition coils of a kind used for spark-ignition or compression-ignition internal combustion engines	Distributors and ignition coils	Engine or Emissions	Automotive part	29.31.21	31.61.21	(“F02P” OR “H01T” OR “H01F”)	(Distributor* OR “Ignition Coil*” OR “Coil* Ignition”)
851140	Starter motors and dual purpose starter-generators of a kind used for spark-ignition or compression-ignition internal combustion engines	Starter motors	Engine or Emissions	Automotive part	29.31.22	31.61.22	(“F02N”)	(“Start* Motor*” OR “Starter* Generator*”)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
851150	Generators of a kind used for internal combustion engines (excl. magneto dynamos and dual purpose starter-generators)	Alternators	Electrical	Automotive part	29.31.22	31.61.22	(“H02K” OR “H02P”)	(Generator* OR “AC Generator*” OR “A.C. Generator*” OR Alternator*)
851180	Electrical ignition or starting equipment, incl. cut-outs, of a kind used for spark-ignition or compression-ignition internal combustion engines (excl. generators, starter motors, distributors, ignition coils, ignition magnetos, magnetic flywheels and sparking plugs)	Electrical ignition or starting equipment	Engine or Emissions	Automotive part	29.31.22	31.61.22	(“F02P” OR “F02B”)	(“Electrical Ignition”)
851190	Parts of electrical ignition or starting equipment	Parts of electrical ignition or starting equipment	Engine or Emissions	Automotive part	29.31.30	31.61.24		
851220	Electrical lighting or visual signalling equipment for motor vehicles (excl. lamps of heading 8539)	Lighting	Body, Fuel Tank or Cap	Automotive part	27.40.39	31.61.23	(“B60Q” OR “F21M” OR “H01K” OR “F21S” OR “F21V”)	(“Electrical Lighting” OR “Visual Signalling” ANDNOT “Sealed Beam Lamp*”)
851230	Electrical sound signalling equipment for cycles or motor vehicles	Horns	Electrical	Automotive part	29.31.23	31.61.23	(“B60R 25/00” OR “B60Q 5/00” OR “G10K 9/00”)	(“Sound Signal*” OR Horn OR Horns)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
851240	Electrical windscreen wipers, defrosters and demisters, for motor vehicles	Windshield wipers	Body, Fuel Tank or Cap	Automotive part	29.31.23	31.61.23	(“B60S 1/00” OR “H05B 3/84”)	(“Windscreen Wiper*” OR “Windshield Wiper*” OR “Windscreen Wash*” OR “Windshield Wash*” OR Defroster* OR Demister*)
851290	Parts of cycle & vehicle light, signal, etc equipment	Parts of cycle & vehicle light, signal, etc equipment	Body, Fuel Tank or Cap	Automotive part	29.31.30	31.61.24		
852721	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles, combined with sound recording or reproducing apparatus	Radios	Electrical	Automotive part	26.40.12	32.30.12	(“B60R 11/00”)	(Radio OR Radios)
852729	Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles, not combined with sound recording or reproducing apparatus							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
853641	Relays for a voltage <= 60 V	Flasher units	Body, Fuel Tank or Cap	Automotive part	27.12.24	31.20.24	(“H01H” OR “B60Q”)	(Flasher OR Flashers OR Relay OR Relays)
853910	Sealed beam lamp units	Sealed beam lamp units	Body, Fuel Tank or Cap	Automotive part	27.40.11	31.50.11	(“B60Q” OR “F21M” OR “H01K” OR “F21S” OR “F21V”)	(“Sealed Beam Lamp*”)
853921	Tungste halogen filament lamps (excl. sealed beam lamp units)	Tungsten halogen filament lamps	Body, Fuel Tank or Cap	Automotive part	27.40.12	31.50.12	(“B60Q” OR “H01K” OR “F21V”)	(“Halogen Lamp?”)
854430	Ignition wiring sets and other wiring sets for vehicles, aircraft or ships	Wiring sets	Electrical	Automotive part	29.31.10	31.61.10	(“H02G” OR “H01R” OR “H01B” OR “B60R 16/00”)	(“Wir* Harness*” OR “Wir* Set*” ANDNOT Wireless*)
860900	Containers (including containers for the transport of fluids) specially designed and equipped for carriage by one or more modes of transport	Containers	Other Parts	Automotive part	29.20.21	34.20.21		
870000	Motor vehicles and others	Tractors	Motor Vehicle	Motor vehicle				
870110	Pedestrian-controlled agricultural tractors and similar tractors for industry (excl. tractor units for articulated lorries)				28.30.10	29.31.10		
870130	Track-laying tractors (excl. pedestrian-controlled)				28.92.50	29.52.50		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870190	Tractors (excl. those of heading 8709, pedestrian-controlled tractors, road tractors for semi-trailers and track-laying tractors)				28.30.21	29.31.21		
					28.30.22	29.31.22		
					28.30.23	29.31.23		
						29.31.24		
870120	Road tractors for semi-trailers				29.10.43	34.10.44		
870210	Motor vehicles for the transport of >= 10 persons, incl. driver, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine”	Vehicle for the transport of 10 or more passengers	Motor Vehicle	Motor vehicle	29.10.30	34.10.30		
870290	Motor vehicles for the transport of >= 10 persons, incl. driver, not with compression-ignition internal combustion piston engine “diesel or semi-diesel engine“, of a cylinder capacity of >2.500 cm^3, new							
870310	Vehicles for the transport of persons on snow; golf cars and similar vehicles	Passenger cars	Motor Vehicle	Motor vehicle	29.10.52	34.10.53		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870321	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity <= 1.000 cm^3 (excl. vehicles for the transport of persons on snow and other specially designed vehicles of subheading 8703.10)				29.10.21	34.10.21		
870322	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity >1.000 cm^3 but <= 1.500 cm^3 , new (excl. those of heading 8702 and vehicles for the transport of persons on snow and similar vehicles of subheading 8703.10)							
870323	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity >1.500 cm^3 but <= 3.000 cm^3, new				29.10.22	34.10.22		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870324	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity >3.000 cm^3 (excl. vehicles for the transport of persons on snow and other specially designed vehicles of subheading 8703.10)							
870331	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with compression-ignition internal combustion piston engine "diesel or semi-diesel engine" of a cylinder capacity <= 1.500 cm^3, new (excl. vehicles for the transport of persons on snow and other specially designed vehicles of subheading 8703.10)				29.10.23	34.10.23		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870332	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine” of a cylinder capacity >1.500 cm^3 but <= 2.500 cm^3, new (excl. motor caravans and vehicles specially designed for travelling on snow and other special purpose vehicles of subheading 8703.10)							
870333	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine” of a cylinder capacity >2.500 cm^3, new (excl. motor caravans and vehicles specially designed for travelling on snow and other special purpose vehicles of subheading 8703.10)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870390	Motor cars and other vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with engines other than spark-ignition internal combustion reciprocating piston engine “diesel or semi-diesel engine” (excl. vehicles for the transport of persons on snow and other specially designed vehicles of subheading 8703,10)				29.10.24	34.10.24		
870410	Dumpers for off-highway use	Goods vehicle	Motor Vehicle	Motor vehicle	28.92.29	34.10.51		
870421	Motor vehicles for the transport of goods, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine” of a gross vehicle weight <= 5 t (excl. dumpers for off-highway use of subheading 8704.10 and special purpose motor vehicles of heading 8705 and special motor vehicles for the transport of highly radioactive materials)				29.10.41	34.10.41		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870422	Motor vehicles for the transport of goods, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine” of a gross vehicle weight >5 t but <= 20 t, new (excl. dumpers for off-highway use of subheading 8704.10, special purpose motor vehicles of heading 8705 and special motor vehicles for the transport of highly radioactive materials)							
870423	Motor vehicles for the transport of goods, with compression-ignition internal combustion piston engine “diesel or semi-diesel engine” of a gross vehicle weight >20 t, new (excl. dumpers for off-highway use of subheading 8704.10, special purpose motor vehicles of heading 8705 and special motor vehicles for the transport of highly radioactive materials)							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870431	Motor vehicles for the transport of goods, with spark-ignition internal combustion piston engine, of a gross vehicle weight <= 5 t (excl. dumpers for off-highway use of subheading 8704.10 and special purpose motor vehicles of heading 8705)				29.10.42	34.10.42		
870432	Motor vehicles for the transport of goods, with spark-ignition internal combustion piston engine, of a gross vehicle weight >5 t (excl. dumpers for off-highway use of subheading 8704.10 and special purpose motor vehicles of heading 8705)							
870490	Motor vehicles for the transport of goods, with engines other than internal combustion piston engine (excl. dumpers for off-highway use of subheading 8704.10 and special purpose motor vehicles of heading 8705)							
870510	Crane lorries (excl. breakdown lorries)	Special purpose motor vehicle	Motor Vehicle	Motor vehicle	29.10.51	34.10.52		
870520	Mobile drilling derricks				29.10.59	34.10.54		

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870530	Fire fighting vehicles (excl. vehicles for transporting persons)							
870540	Concrete-mixer lorries							
870590	Special purpose motor vehicles (other than those principally designed for the transport of persons or goods and excl. concrete-mixer lorries, fire fighting vehicles, mobile drilling derricks and crane lorries)							
870600	Chassis fitted with engines, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles of heading 8705	Chassis	Chassis, Transmission and Steering	Automotive part	29.10.44	34.10.45	(“B62D 21/00”)	(Chassis*)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870710	Bodies for motor cars and other motor vehicles principally designed for the transport of persons	Body shells and body stampings	Body, Fuel Tank or Cap	Automotive part	29.20.10	34.20.10	(“B62D 23/00” OR “B62D 24/00” OR “B62D 25/00” OR “B62D 27/00” OR “B62D 29/00” OR “B62D 31/00” OR “B62D 33/00” OR “B62D 35/00” OR “B62D 37/00” OR “B62D 39/00” OR “B21D 1/00” OR “B60J”)	(“Body* Shell*” OR Bodyshell* OR Superstructure* OR “Body Stamping?”)
870790	Bodies for tractors, motor vehicles for the transport of ten or more persons, motor vehicles for the transport of goods and special purpose motor vehicles of heading 8705							
870810	Bumpers and parts thereof for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Bumpers	Body, Fuel Tank or Cap	Automotive part	29.32.30	34.30.20	(“B60R 19/00”)	(Bumper*)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870821	Safety seat belts for motor vehicles	Safety belts	Body, Fuel Tank or Cap	Automotive part	29.32.20	34.30.30	("B60R 22/00")	("Seat Belt*" OR Seat-belt* OR "Safe* Belt*" OR Safetybelt*)
870829	Parts and accessories of bodies for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Parts	Other Parts	Automotive part	29.32.20	34.30.30		
870830	Brakes and servo-brakes and their parts, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Brakes	Chassis, Transmission and Steering	Automotive part	29.32.30		("B60T")	(Brak*)
870831	Mounted brake linings					34.30.20		
870839	Brakes and parts, brake drums and rotors, brake drums, brake rotors, brakes & servo-brakes, other brakes							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870840	Gear boxes and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Transmissions	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	(“B60W” OR “F16H” OR “B60K 17/00” OR “B60K 20/00” OR “B60K 23/00” OR “B60K 31/00”)	(Gear* OR “Gear Box*” OR Transmis*)
870850	Drive-axles with differential, whether or not provided with other transmission components, and non-driving axles, and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Axles and drive shafts	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	(“B60B 35/00” OR “F16C 3/00” OR “F16D 1/00” OR “F16H 3/00”)	(Axle? OR Differential? OR “Drive Shaft?” OR Driveshaft?)
870860	Non-driving axles, spindles							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870870	Road wheels and parts and accessories thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Wheels	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	(“B60B” OR “B21H 1/00” OR “B21K 1/28”)	(Wheel*)
870880	Suspension systems and parts thereof, incl. shock-absorbers, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Shock absorbers	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	(“B60G”)	(Suspen* OR “Shock* Absorb*” OR Shockabsorb*)
870891	Radiators and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Radiators	Engine or Emissions	Automotive part	29.32.30	34.30.20	(“B60K 11/00” OR “F01P”)	(Radiator*)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870892	Silencers "mufflers" and exhaust pipes, and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Mufflers and exhaust pipes	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	("B60K 13/00" OR "F01N")	(Muffler* OR "Exhaust Pipe*" OR Silencer* ANDNOT "Catalytic Converter*")
870893	Clutches and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Clutches	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	("B60K 17/00" OR "B60K 20/00" OR "B60K 23/00")	(Clutch*)
870894	Steering wheels, steering columns and steering boxes, and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles	Steering	Chassis, Transmission and Steering	Automotive part	29.32.30	34.30.20	("B62D 1/00" OR "B62D 3/00" OR "B62D 5/00" OR "B62D 6/00" OR "B62D 7/00" OR "B62D 9/00" OR "B62D 11/00" OR "B62D 12/00" OR "B62D 13/00" OR "B62D 15/00")	(Steer*)

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
870895	Safety airbags with inflator system and parts thereof, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Airbag	Electrical	Automotive part	29.32.20		("B60R 21/00")	("Safe* Airbag*" OR Safetyairbag* OR "Air* Bag*" OR Airbag*)
870899	Parts and accessories, for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicles, n.e.s.	Other parts	Other Parts	Automotive part	29.32.30	34.30.20		
871610	Trailers and semi-trailers of the caravan type, for housing or camping	Trailers	Other Parts	Automotive part	29.20.22	34.20.22		
871631	Other trailers and semi-trailers for the transport of goods				29.20.23	34.20.23		
871639	Other trailers and semi-trailers for the transport of goods							
871640	Other trailers and semi-trailers							

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List of Automotive Parts and Motor Vehicles (Continued)

HS 6-Digit Code	HS 6-Digit Code Description	ID Description	Group	Kind of Item	Prodcom 2010 6-Digit Code	Prodcom 2006 6-Digit Code	International Patent Classification (IPC) Code(s)	Keyword(s)
871690	Trailer/non-mechanically propelled vehicle parts nes	Parts of trailers	Other Parts	Automotive part	29.20.30	34.20.30		
902910	Revolution counters, production counters, taximeters, milometers, pedometers and the like (excl. gas, liquid and electricity meters)	Meters	Electrical	Automotive part	26.51.64	33.20.64	(“G07B 13/00” OR “G01C 22/00”)	(Taximeter* OR “Taxi Meter*” OR Milometer* OR Mileometer* OR Odometer*)
902920	Speed indicators and tachometers, stroboscopes	Speed indicators and their parts	Electrical	Automotive part	26.51.64	33.20.64	(“G01P”)	(“Speed Indicator*” OR Speedometer* OR Speedo OR “Revolution Counter*” OR “Rev Counter*” OR Tachometer*)
910400	Instrument panel clocks and clocks of a similar type for vehicles, aircraft, vessels and other vehicles	Clocks	Electrical	Automotive part	26.52.13	33.50.13	(“B60K 37/00” OR “B62D 25/14”)	(Fascia OR Facia OR “Instrument Panel*” OR Dashboard* OR “Dash Board*” OR “Dash Panel*” OR Dashpanel* OR Dash*)
940120	Seats for motor vehicles	Seats, seat parts and furniture parts	Body, Fuel Tank or Cap	Automotive part	29.32.10	36.11.11	(“B60N 2/00” ANDNOT “A47C”)	(Seat*)

Source: Please see subsection 5.2.2 for how this list is created.

Appendix E

Tables

Table E.1 Summary Statistics of Automotive Items

	Time Period	Obs	Mean
PATENTC (PATCOSTAC)	2002-13	672	61.12
ECR	2002-13	408	5.15
ln(IMPVDOLLAR)	2002-13	806	17.86
ln(IMPVTL)	2002-13	806	18.27
ln(EXPVDOLLAR)	2002-13	806	16.96
ln(EXPVTL)	2002-13	806	17.37
ln(PRODVTL)	2005-12	505	18.42

Notes: Means are rounded. Please see Appendix D: Table D.3 for description of variable names and see subsection 5.2.3 for how "PATENTC (PATCOSTAC)" is created.

Source: The TurkStat, and please see subsection 5.4.1 and Appendix A: Data Sources for detail.

Tables: Import Cross-section Regressions

Table E.2 Technological Intensity of Import and Association of Import with Export at Automotive Parts Level: Cross-section 2002-07 OLS (Dependent Variable: ln(IMPVDOLLAR))

	2002	2003	2004	2005	2006	2007
PATCOSTAC	0.004***	0.003***	0.004***	0.006***	0.006***	0.005***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]
ECR	0.035	0.081	0.06	0.064	0.075	0.110*
	[0.073]	[0.065]	[0.061]	[0.067]	[0.072]	[0.058]
ln(EXPVDOLLAR)	0.425***	0.294	0.376**	0.366**	0.414***	0.555***
	[0.143]	[0.176]	[0.152]	[0.171]	[0.140]	[0.108]
GROUP Dummies	yes	yes	yes	yes	yes	yes
Constant	9.247***	11.458***	10.683***	10.775***	10.046***	7.673***
	[2.297]	[2.883]	[2.534]	[2.907]	[2.435]	[1.957]
Observations	34	34	34	34	34	34
R-squared	0.667	0.605	0.642	0.649	0.678	0.787

Notes: Robust standard errors are in brackets and
*** *p<0.01,* ** *p<0.05,* * *p<0.1* indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Table E.3 Technological Intensity of Import and Association of Import with Export at Automotive Parts Level: Cross-section 2008-13 OLS (Dependent Variable: ln(IMPVDOLLAR))

	2008	2009	2010	2011	2012	2013
PATCOSTAC	0.005***	0.006***	0.007***	0.007***	0.014***	0.023***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.003]	[0.004]
ECR	0.125**	0.099	0.019	0.041	-0.024	0.063
	[0.061]	[0.067]	[0.045]	[0.042]	[0.063]	[0.043]
ln(EXPVDOLLAR)	0.550***	0.730***	0.527***	0.514***	0.553***	0.387***
	[0.108]	[0.119]	[0.085]	[0.069]	[0.100]	[0.063]
GROUP Dummies	yes	yes	yes	yes	yes	yes
Constant	7.776***	4.539**	8.370***	8.557***	8.108***	10.788***
	[2.026]	[2.152]	[1.385]	[1.150]	[1.600]	[1.136]
Observations	34	34	34	34	34	34
R-squared	0.778	0.846	0.821	0.831	0.771	0.832

Notes: Robust standard errors are in brackets and
*** *p<0.01,* ** *p<0.05,* * *p<0.1* indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Tables: Export Cross-section Regressions

Table E.4 Technological Intensity of Export and Association of Export with Import at Automotive Parts Level: Cross-section 2002-07 OLS (Dependent Variable: ln(EXPVDOLLAR))

	2002	2003	2004	2005	2006	2007
PATCOSTAC	-0.002	-0.001	-0.003*	-0.004*	-0.006*	-0.005**
	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]
ECR	-0.078	-0.114	-0.067	-0.078	-0.103	-0.162*
	[0.113]	[0.115]	[0.106]	[0.111]	[0.109]	[0.084]
ln(IMPVDOLLAR)	0.812***	0.683**	0.770***	0.723**	0.798**	1.131***
	[0.214]	[0.316]	[0.271]	[0.282]	[0.301]	[0.208]
GROUP Dummies	yes	yes	yes	yes	yes	yes
Constant	2.747	5.062	3.45	4.485	3.372	-2.175
	[3.561]	[5.338]	[4.790]	[4.987]	[5.269]	[3.823]
Observations	34	34	34	34	34	34
R-squared	0.633	0.554	0.559	0.517	0.516	0.68

Notes: Robust standard errors are in brackets and
*** *p<0.01*, ** *p<0.05*, * *p<0.1* indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Table E.5 Technological Intensity of Export and Association of Export with Import at Automotive Parts Level: Cross-section 2008-13 OLS (Dependent Variable: ln(EXPVDOLLAR))

	2008	2009	2010	2011	2012	2013
PATCOSTAC	-0.004*	-0.005*	-0.007	-0.007*	-0.012*	-0.026**
	[0.002]	[0.003]	[0.004]	[0.004]	[0.006]	[0.012]
ECR	-0.185**	-0.133	-0.065	-0.088	0.004	-0.152*
	[0.089]	[0.086]	[0.086]	[0.075]	[0.097]	[0.089]
ln(IMPVDOLLAR)	1.116***	1.038***	1.262***	1.343***	1.091***	1.638***
	[0.232]	[0.136]	[0.216]	[0.193]	[0.218]	[0.237]
GROUP Dummies	yes	yes	yes	yes	yes	yes
Constant	-1.845	-0.502	-4.619	-5.974	-1.873	-11.075**
	[4.307]	[2.562]	[3.999]	[3.625]	[4.128]	[4.377]
Observations	34	34	34	34	34	34
R-squared	0.677	0.792	0.733	0.749	0.669	0.7

Notes: Robust standard errors are in brackets and
*** *p<0.01*, ** *p<0.05*, * *p<0.1* indicate significance levels.

Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Tables: Production - Import Cross-section Regressions

Table E.6 Technological Intensity of Production and Association of Production with Import at Automotive Parts Level: Cross-section 2005-08 OLS (Dependent Variable: ln(PRODVTL))

	2005	2006	2007	2008
PATCOSTAC	-0.006***	-0.007***	-0.008***	-0.011***
	[0.002]	[0.002]	[0.002]	[0.002]
ECR	-0.13	-0.230**	-0.210**	-0.167*
	[0.097]	[0.096]	[0.090]	[0.083]
ln(IMPVTL)	1.126***	1.171***	1.170***	1.293***
	[0.234]	[0.190]	[0.165]	[0.173]
GROUP Dummies	yes	yes	yes	yes
Constant	-1.08	-1.617	-1.729	-4.377
	[4.038]	[3.263]	[2.827]	[3.090]
Observations	31	33	33	32
R-squared	0.582	0.658	0.731	0.757

Notes: Robust standard errors are in brackets and
*** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.
Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Table E.7 Technological Intensity of Production and Association of Production with Import at Automotive Parts Level: Cross-section 2009-12 OLS (Dependent Variable: ln(PRODVTL))

	2009	2010	2011	2012
PATCOSTAC	-0.012***	-0.012	-0.006	-0.012
	[0.002]	[0.007]	[0.007]	[0.009]
ECR	-0.198**	-0.236*	-0.259**	-0.244**
	[0.082]	[0.136]	[0.100]	[0.109]
ln(IMPVTL)	0.962***	1.375***	0.678	0.867*
	[0.125]	[0.418]	[0.445]	[0.451]
GROUP Dummies	yes	yes	yes	yes
Constant	1.897	-5.275	7.455	4.155
	[2.349]	[7.674]	[8.198]	[8.410]
Observations	31	32	31	31
R-squared	0.784	0.624	0.52	0.57

Notes: Robust standard errors are in brackets and
*** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.
Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Tables: Production - Export Cross-section Regressions

Table E.8 Technological Intensity of Production and Association of Production with Export at Automotive Parts Level: Cross-section 2005-08 OLS (Dependent Variable: ln(PRODVTL))

	2005	2006	2007	2008
PATCOSTAC	0	0.002	-0.002***	-0.005***
	[0.001]	[0.002]	[0.001]	[0.001]
ECR	-0.033	-0.150*	-0.088	-0.016
	[0.050]	[0.076]	[0.057]	[0.096]
ln(EXPVTL)	0.891***	0.931***	0.891***	0.900***
	[0.115]	[0.126]	[0.090]	[0.164]
GROUP Dummies	yes	yes	yes	yes
Constant	3.137	2.796	3.221*	2.57
	[2.051]	[2.303]	[1.629]	[3.090]
Observations	31	33	33	32
R-squared	0.777	0.778	0.861	0.773

Notes: Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.
Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Table E.9 Technological Intensity of Production and Association of Production with Export at Automotive Parts Level: Cross-section 2009-12 OLS (Dependent Variable: ln(PRODVTL))

	2009	2010	2011	2012
PATCOSTAC	-0.006***	-0.002	-0.002	-0.003
	[0.002]	[0.004]	[0.003]	[0.003]
ECR	-0.039	-0.106	-0.153**	-0.170**
	[0.092]	[0.073]	[0.062]	[0.062]
ln(EXPVTL)	0.882***	1.156***	0.815***	0.889***
	[0.129]	[0.145]	[0.131]	[0.130]
GROUP Dummies	yes	yes	yes	yes
Constant	2.965	-1.637	4.678*	3.638
	[2.477]	[2.572]	[2.345]	[2.339]
Observations	31	32	31	31
R-squared	0.809	0.831	0.809	0.844

Notes: Robust standard errors are in brackets and *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels.
Source: The TurkStat, WIPO and Monteverde and Teece (1982)

Appendix F

Figures

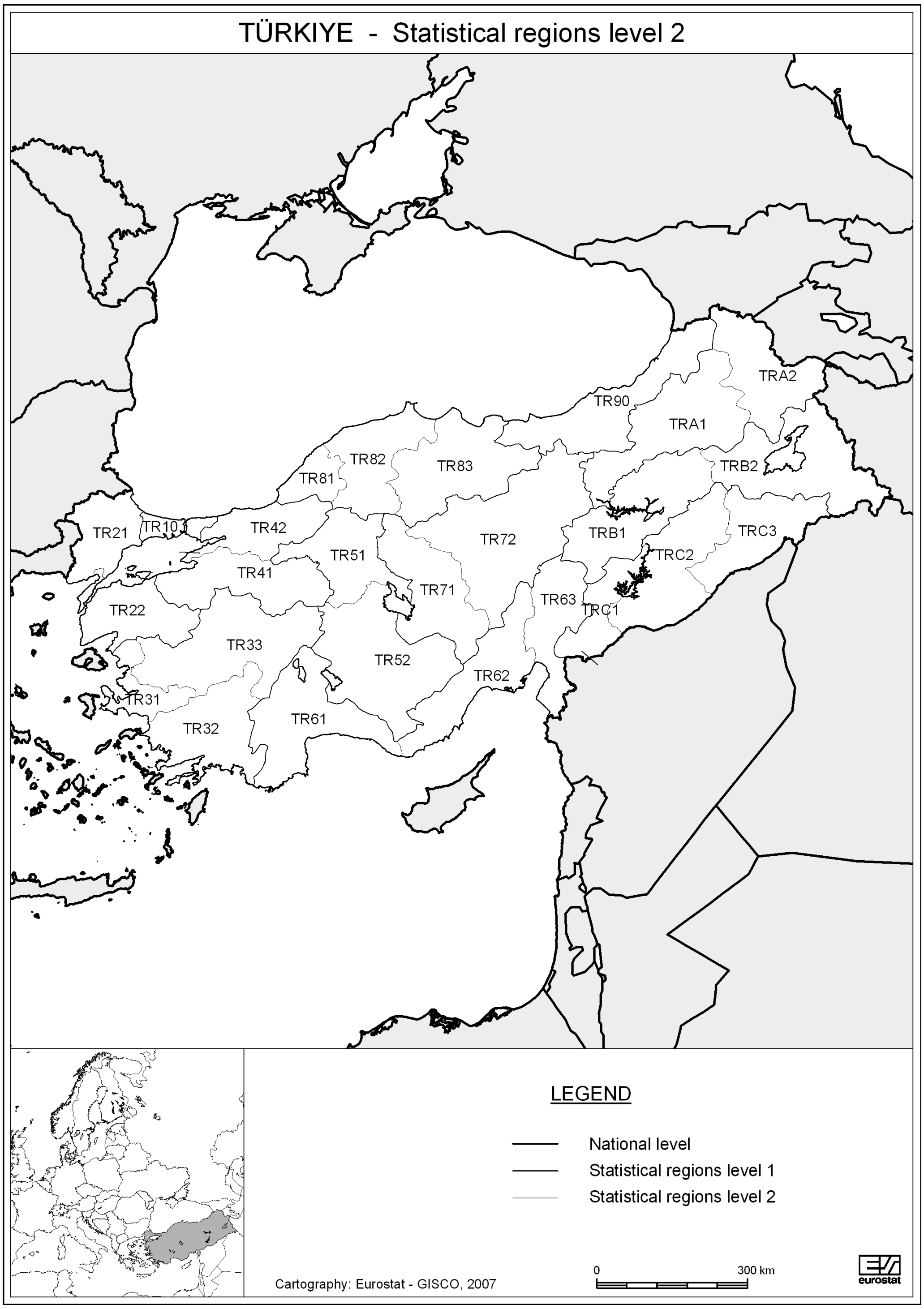
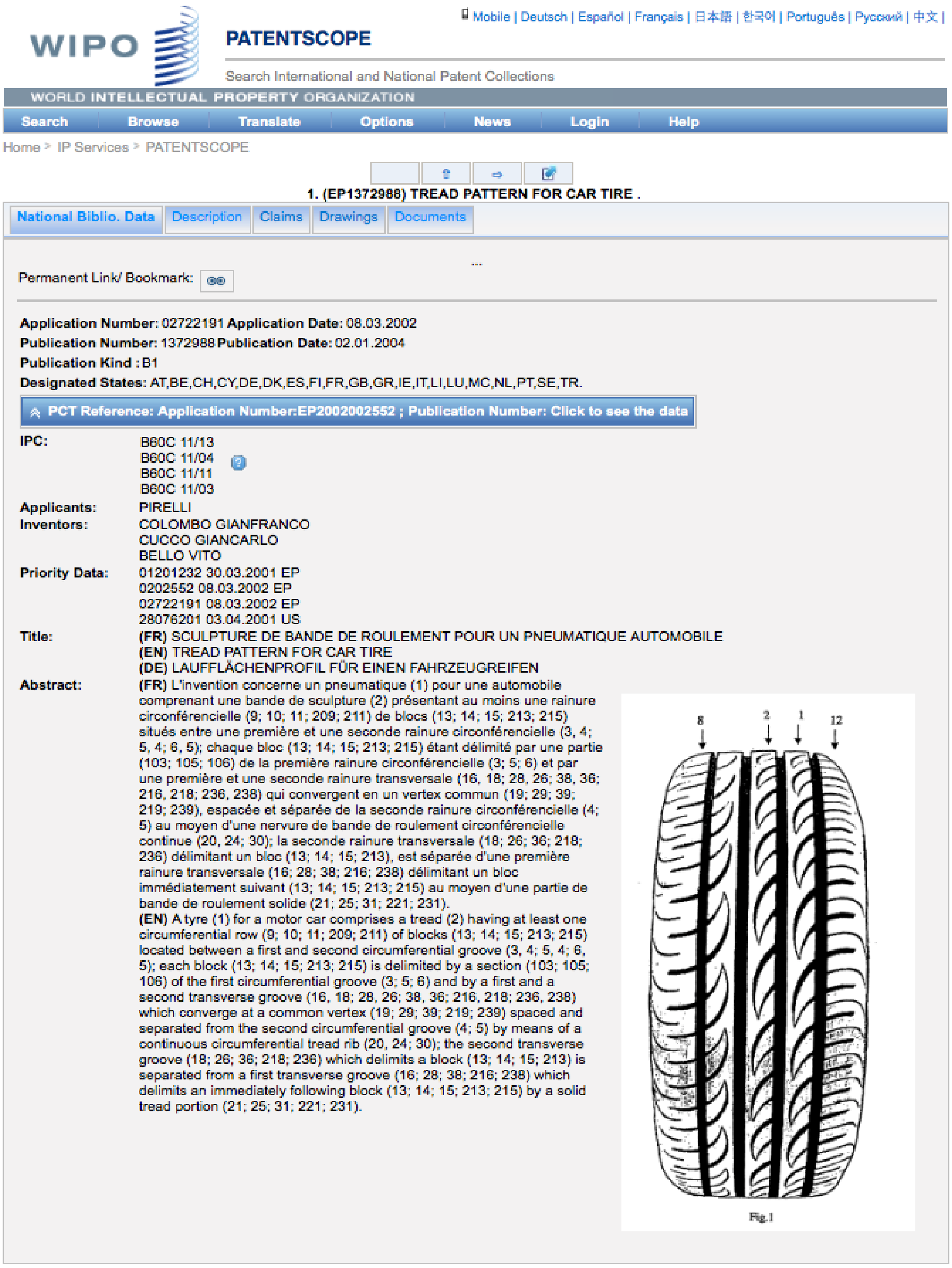


Figure F.1 Map of Statistical Regions of Turkey (NUTS 2)

Source: Eurostat (2008, p.41)



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1. (EP1372988) TREAD PATTERN FOR CAR TIRE .

National Biblio. Data | Description | Claims | Drawings | Documents

Permanent Link/ Bookmark:

Application Number: 02722191 **Application Date:** 08.03.2002
Publication Number: 1372988 **Publication Date:** 02.01.2004
Publication Kind : B1
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IPC: B60C 11/13
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Applicants: PIRELLI

Inventors: COLOMBO GIANFRANCO
CUCCO GIANCARLO
BELLO VITO

Priority Data: 01201232 30.03.2001 EP
0202552 08.03.2002 EP
02722191 08.03.2002 EP
28076201 03.04.2001 US

Title: **(FR)** SCULPTURE DE BANDE DE ROULEMENT POUR UN PNEUMATIQUE AUTOMOBILE
(EN) TREAD PATTERN FOR CAR TIRE
(DE) LAUFFLÄCHENPROFIL FÜR EINEN FAHRZEUGREIFEN

Abstract: **(FR)** L'invention concerne un pneumatique (1) pour une automobile comprenant une bande de sculpture (2) présentant au moins une rainure circonférencielle (9; 10; 11; 209; 211) de blocs (13; 14; 15; 213; 215) situés entre une première et une seconde rainure circonférencielle (3, 4; 5, 4; 6, 5); chaque bloc (13; 14; 15; 213; 215) étant délimité par une partie (103; 105; 106) de la première rainure circonférencielle (3; 5; 6) et par une première et une seconde rainure transversale (16, 18; 28, 26; 38, 36; 216, 218; 236, 238) qui convergent en un vertex commun (19; 29; 39; 219; 239), espacée et séparée de la seconde rainure circonférencielle (4; 5) au moyen d'une nervure de bande de roulement circonférencielle continue (20, 24; 30); la seconde rainure transversale (18; 26; 36; 218; 236) délimitant un bloc (13; 14; 15; 213), est séparée d'une première rainure transversale (16; 28; 38; 216; 238) délimitant un bloc immédiatement suivant (13; 14; 15; 213; 215) au moyen d'une partie de bande de roulement solide (21; 25; 31; 221; 231).
(EN) A tyre (1) for a motor car comprises a tread (2) having at least one circumferential row (9; 10; 11; 209; 211) of blocks (13; 14; 15; 213; 215) located between a first and second circumferential groove (3, 4; 5, 4; 6, 5); each block (13; 14; 15; 213; 215) is delimited by a section (103; 105; 106) of the first circumferential groove (3; 5; 6) and by a first and a second transverse groove (16, 18; 28, 26; 38, 36; 216, 218; 236, 238) which converge at a common vertex (19; 29; 39; 219; 239) spaced and separated from the second circumferential groove (4; 5) by means of a continuous circumferential tread rib (20, 24; 30); the second transverse groove (18; 26; 36; 218; 236) which delimits a block (13; 14; 15; 213) is separated from a first transverse groove (16; 28; 38; 216; 238) which delimits an immediately following block (13; 14; 15; 213; 215) by a solid tread portion (21; 25; 31; 221; 231).

Figure F.2 An Example Patent Document for Tire

Source: WIPO's PATENTSCOPE Database

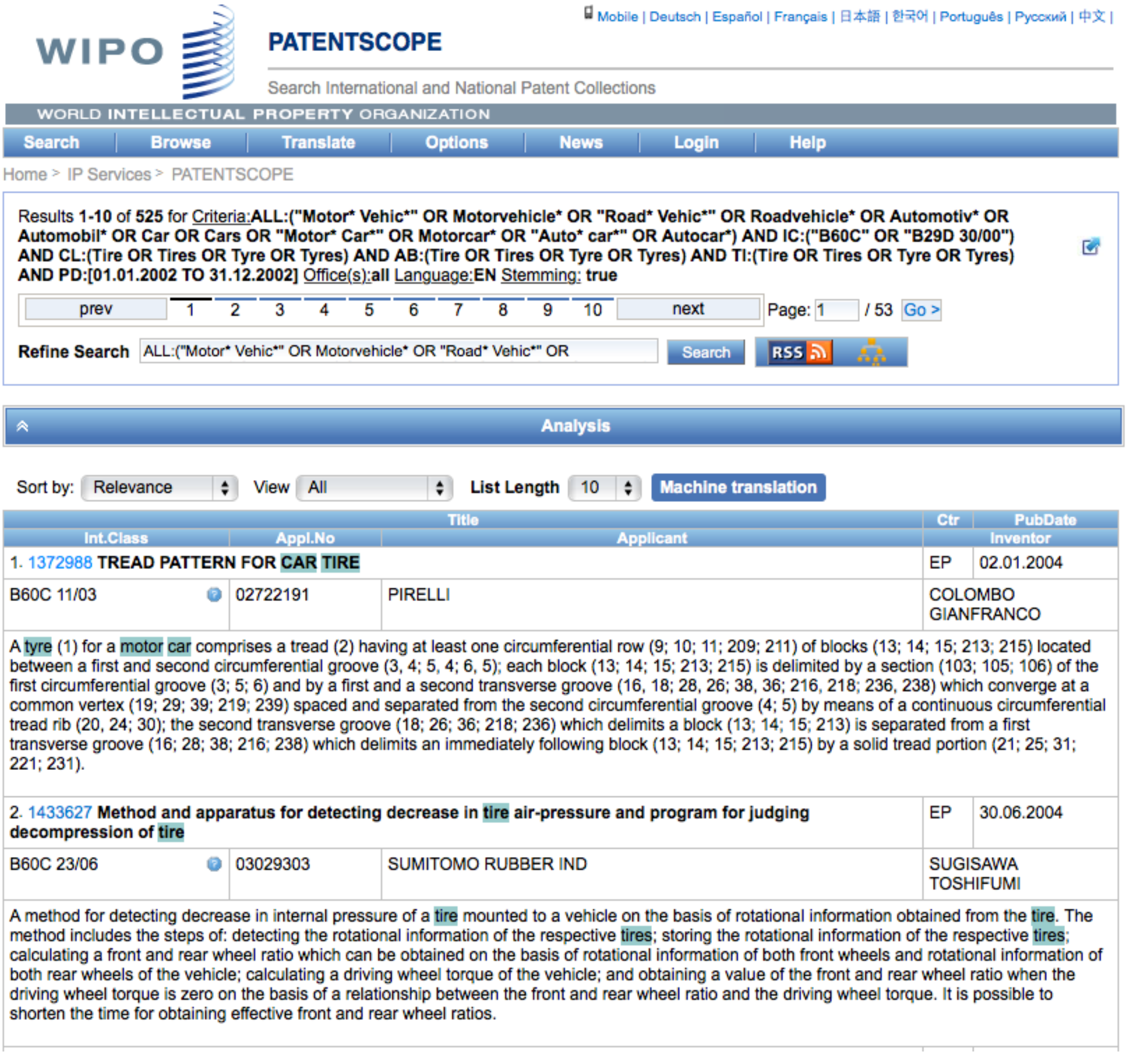

Figure F.3 An Example Patent Search for Tires

Source: WIPO's PATENTSCOPE Database