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Regulating entrepreneurship quality and quantity

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ABSTRACT

How does regulation affect entrepreneurship outcomes? We examine the effect of two regulatory policy mechanisms—costs and procedures—on entrepreneurship quality and quantity. Based on the national systems of entrepreneurship perspective, we apply public interest and public choice theories to hypothesize how regulatory costs and regulatory procedures can affect entrepreneurship quality and quantity differently. Using a multi-level approach, we test the direction, size, and shape of these effects with data on 51,330 innovation-oriented entrepreneurs (reflecting quality) and 871,241 entrepreneurs who started new ventures (reflecting quantity) across 76 countries during 2008–2017. We find that regulatory procedures in a country often have an inverted U-shaped relationship with entrepreneurship quality, suggesting that both too few and too many procedures might be detrimental when policymakers target innovation. We find that regulatory costs tend to have negative or inverted U-shaped effects on entrepreneurship quality and quantity. Our findings show that the way regulations are administered—by imposing financial costs or administrative requirements—is a boundary condition for entrepreneurship that affects the overall quantity of entrepreneurship and the innovation-centered quality of entrepreneurship.

1. Introduction

There is growing interest in how policies may better target specific goals (World Bank, 2023) and which levers can be adjusted to induce a particular entrepreneurship effect. Scholars and policymakers increasingly see regulation as a tool to influence entrepreneurship, and in some cases to target activities such as innovation, firm growth, and exporting. How the regulatory environment affects entrepreneurs is a complicated question. For example, should regulators simplify regulations or reduce filing fees for mandatory forms if their goal is to encourage more entrepreneurship in general? What if the goal is to achieve more innovation? Some policies favor prioritizing the “quality” of entrepreneurship, such as job creation, new products development, opportunity exploration, and innovation, versus generally a higher volume of entrepreneurship. Other perspectives consider whether the role of public policy is to focus on knowledge dissemination and creation via entrepreneurship. For example, will innovation be undersupplied without public support (see Mazzucato and Perez, 2015)?

The economic effects of differences in regulation on entrepreneurship are often not well understood (Audretsch et al., 2019; Fritsch et al., 2021). Entrepreneurship and institutions research examines which regulatory domains matter, such as tax policy, property registration, entry regulation, bankruptcy laws, and export permitting (e.g., Autio et al., 2014; Busenitz et al., 2000; Estrin et al., 2016, 2019; Klapper et al., 2006), but how the effects are induced needs more attention (Audretsch et al., 2022). Findings on the direction and size of key relationships can be inconclusive (Stenholm et al., 2013; Estrin et al., 2013a), with some recent studies point to non-linear relationships (Braunerhjelm et al., 2021; Braunerhjelm, 2022; Audretsch et al., 2019). This could stem from the heterogeneity of both regulation and entrepreneurship; regulation varies widely in type and nature of change, and entrepreneurship can take many forms (see Klapper and Love, 2016; Braunerhjelm et al., 2015, 2021; Chowdhury et al., 2019; Colombelli et al., 2016). Prior work often examined the rate of entrepreneurship activity, such as events, entry, and flows (e.g., Parker, 2009; Reynolds et al., 2002), and the research lacks consensus about determinants, including regulation,

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of entrepreneurship quality and quantity (see Cole et al., 2016; Colombelli et al., 2016; Sobel, 2008).

Therefore, the purpose of this study is to assess the effect of two specific regulatory settings, financial costs and administrative requirements (procedures), on entrepreneurship quality and quantity. We theoretically and empirically examine how regulatory costs and procedures may differ in their effects on entrepreneurship quality and quantity, using multi-sourced data on 51,330 entrepreneurs who innovated (quality) and 871,241 entrepreneurs who started new ventures (quantity) across 76 countries for the period 2008–2017. We find that entrepreneurship quality is negatively affected by regulatory costs and has an inverted U-shaped relationship with regulatory procedures. We find that entrepreneurship quantity is mainly negatively affected by regulatory costs and procedures of different domains, and sometimes shows several U-shaped relationships.

Our study advances knowledge on entrepreneurship and institutions, adding to research rooted in national systems of entrepreneurship (e.g., Acs et al., 2014, 2016; Schillo et al., 2016) and institutional economics (e.g., Autio et al., 2014), by showing that entrepreneurship quality and quantity are conditional on institutional context. We clarify some contradictory previous findings on the role of regulatory settings (cost and procedures) in several domains (e.g., entry, tax, property rights, contract enforcement, etc.) in shaping entrepreneurship quality and quantity.

2. Theoretical framework

2.1. National systems of entrepreneurship: a lens on regulation and entrepreneurship

In order to understand why and in what way individuals pursue economic opportunities via entrepreneurship, Acs et al. (2014) explain the national systems of entrepreneurship (NSE) concept. Individuals take action, and institutional conditions regulate these actions and their outcomes, suggesting that population-level processes of entrepreneurial action and their outcomes are tied to and within the broader surrounding context (Acs et al., 2014). Individual characteristics, resources, and capabilities (Bowen and De Clerq, 2008; Bosma et al., 2012) can be understood by also considering the relationship between institutional context and entrepreneurial outcomes.

The NSE approach points to several themes that may help shed light on the relationship between institutional context and entrepreneurship and some contradictory results in previous research (Mickiewicz et al., 2021; Sobel, 2008). We highlight the importance of considering both *regulation*, which previous research has found to both encourage and disincentivize entrepreneurial activity (e.g., Audretsch et al., 2019; Braunerhjelm, 2022; Klapper and Love, 2016; Rakoff, 2000) and *entrepreneurship* itself, which is relevant both in terms of both volume (quantity) and innovation (quality) (Chowdhury et al., 2019).

Neither regulation nor entrepreneurship are homogeneous; there are many kinds of regulation, as well as many mechanisms through which regulation affects entrepreneurs (Sobel, 2008) and their contribution to the economy. There are also multiple types of entrepreneurial outcomes of interest, such as new firm entry, entrepreneurial growth aspirations (Stenholm et al., 2013), new venture job growth, and innovation (Darnihamedani et al., 2018). This heterogeneity of both regulation and entrepreneurship contributes to findings that may be nonlinear, contradictory, and sometimes inconclusive.

2.2. On entrepreneurship quality and quantity

Policymakers may seek several outcomes when considering how they regulate entrepreneurship. There can be differences between how much entrepreneurship is occurring in an economy (quantity) and a specific kind of activity, such as innovation-oriented entrepreneurship, that is being undertaken (quality). While lots of entry and exit are the foundation of a competitive economy, not all entrepreneurship will survive

and grow, and not all entrepreneurs will make the same contributions to the economy. Some entrepreneurs will do exceptionally well and keep the creative destruction wheels of an economy turning, and some simply will not. This places importance both on having lots of entrepreneurship quantity and having some promising prospects among the new starts (quality). This means that policymakers could have a wide set of targets based on their priorities.

We examine entrepreneurship quantity and quality as both can be important based on the policy priority, and new insights can expand the suite of tools available for policymakers (Xie et al., 2021). Our examination of quantity focuses on the total volume of entrepreneurial activity regardless of the type and form it takes; our examination of quality focuses on innovativeness, allowing us to capture the importance of newness rather than a specific output (e.g., patents).

Our emphasis on innovativeness as a reflection of quality is tied to its role in economic advancement and the disproportionate gains (Acemoglu and Robinson, 2008) from innovation versus imitation (Young et al., 2018). Our interest is driven by the nuances surrounding innovation (Pérez-Luño et al., 2011) and the argument that the typical new venture is not innovative, generates little wealth, and creates few jobs (Shane, 2009). However, we recognize of course that this is not the only way to consider quality, and that it is not necessarily the case that all entrepreneurs must innovate in order to move the economy forward (see Darnihamedani et al., 2018).

Recent work suggests that some policy frameworks can be uniquely important for innovativeness in entrepreneurship (Yoon et al., 2018), and this warrants deeper study (Colombelli et al., 2016; Young et al., 2018). Darnihamedani et al. (2018) studied whether early-stage entrepreneurs are innovative and found that regulation can have a strong relationship with innovation-driven entrepreneurship.

2.3. On the heterogeneity of regulation

Regulation, which sets standards, rules, and processes for a wide range of functions required to start and grow a business (Williamson, 2000), is seen differently in public choice and public interest theories (see Audretsch et al., 2019). Regulation mainly acts as a negative cost for firms in a public choice perspective. More costly or difficult regulations may have compounding effects on entrepreneurs and could lead to higher adjustment, adaptation, and other costs of negotiating with authorities and learning about regulatory changes. They could have disproportionate effects on small firms compared to large firms, and new firms compared to incumbents, leading to unfair competition, greater uncertainty and market failures, including hindering the commercialization of new technologies and products (Buchanan et al., 1980; Chambers et al., 2022).

In contrast, regulations can be a benefit to society and entrepreneurs in public interest theory, by creating safeguards and protections (Hantke-Domas, 2003; Pigou, 1938) which can direct standards for products, provide incentives for business engagement, and buffer risk. Regulations in this perspective may prevent entrepreneurs with poor quality products from bringing them to market, protecting consumers; stimulate specific types of entrepreneurship, such as highly productive activities, that policymakers may want to target (Wurth et al., 2022); help entrepreneurs protect their businesses and property rights, resolve insolvency, and enforce legal obligations; and reduce market uncertainty (Hoffmann et al., 2009).

Governments can experiment with regulations in many domains relevant to entrepreneurship, such as business registration, product market regulation, intellectual property frameworks, property registration, permitting and licensing, trade requirements, and tax structures. Regulators can take many actions that shape the environment for entrepreneurship. For example, business registration paperwork may not require a fee, but it could require multiple documents which in turn take additional time and resources to complete. Similarly, permits may have a straightforward application process, but the steps could include a

requirement to complete related documentation, creating a scenario where one step depends on completing a previous step. Thus, how regulations affect entrepreneurs matters. Klapper and Love (2016) argue that it is helpful to look at the impacts of a reform process, noting that the magnitude of regulatory change can matter. They identify how the magnitude of change in entry regulation matters for new business registration, and how entrepreneurs respond to financial, administrative, and time settings of regulation. Their results show that entrepreneurs can respond differently to changes in fee structure and administrative requirements.

We explore how regulatory costs and procedures may have varied effects on entrepreneurship, building on the importance of regulatory heterogeneity (Audretsch et al., 2019; Bowen and De Clerq, 2008; Braunerhjelm and Eklund, 2014; Klapper and Love, 2016).

2.4. Regulation and entrepreneurship quality

Policy interest in improving entrepreneurship quality—and the subsequent benefits for society—could be one manifestation of a regulator acting in the public interest. A benevolent regulator (Pigou, 1938) could seek opportunities to encourage entrepreneurs through protective regulations. These protections may differ for entrepreneurs who want to innovate compared to those who do not. Investing in product development, for example, is not only about the cost of experimenting with new materials or market testing; it also needs protection for new inventions and security of commercialization processes for new products. Intellectual property protection can incentivize investment in innovation and new product development (Colombelli et al., 2016). This also means that entrepreneurs will need to know if they can enforce contract terms when they take on risks to develop new products (see Johnson et al., 2002).

Regulatory procedures can shape entrepreneurship quality in different ways. Clear procedures aiming to ensure that entrepreneurs are protected and set basic rules (such as for technical product requirements, standards and certifications, etc.) can ensure a minimum quality of products and services developed by entrepreneurs, and protect them from unintended leakage of knowledge (see Cassiman and Veugelers, 2002). This can also reduce uncertainty about what is required and when. For this reason, some procedures related to ensuring quality of products and services of entrepreneurs could improve the entry of higher quality activities. For example, protection from counterfeit products can reassure entrepreneurs that they will recoup their investment. Some amount of protection for parts of the process for new firms can also lower uncertainty for investors (Hoffmann et al., 2009) so they may be more willing to invest their capital in innovative activities.

At the same time, more procedural complexity can at some point become too much and add too much cost to doing business. Complex procedures, particularly in resource-constrained early business stages, such as registering the business and property, can slow down entry and introduction of new products in industries, such as where technology shocks rapidly open up opportunities (see Ciccone and Papaionnou, 2007). More procedures to protect innovation and access markets can mean smaller or underfunded new firms (even with promising ideas and products) may not have the expertise or knowledge to comply, slowing them down or cutting them out.

Powerful actors, like incumbent firms, may lobby to create barriers through procedures and standards that make it harder for potential competitors to enter the market (Braunerhjelm et al., 2015) and gain market share. A public choice view might consider the potential for collusion with policymakers to increase difficulty with more red tape, hence reducing the entry of new innovative firms. Also, more possibilities to extract rents through bribes and manipulation could be linked to more procedures that increase interactions with public officials or systems (Belitski et al., 2016). If that particular official happens to be corrupt, this raises exposure to corruption. This could disincentivize ambitious entrepreneurs from innovative activities such as product development.

Thus, we expect a non-linear relationship where more regulatory procedures will initially encourage and then discourage entrepreneurship quality. We expect that regulatory procedures will provide clarity and reduce uncertainty for entrepreneurs who are making larger investments and taking on risk, encouraging entrepreneurship quality; however, at a certain point, it could become difficult for new ventures to comply. Therefore, we expect:

Hypothesis 1A. There is an inverted U-shape relationship between regulatory procedures and entrepreneurship quality.

When it comes to regulatory costs, we expect more straightforward effects because of the direct and immediate impact of a change in funds in a new venture. In a public choice view, rent-seeking officials may want to raise regulatory fees and increase compliance in order to negotiate better deals with firms that can afford to pay (Belitski et al., 2016). Yet even when this is not the motivation and regulators operate in the public interest, there are few circumstances where more costly fees would not reduce funds available for other business activities.

Regardless of regulator intention, paying regulatory fees means not paying for something else with the same funds. This should matter for entrepreneurship quality because new ventures tend to face funding constraints (Tonoyan et al., 2010) compared to incumbents, as well as the actual costs related to innovative activities. These activities could improve business success, such as market research, exploration into export markets, hiring experts, product development, and investing in production capacity (Chowdhury et al., 2019).

An increase in regulatory costs increases the risk and cost of doing business, affecting fixed and variable costs of undertaking innovative activities and returns to investment. New ventures that expect high enough profits to absorb regulatory costs could pay, but this could be out of reach for innovative entrepreneurs who have to first invest in the newness they want to create before they can generate profits. High taxes and strict labor market regulations reduce high-impact entrepreneurship as the costs of doing business increase (Henrekson et al., 2010). These entrepreneurs may leave the market or simply never enter. Thus, we expect that higher regulatory costs will deter entrepreneurs from potentially innovative investments (Braunerhjelm and Eklund, 2014; Braunerhjelm, 2022), reducing entrepreneurship quality:

Hypothesis 1B. An increase in regulatory costs reduces entrepreneurship quality.

2.5. Regulation and entrepreneurship quantity

While some administrative procedures that can protect entrepreneurs and the public at large are important (Rakoff, 2000), excessive procedures could adversely affect entrepreneurship by discouraging aspirations (Estrin et al., 2013a). Regulatory procedures that are more transparent and quicker to implement can facilitate growth aspirations (Estrin et al., 2013a, 2013b).

Three dynamics are worth considering. First, regulatory uncertainty could increase (Hoffmann et al., 2009), with entrepreneurs entering with limited employment choices (Coffman and Sunny, 2021). Second, the time to adopt and adjust to regulations and procedures could increase, raising uncertainty (Hoffmann et al., 2009). As regulatory procedures become more diverse and complex, it becomes more difficult to learn, compare, and comply with them. Some procedures may contradict each other or be interdependent, which means completing the next procedure is not possible without the previous one (McMullen, 2011). More regulatory procedures can raise transaction and time costs for entrepreneurs, and entrepreneurs can interpret this in terms of their future expected profits and returns on investments.

Third, some entrepreneurs will react to increasing transaction and adjustment costs by pulling out (Anokhin and Schulze, 2009; Cuervo-Cazurra, 2006) or delaying entry. Nascent or latent entrepreneurs who have not yet entered the market could be particularly discouraged

(Audretsch et al., 2022). Whether they abandon entrepreneurship permanently or temporarily, this means a reduction in quantity at a given time.

Early entrants could move to a dormant stage, putting the business on hold or reducing the extent of business activities. This again will reduce the number of new entrants. In a recent study, Chambers et al. (2022) introduced various types of regulatory costs; for example, in addition to direct financial costs of paying for procedures, other compliance costs of regulation are incurred when fulfilling needs such as filling out paperwork, meeting standards, or paying lawyers to advise on compliance. While an increase in regulatory costs may be offset by economies of scale in incumbent and large businesses, entrepreneurs can be more affected if fewer people are employed, and more tasks need to be performed by each person. Also, incumbents may have lawyers and accountants who can learn new laws or amendments, and take care of legal matters and payroll, whereas new firms may need to outsource legal and accounting functions. We thus expect:

Hypothesis 2A. An increase in regulatory procedures reduces entrepreneurship quantity.

The costs compliance with regulation (including fixed costs, such as those related to entry or labor market regulation (Chowdhury et al., 2019), and variable costs, such as those related to property registration and entry regulation) can divert resources from venture creation. In particular, high start-up costs, property registration costs, and high tax rates (Braunerhjelm et al., 2021) may reduce market entry (da Fonseca, 2022). A typical potential startup may process high regulatory costs as a barrier to market entry.¹

These arguments are consistent with the public choice view and imply that an increase in regulatory procedures will also affect cost directly and will lead to fewer firms (Chambers et al., 2022). For example, large firms can distribute fixed costs of regulation over a larger number of products and services, reducing the cost per unit of production due to economies of scale. Small firms and startups may be less able to distribute the cost of regulation over greater output as they may be at the pre-market entry or pre-sale stage. Higher costs can further constrain the limited resources of entrepreneurs.

For this reason, the regulatory costs are likely to be disproportionate for new compared to incumbent firms, and this may reduce liquidity and capability to fundraise (Cumming et al., 2021). More costly regulation could result in a “toll-booth” effect (Djankov et al., 2002) for entrepreneurs, and latent or nascent entrepreneurs may pause or delay market entry. Based on this, we hypothesize:

Hypothesis 2B. An increase in regulatory cost reduces entrepreneurship quantity.

3. Data and methodology

3.1. Data and sample

We start by matching the Global Entrepreneurship Monitor (GEM) Adult Population Survey, which uses survey techniques to avoid common method bias (Bosma et al., 2012), with the World Development Indicators and Doing Business Statistics (World Bank, 2021, 2022). We use the period 2008–2017 as this is the overlap between the GEM data and Doing Business data (launched in 2004 and ended in 2021).

We draw our sample from every country surveyed in GEM. However, missing values for some of the countries limits our study to 76 countries. Thus, our starting point is cross-country multilevel panel data of individuals for the period 2008–2017. The GEM project uses harmonized cluster sampling, normally of at least 2000 individuals per country, to

identify nascent entrepreneurs. We thus exclude countries with fewer than 2000 individual respondents. The GEM data include individual characteristics such as individual's age, gender, level of education, stage of business, knowing entrepreneurship, individuals' attitude to the entrepreneurial status, media coverage of entrepreneurship, and the perception of skills and knowledge required to start a business (see Reynolds et al., 2002, 2005). GEM identifies adults engaged and planning to engage in entrepreneurial activity, including self-employment, and the data are internationally comparable and widely used in entrepreneurship research (e.g., Bowen and De Clerq, 2008; Darnihamedani et al., 2018). It is appropriate for our purposes because it allows us to examine our two interests, namely quantity, representing overall volume regardless of composition, motivation, form or entry mode, and informality; and quality, representing innovation-oriented entrepreneurship.

We use two samples from 76 countries: the first for entrepreneurship quality ($N = 51,330$ obs.) and the second for quantity ($N = 871,241$ obs.) for the 2008–2017 period. Only 39 countries have less than six years of observations. Table 1 describes both samples.

3.2. Dependent variables

We use measures for the quality and quantity of entrepreneurship as our dependent variables. We use *total entrepreneurial activity* (TEA) to operationalize entrepreneurship quantity, drawing on studies by McMullen et al. (2008), Parker (2009), Stenholm et al. (2013), and Yoon et al. (2018). The TEA comes from GEM and represents nascent entrepreneurship activity, with an individual aged 18–64, planning to start a business in the next 3 years or (and) new business ownership, with an individual aged 18–64 who owns a new business, i.e., who owns and manages a startup, pays salaries, wages, or any other payments for more than three months, but not >42 months (see Reynolds et al., 2002). We consider this an appropriate proxy for entrepreneurship quantity because it essentially captures entrepreneurial activity regardless of form, entry mode, motivation, and activity. For example, it does not distinguish between necessity or opportunity-driven motivations for entrepreneurship, or between new formal entities or informal entry. Many conditions can influence why and how an entrepreneur emerges and what kind of organizational or legal form they choose, but our principal interest is how much entrepreneurship occurs at a given time. Thus, the TEA measure effectively presents the overall rate of individuals aspiring (nascent) or already started a new venture (owner-managers), and captures individuals who are planning, starting, and running a new business (Yoon et al., 2018).

We use innovation-oriented entrepreneurship to operationalize entrepreneurship quality (Acs et al., 2014; Darnihamedani et al., 2018; Stenholm et al., 2013; Lafuente et al., 2020, 2022; Wurth et al., 2022; Yoon et al., 2018; Young et al., 2018), from GEM at the individual level, asking entrepreneurs whether they provide a new product or service to the market (Yoon et al., 2018). We recognize this is not the only way to consider entrepreneurship quality. Since our interest is in the importance of newness rather than a specific innovation outcome (e.g., patenting) or area of activity (e.g., technology-intensive), this proxy is appropriate given the relationship between innovation, entrepreneurship, and economic advancement, and between innovation and startups with high growth potential (Xie et al., 2021). Previous research relevant to the measures we select for our variables is listed in Table 2.

3.3. Independent variables

Our explanatory variables measure the financial cost of regulations and procedures related to resolving insolvency and registering a business, registering property, paying taxes, and enforcing contracts. We use the time to resolve insolvency instead of procedures for resolving insolvency because this indicator is provided by the World Bank. We use these regulatory domains because they reflect both the immediate

¹ Exceptions, such as platform startups, could be marked by low market entry costs (see Kenney and Zysman, 2019).

Table 1
Entrepreneurship quality and quantity by country used in this study.

Country	Sample N = 51,330		Sample N = 871,241	
	Quality	Obs.	Quantity	Obs.
United States	0.52	389	0.12	4647
Russia	0.24	254	0.06	1734
Egypt	0.41	638	0.12	10,476
South Africa	0.58	758	0.07	17,176
Greece	0.50	326	0.06	10,462
Netherlands	0.55	529	0.08	15,769
Belgium	0.58	301	0.05	9288
France	0.61	391	0.04	15,309
Spain	0.49	4432	0.05	199,683
Hungry	0.47	509	0.08	11,684
Italy	0.74	269	0.04	12,279
Romania	0.55	410	0.08	9830
Switzerland	0.52	444	0.06	13,246
United Kingdom	0.49	2426	0.08	63,481
Denmark	0.65	282	0.06	3577
Sweden	0.52	366	0.05	13,333
Norway	0.47	296	0.08	7287
Poland	0.70	507	0.08	11,004
Germany	0.42	425	0.06	11,523
Peru	0.61	569	0.32	2970
Mexico	0.50	728	0.11	8796
Argentina	0.56	1066	0.16	12,268
Chile	0.91	6317	0.22	46,064
Columbia	0.69	5178	0.21	41,260
Malaysia	0.42	480	0.07	13,739
Australia	0.50	206	0.11	3231
Indonesia	0.50	229	0.12	4858
Philippines	0.64	421	0.18	4358
Thailand	0.58	1038	0.19	12,773
Korea(South)	0.62	345	0.09	11,731
China	0.80	266	0.09	7301
India	0.72	179	0.10	6164
Iran	0.30	1479	0.14	20,777
Morocco	0.34	215	0.10	5150
Algeria	0.51	216	0.08	7937
Tunisia	0.65	234	0.05	2629
Burkina Faso	0.44	288	0.34	1591
Ghana	0.25	685	0.32	6169
Cameroon	0.40	295	0.24	2052
Uganda	0.30	597	0.31	6358
Zambia	0.32	1007	0.41	3861
Madagascar	0.57	144	0.23	1513
Botswana	0.41	971	0.26	5839
Portugal	0.44	302	0.09	5494
Luxembourg	0.79	254	0.08	4177
Ireland	0.57	654	0.08	13,872
Iceland	0.63	287	0.15	3323
Cyprus	0.63	177	0.08	3560
Finland	0.57	355	0.06	12,545
Bulgaria	0.29	255	0.05	2672
Lithuania	0.47	249	0.10	4742
Latvia	0.55	502	0.12	6569
Estonia	0.52	625	0.12	7828
Serbia	0.31	125	0.14	1771
Montenegro	0.33	175	0.16	1402
Croatia	0.28	823	0.10	11,545
Slovenia	0.57	482	0.06	15,038
Bosnia & Herzegovina	0.28	302	0.07	6989
Sk:Slovakia	0.55	621	0.10	9316
Belize	0.58	486	0.18	3903
Guatemala	0.79	481	0.19	4203
El Salvador	0.35	480	0.16	5394
Costa Rica	0.33	347	0.13	3898
Panama	0.33	706	0.18	5969
Ecuador	0.44	1191	0.31	6754
Uruguay	0.61	688	0.18	6383
Kazakhstan	0.36	414	0.17	4044
Hong Kong(Sar)	0.71	195	0.15	2605
Jamica	0.29	1177	0.22	11,539
Jordan	0.60	168	0.12	2549
Syria	0.46	259	0.11	1179
Israel	0.61	489	0.09	9280
Qatar	0.53	732	0.13	8583
Georgia	0.34	224	0.07	2938

Source: WDI= World Bank (2021); DB=World Bank Doing Business Statistics (World Bank, 2022); GEM = Global Entrepreneurship Monitor.

compliance needs that any potential entrepreneur faces as well as potential future compliance needs of innovation-oriented entrepreneurs. Entry regulations directly govern the process of market entry (Chambers et al., 2022) and can represent a first regulatory interaction for an entrepreneur. Summary statistics for all variables included in this study is illustrated in (Table 3).

Protecting property is important for innovation and strong intellectual property protection can help increase confidence of entrepreneurs, lenders and investors as well as reduce their investment risk (Chambers et al., 2022; Bae and Goyal, 2009; Braunerhjelm et al., 2015; Estrin et al., 2013a) - but they could also be costly. The tax rate and filing procedures can affect resources when an individual is considering entrepreneurship and across the life of the business (Balioune-Lutz and Garello, 2014; Braunerhjelm et al., 2021). Regulations governing contract enforcement can affect uncertainty, and being able to enforce contracts with suppliers and customers can increase confidence in an entrepreneur's claims and returns (Hoffmann et al., 2009; Johnson et al., 2002).

3.4. Control variables

We include several controls. We use *domestic credit* in a country, which refers to the financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable that establish a claim for repayment from the World Bank (2021), and the availability of alternative sources of funding for entrepreneurs (Cumming et al., 2021), such as venture capital and other finance sources. Financial capital is important for entrepreneurs (La Porta et al., 2002; Chowdhury et al., 2019) wishing to engage in innovation-driven entrepreneurship and sustain their market competitive advantage (Cumming and Zhang, 2016). Government *spending* is the general government's final consumption expenditure as a percentage of GDP and is part of the Index of Economic Freedom. We include this as the government can provide infrastructure and financial resources for entrepreneurs (Estrin et al., 2013a). We include access to natural *resources*, measured as the income generated from the mineral rents as a percentage of GDP, from the World Bank. *Unemployment* in a country is measured as the share of the labor force that is without work but available for and seeking employment. The *trade* openness of a country is measured by total trade, which includes the sum of exports and imports of goods and services measured as a share of the gross domestic product (McMullen et al., 2008).

The gross *enrolment* ratio in tertiary education (%), regardless of age, expressed as a percentage of the total population, is an important control for human capital (Bosma et al., 2012; Mincer, 1974). The *gross domestic product* per capita in logarithms is measured as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products (per capita) in constant 2015 prices.

Due to potential endogeneity between the country-level control variables (e.g., GDP per capita, unemployment) and the quality and quantity of entrepreneurship, we used one-year lagged values for all country-level variables for the cost and procedures of regulation and control variables. Table 2 lists sources and descriptions of variables used in our study. Tables A1 and A2 in the Appendix report correlations for the entrepreneurship quality and quantity samples.

4. Empirical strategy

We conduct a multilevel data analysis drawing on Rabe-Hesketh et al. (2005), applied to the entrepreneurship context (Bell et al., 2019; Mickiewicz et al., 2021). This approach accounts for the hierarchical structure of the data, where individuals represent Level 1 and country-year represents Level 2. Observations from entrepreneurs within the

Table 2
Variables, sources, descriptions, and relevant literature.

Variables in our study	Description / measurement	Source	Relevant studies
Entrepreneurship quality	Binary variable equals one if a start-up has introduced new product and services (to all and to some) customers, zero otherwise.	GEM	Chowdhury et al. (2019), Acs et al. (2016), Darnihamedani et al. (2018), Sobel (2008), Stenholm et al. (2013), Yoon et al. (2018)
Entrepreneurship quantity	The TEA is taken from GEM and it represents <i>nascent entrepreneurship activity, with an individual aged 18–64, planning to start a business in the next 3 years or (and) new business ownership which</i> represents an individual aged 18–64 who owns a new business	GEM	Audretsch et al. (2022), Mickiewicz et al. (2021), Stenholm et al. (2013)
Age	Full age of entrepreneur	GEM	Bosma et al. (2012), Bowen and De Clerq (2008), Mickiewicz et al. (2021), Reynolds et al. (2005), Stenholm et al. (2013)
Female	Binary variable equals one if an entrepreneur is a female, zero if male	GEM	
Education	Highest achieved level of education categorized into primary (reference), some secondary, secondary, tertiary	GEM	
Discontinued business	Discontinued a business in past 12 months	GEM	
Knows an entrepreneur	Binary variable =1 if knows an entrepreneur personally who started a business in the previous two years, zero otherwise	GEM	
Startup skills	Binary variable =1 if believes to have the required skills and knowledge to start a business zero otherwise.	GEM	
High status	Binary variable =1 if an entrepreneur agrees with the statement that in their country people attach high status to successful entrepreneurs, 0 otherwise.	GEM	
Media attention	Binary variable =1 if an entrepreneur agrees with the statement that in their country they will often see stories in the public media about successful new businesses, zero otherwise	GEM	
Resolving insolvency (cost)	Resolving insolvency cost (% of estate value)	DB	Bruhn (2011), Djankov et al. (2006), van Stel et al. (2007)
Resolving insolvency (procedures)	Resolving insolvency time (years)	DB	
Starting business (cost)	The cost to start a business, as % of income per capita	DB	Audretsch et al. (2019), Parker and Kirkpatrick (2012), Darnihamedani et al.
Starting business (procedures)	Number of procedures to start business	DB	

Table 2 (continued)

Variables in our study	Description / measurement	Source	Relevant studies
Register property (cost)	Registering property cost (% of property value)	DB	(2018), van Stel et al., 2007 Chambers et al. (2022), Claessens and Laeven (2003), Johnson et al. (2002),
Register property (procedures)	Number of procedures to register property	DB	
Paying taxes (cost)	Profit tax (% of profit)	DB	Baliamoune-Lutz and Garelli (2014), Braunerhjelm et al. (2015, 2021), Belitski et al. (2016), Djankov et al. (2002, 2006, 2010, 2020)
Paying taxes (procedures)	Tax payments (number per year)	DB	Ardagna and Lusardi (2010), Bae and Goyal (2009), Chowdhury et al. (2019), Djankov et al. (2006)
Enforcing contract (cost)	The cost of enforcing a contract as % of the claim	DB	
Enforcing contract (procedures)	Time required to enforce contracts (in days)	DB	
Disclosure	Business extent of disclosure index (0 = less disclosure to 10 = more disclosure)	DB	Chowdhury et al. (2019)
Population density	Population density (people per sq. km of land area)	WDI	Audretsch et al. (2015)
Unemployment	Unemployment refers to the share of the labor force that is without work but available for and seeking employment (% of total labor force) calculated by International Labor Organization	WDI	Thurik et al. (2008)
Trade	Trade is the sum of exports and imports of goods and services to gross domestic product of a country.	WDI	McMullen et al. (2008)
Domestic credit	Domestic credit to private sector by banks (% GDP) refers to financial resources provided to the private sector by other depository corporations (deposit taking corporations except central banks).	WDI	Bae and Goyal (2009), Cumming et al. (2021), Cumming and Zhang, 2016; Chowdhury et al. (2019)
Resources	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents (% to country GDP).	WDI	Kalyuzhnova and Belitski (2019)
Spending	General government final consumption expenditure (a percentage of GDP).	WDI	Estrin et al. (2013a), Stenholm et al. (2013)
Tertiary	Total enrolment in tertiary education (ISCED 5 to 8), regardless of age, expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.	WDI	Bosma et al. (2012), Chowdhury et al. (2019)
GDP	GDP per capita (constant 2015 prices US\$), logarithm	WDI	Audretsch et al. (2015, 2019)

Source: WDI= World Bank (2021); DB=World Bank Doing Business Statistics (World Bank, 2022); GEM = Global Entrepreneurship Monitor. Notes: The number of observations for quality of entrepreneurship sample is 51,330 obs. For 76 countries during 2008–17. The number of observations quantity of entrepreneurship is 871,241 obs. For 76 countries during 2008–2017.

same country and year are usually more similar to each other than those from a different country and year. Thus, the use of statistical methods that assume independence of observations can lead to biased and inefficient results. A multilevel approach addresses the unobserved heterogeneity of the database (Rabe-Hesketh et al., 2005). We use a multilevel random intercept model that includes random intercepts and fixed slopes at specified levels, drawing on Gelman and Hill (2006) and Cameron and Miller (2015), which suggests including country random effects alongside year and industry fixed effects. In doing so, we consider the Level 2 clustering effect, modeling standard errors in a similar way to Cameron and Miller (2015) by including the “vce” (exchangeable) option in Stata 17.

Since we examine a dichotomous outcome (entrepreneurship quality and quantity), either logit or the probit models could be used, which render similar results. Logit is far less intensive computationally and is preferred. We transform the coefficients into odds ratios for reporting and interpreting purposes. The odd ratios help us explain a direct measure of the size of an effect. The model is as follows:

$$Pr[y_{it} = 1] = f(\rho z_{it}, \beta x_{ct-1}, \Theta g_{ct}, \alpha, d_t, h_t, \mu_{it}) \tag{1}$$

$$u_{it} = v_i + e_{it}, i = 1, \dots, N; t = 1, \dots, T \tag{2}$$

where y_{it} is a dichotomous variable for entrepreneurship quality or quantity of individual i at time t in country c . ρ is the individual

parameter to be estimated; β and Θ are country-level parameters to be estimated. z_{it} is a vector of independent individual characteristics of control variables at the individual level; x_{ct-1} relates to the country-year level explanatory variables (t-1) which include regulatory costs and regulatory procedures in several domains. Both are accompanied by vectors of coefficients. g_{ct} relates to the country-year level control variables (t-1), including socio-economic characteristics of a country; α presents the country random effects; d_t and h_t are time and industry fixed effects. In the panel estimation, the error term u_{it} consists of unobserved individual-specific effects, v_i and the observation-specific errors, e_{it} . We perform the estimation across our two samples and incorporate non-linearity between regulatory costs and procedures with entrepreneurship quality and quantity (Lind and Mehlum, 2010). We use variance inflation factor (VIF) to address multicollinearity concerns, and all variables have a VIF score between five and ten (Wooldridge, 2002).

5. Results

We use a six-step approach to test our hypotheses. First, we test the significance of the country-year group variance for the dependent variable by excluding individual and country-year level independent variables and controls (i.e., the null random model) (specification 1, Tables 4 and 5) to justify the use of multilevel models (Rabe-Hesketh et al., 2005). Second, we add individual predictors and year and industry controls to test the effects of entrepreneurs' internal resources and capabilities on change in the likelihood of engaging in innovation and new entry. Third, in addition to our individual variables, we include country-year explanatory variables in levels (specification 3, Tables 4 and 5). Fourth, we add country-year explanatory variables for regulatory costs and procedures in levels, together with the quadratic term, to establish

Table 3
Summary statistics.

Sample Variables	Sample entrepreneurship quality = 51,330 observations				Sample for entrepreneurship quantity = 871,241 observations			
	Mean	S-D	Min.	Max.	Mean	S-D	Min.	Max.
Quality of entrepreneurship	0.56	0.50	0.00	1.00				
Quantity of entrepreneurship					0.11	0.31	0.00	1.00
Age	37.25	11.92	18.00	74.00	40.93	13.87	18.00	74.00
Female	0.40	0.49	0.00	1.00	0.50	0.50	0.00	1.00
Education primary	0.23	0.35	0.00	1.00	0.26	0.39	0.00	1.00
Education secondary	0.34	0.47	0.00	1.00	0.34	0.47	0.00	1.00
Education tertiary	0.10	0.30	0.00	1.00	0.08	0.27	0.00	1.00
Discontinued business	0.11	0.31	0.00	1.00	0.04	0.20	0.00	1.00
Knows an entrepreneur	0.64	0.48	0.00	1.00	0.38	0.49	0.00	1.00
Startup skills	0.87	0.34	0.00	1.00	0.52	0.50	0.00	1.00
High status	0.71	0.45	0.00	1.00	0.68	0.47	0.00	1.00
Media attention	0.64	0.48	0.00	1.00	0.57	0.50	0.00	1.00
Resolving insolvency (cost) (t-1)	13.46	6.66	1.00	38.00	12.34	6.23	1.00	38.00
Resolving insolvency (procedures) (t-1)	2.34	1.08	0.40	5.70	2.01	0.96	0.40	5.70
Starting business (cost) (t-1)	12.77	14.60	0.00	100.70	10.42	12.07	0.00	100.70
Starting business (procedures) (t-1)	8.41	2.90	2.00	17.00	8.07	2.93	2.00	17.00
Register property (cost) (t-1)	4.41	3.18	0.00	27.80	5.05	2.94	0.00	27.80
Register property (procedures) (t-1)	6.11	1.68	1.00	11.00	5.92	1.75	1.00	11.00
Paying taxes (cost) (t-1)	17.15	7.35	0.00	31.30	16.76	7.48	0.00	31.30
Paying taxes (procedures) (t-1)	20.33	18.47	3.00	113.00	16.75	16.20	3.00	113.00
Enforcing contract (cost) (t-1)	28.77	12.21	7.70	81.70	25.26	11.05	7.70	81.70
Enforcing contract (procedures) (t-1)	662.01	298.75	230.00	1580.00	614.00	270.90	230.00	1580.00
Disclosure (t-1)	6.35	2.53	0.00	10.00	6.29	2.45	0.00	10.00
Population density (t-1)	124.58	421.24	3.03	6944.10	141.82	382.34	3.03	6944.10
Unemployment (t-1)	9.10	5.61	0.15	28.01	10.64	6.65	0.15	28.01
Trade (t-1)	77.24	44.69	22.49	389.41	78.61	44.15	22.49	389.41
Domestic credit (t-1)	73.38	50.80	8.20	304.58	96.78	54.38	8.20	304.58
Resources (t-1)	2.82	6.01	0.00	33.42	2.14	5.43	0.00	33.42
Spending (t-1)	15.94	3.88	6.59	26.37	17.66	3.99	6.59	26.37
Tertiary (t-1)	53.52	23.50	3.89	131.54	60.49	22.09	3.89	131.54
GDP (t-1)	9.30	1.03	6.16	11.59	9.68	0.98	6.16	11.59

Source: WDI= World Bank (2021); DB=World Bank Doing Business Statistics (World Bank, 2022); GEM = Global Entrepreneurship Monitor. Notes: The number of observations for quality of entrepreneurship sample is 51,330 obs. for 76 countries during 2008–17. The number of observations quantity of entrepreneurship is 871,241 obs. for 76 countries during 2008–2017.

Table 4
Multilevel random intercept models for entrepreneurship quality.

Models	(1)	(2)	(3)	(4)	(5)	(6)
Individual-level control variables						
Age		0.976*** (0.00)	0.977*** (0.00)	0.977*** (0.00)	0.977*** (0.00)	0.973*** (0.01)
Age squared		1.000*** (0.00)	1.000*** (0.00)	1.000*** (0.00)	1.000*** (0.00)	1.000*** (0.00)
Female		1.045*** (0.02)	1.091*** (0.02)	1.092*** (0.02)	1.092*** (0.02)	1.082*** (0.02)
Education some secondary		1.181*** (0.04)	1.128*** (0.05)	1.119*** (0.05)	1.131*** (0.05)	1.136*** (0.05)
Education secondary		1.348*** (0.06)	1.285*** (0.08)	1.276*** (0.08)	1.295*** (0.08)	1.295*** (0.08)
Education tertiary		1.610*** (0.06)	1.541*** (0.08)	1.519*** (0.08)	1.538*** (0.08)	1.535*** (0.08)
Discontinued business		1.095*** (0.03)	1.041 (0.03)	1.042 (0.03)	1.043 (0.03)	1.073** (0.03)
Knows an entrepreneur		1.096*** (0.02)	1.111*** (0.02)	1.113*** (0.02)	1.111*** (0.02)	1.115*** (0.02)
Startup skills		1.021 (0.02)	1.019 (0.03)	1.026 (0.03)	1.028 (0.03)	1.025 (0.03)
High status		1.001 (0.02)	1.018 (0.02)	1.019 (0.02)	1.018 (0.02)	0.980 (0.02)
Media attention		1.070*** (0.02)	1.073*** (0.02)	1.073*** (0.02)	1.069*** (0.02)	1.071*** (0.02)
Country-year level variables						
Resolving insolvency cost (H1b)			1.007 (0.01)	0.984 (0.02)	0.976** (0.02)	0.833*** (0.02)
Resolving insolvency cost squared (H1b)				1.001 (0.00)	1.001 (0.00)	1.002*** (0.00)
Resolving insolvency procedures (H1a)			0.886*** (0.03)	1.321** (0.14)	1.382*** (0.15)	3.506*** (0.45)
Resolving insolvency procedures squared (H1a)				0.934*** (0.02)	0.930*** (0.02)	0.788*** (0.02)
Starting business cost (H1b)			1.003 (0.00)	1.005 (0.01)	0.996 (0.01)	0.992 (0.01)
Starting business cost squared (H1b)				1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Starting business procedures (H1a)			1.019* (0.01)	1.004 (0.04)	1.094** (0.05)	1.145*** (0.05)
Starting business procedures squared (H1a)				1.002 (0.00)	0.998* (0.00)	0.993*** (0.00)
Registering property cost (H1b)			0.976** (0.01)	0.881*** (0.03)	0.909** (0.04)	0.868*** (0.04)
Registering property cost squared (H1b)				1.006*** (0.00)	1.005** (0.00)	1.000** (0.00)
Registering property procedures (H1a)			0.963* (0.02)	1.014*** (0.00)	1.013*** (0.00)	1.185* (0.10)
Registering property procedures squared (H1a)				0.814*** (0.05)	0.821*** (0.05)	0.963*** (0.01)
Paying taxes cost (H1b)			1.003 (0.00)	1.043*** (0.01)	1.030*** (0.01)	1.045*** (0.01)
Paying taxes cost squared (H1b)				0.999*** (0.00)	0.999*** (0.00)	0.998*** (0.00)
Models	(1)	(2)	(3)	(4)	(5)	(6)
Paying taxes procedures (H1a)			0.994*** (0.00)	0.979*** (0.00)	0.978*** (0.00)	0.992** (0.00)
Paying taxes procedures squared (H1a)				1.000*** (0.00)	1.000*** (0.00)	1.000* (0.00)
Enforcing contracts cost (H1b)			1.004 (0.01)	0.927*** (0.02)	0.919*** (0.02)	0.999*** (0.02)
Enforcing contracts cost squared (H1b)				1.000*** (0.00)	1.000*** (0.00)	1.000* (0.00)
Enforcing contracts procedures (H1a)			1.001*** (0.00)	1.000 (0.00)	0.999 (0.00)	1.001 (0.00)
Enforcing contracts procedures squared (H1a)				1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Disclosure			1.038** (0.02)	1.011 (0.02)	1.026 (0.02)	1.026 (0.03)
Population density					1.000* (0.00)	1.000 (0.00)
Unemployment					0.990 (0.01)	0.988* (0.01)
Trade					0.997** (0.00)	0.995*** (0.00)

(continued on next page)

Table 4 (continued)

Models	(1)	(2)	(3)	(4)	(5)	(6)
Domestic credit					0.999** (0.00)	1.002* (0.00)
Resources					1.003 (0.01)	0.982*** (0.01)
Spending					0.997 (0.01)	0.919*** (0.01)
Tertiary					0.987*** (0.00)	0.989*** (0.00)
GDP					1.432*** (0.15)	0.972 (0.15)
Constant	0.971*** (0.06)	1.604*** (0.11)	1.706*** (0.19)	1.652*** (0.18)	1.615*** (0.17)	6.392*** (2.67)
Industry and year controls	no	yes	yes	yes	yes	yes
Number of observations	51,330	51,330	51,330	51,330	51,330	51,330
LR test of model fit	15,119.73	11,051.55	3400.78	2953.76	2319.23	2553.87
Inter class correlation (ICC)	0.12	0.09	0.10	0.18	0.18	0.36
Variance of random intercept country-year	0.47	0.146	0.61	0.74	0.74	1.85
Wald chi2	499.17	435.97	516.39	565.46	611.89	990.58
Log likelihood	-82,558.40	-61,004.30	-33,306.60	-33,266.40	-33,236.80	-31,117.71

Note: Standard errors in parentheses. Significance levels: *** 1 %, ** 5 %, * 10 %; Likelihood ratio test (LRT) was conducted comparing Models using multilevel method vs. logistic model to test the significance of the multi-level modeling. Industry and year dummies were included to capture unobserved heterogeneity across time and industries and are oppressed to save space. Reference category = primary education.

our baseline specification and to test H1 and H2 (specification 4, Tables 4 and 5). Fifth, we add country-level control variables that predict how other socioeconomic conditions may affect entrepreneurship quality and quantity in a country (specification 5, Tables 4 and 5). Finally, we use individual-level controls, along with one-year lagged linear and quadratic terms of regulatory cost and procedures and other country-level variables (one year lagged), to test the role of regulation in shaping entrepreneurship.

As part of a robustness check, we estimate the predictive margins of responses for the specified values of covariates for each regulation domain and for regulatory cost and procedures (Figs. 1 and 2), finding nuances beyond the results in Tables 4 and 5.

In addition to controlling for the non-linear relationship in the model, we report effect sizes and their confidence intervals graphically, as although “there is no single ideal test, there are multiple approaches that can be used depending on the situation” (Maula and Stam, 2020: 1074) and interpretation is always context specific. Grimes et al. (2018) remark that predictive margins with 95 % confidence intervals (CIs) within the same type of regulation cannot be viewed as hypothesis testing; reporting confidence intervals is important to understand the interval where the relationship may turn significant, though on average the estimated coefficients may not be significant. We follow the procedure of examining nonlinear effects proposed by Mize (2019) to see how effects might vary across different levels of each regulation for entrepreneurship quality and quantity (Figs. 1 and 2). The procedure we adopt to plot the predictive margins to test for non-linearities has been used to study non-linear relationships and complex moderations (see Lantz et al., 2022). We report graphical analysis of the coefficients in Figs. 1 and 2, based on Tables 4 and 5 respectively. We thus calculate post-estimated predictive margins for regulatory costs and procedures using specification 6 (lagged country characteristics in Tables 4 and 5, respectively).

Table 4 reports the results for entrepreneurship quality, proxied as innovation-oriented entrepreneurship. We predict an inverted U-shaped relationship between regulatory procedures and entrepreneurship quality in H1a, and we are largely able to confirm the concavity of this inverted U-shaped relationship in the case of tax and contract procedures (specification 6, Table 4). Our non-linear finding on tax procedures is in line with Braunerhjelm et al. (2015). While procedures may serve as a filter for innovative businesses, an increase in procedures increases the managerial and operational costs of regulation compliance.

The inflection points detected by the *U* test and predictive margins illustrate a maximum setting for regulatory procedures that can support

entrepreneurship quality: a maximum of five years to resolve insolvency, a maximum of ten procedures to start a business, and a maximum of eight procedures to register property.

We find that procedures to pay taxes are negative ($\beta = 0.992$, $p < 0.01$) and significant, and the quadratic term has odds equals one ($\beta = 1.000$, $p < 0.01$, specification 6, Table 4). This means that more procedures to pay taxes reduce entrepreneurship quality. An increase in procedures to enforce contracts is not associated with entrepreneurship quality (specification 6 Table 4), but the predictive margins show that the effect of enforcing contracts on entrepreneurship quality can remain positive when procedures remain <500 days (Fig. 1E).

In H1b, we predict that regulatory costs would reduce entrepreneurship quality. While our findings provide partial support for H1b, they give quite a mixed picture. We find that the cost of paying taxes has an inverted U-shaped relationship with entrepreneurship quality. In fact, countries with the highest level of entrepreneurship quality see taxes that are on average greater than in countries with lower levels of entrepreneurship quality. We also see that at a higher level, tax costs reduce entrepreneurship quality (Fig. 1D). When it comes to the costs of starting a business, we see that a decline in entrepreneurship quality happens before the cost is <60 %, after which there is no association (Fig. 1B). Based on inflection points, we see that a maximum quality of entrepreneurship is achieved by costs that are between 0 and 4 % of estate value to resolve insolvency, between 0 and 4 % of property value to register property, and between 0 and 5 % of the claim to enforce (Fig. 1A, C, and E).

In H2a, we predict that more regulatory procedures would reduce entrepreneurship quantity. Table 5 shows a negative relationship between various regulatory procedures and entrepreneurship quantity, which partially supports H2a. An increase in time to resolve insolvency (by one year) reduces entrepreneurship quantity by 18 % ($\beta = 0.820$, $p < 0.01$) with a linear relationship. An increase in one procedure to register property reduces entrepreneurship quantity by 10 % ($\beta = 0.901$, $p < 0.01$) (specification 6, Table 5). We find that procedures to start a business and pay taxes both have an inverted U-shaped relationship with entrepreneurship quantity. Our results suggest that a certain number of entry and tax procedures may be needed to encourage overall entrepreneurship, but an increase in entry procedures >10 and tax procedures >50 will reduce entrepreneurship quantity (Fig. 2B and D). Finally, we find no association between procedures to enforce contracts with entrepreneurship quantity, as both coefficients are insignificant (specification 6, Table 5).

Our final hypothesis H2b predicts that regulatory costs would reduce

Table 5
Multilevel random intercept models for entrepreneurship quantity.

Models	(1)	(2)	(3)	(4)	(5)	(6)
Individual-level control variables						
Age		1.093*** (0.00)	1.089*** (0.00)	1.089*** (0.00)	1.091*** (0.00)	1.089*** (0.00)
Age squared		0.999*** (0.00)	0.999*** (0.00)	0.999*** (0.00)	0.999*** (0.00)	0.999*** (0.00)
Female		0.785*** (0.01)	0.785*** (0.01)	0.785*** (0.01)	0.789*** (0.01)	0.785*** (0.01)
Education some secondary		1.001** (0.02)	1.026* (0.02)	1.033** (0.02)	1.055*** (0.02)	1.014*** (0.02)
Education secondary		1.120** (0.02)	1.123*** (0.02)	1.128*** (0.02)	1.146*** (0.02)	1.116*** (0.02)
Education tertiary		1.251** (0.03)	1.273*** (0.03)	1.277*** (0.03)	1.269*** (0.02)	1.251*** (0.02)
Discontinued business		1.510*** (0.02)	1.559*** (0.02)	1.560*** (0.02)	1.532*** (0.02)	1.555*** (0.02)
Knows an entrepreneur		2.291*** (0.02)	2.247*** (0.02)	2.247*** (0.02)	2.210*** (0.02)	2.252*** (0.02)
Startup skills		4.563*** (0.05)	4.442*** (0.05)	4.444*** (0.05)	4.568*** (0.05)	4.457*** (0.05)
High status		1.013 (0.01)	1.015* (0.01)	1.015* (0.01)	1.008 (0.01)	1.015* (0.01)
Media attention		1.083*** (0.01)	1.079*** (0.01)	1.080*** (0.01)	1.078*** (0.01)	1.074*** (0.01)
Country-year level variables						
Resolving insolvency cost (H2b)			0.994** (0.00)	1.005 (0.01)	0.958*** (0.01)	0.967*** (0.01)
Resolving insolvency cost squared (H2b)				1.000 (0.00)	1.001*** (0.00)	1.000** (0.00)
Resolving insolvency procedures (H2a)			0.902*** (0.01)	0.676*** (0.03)	0.817*** (0.03)	0.820*** (0.04)
Resolving insolvency procedures squared (H2a)				1.047*** (0.01)	1.012** (0.01)	1.001 (0.01)
Starting business cost (H2b)			0.994*** (0.00)	0.997 (0.00)	0.997* (0.00)	0.978*** (0.00)
Starting business cost squared (H2b)				1.000 (0.00)	1.000 (0.00)	1.000*** (0.00)
Starting business procedures (H2a)			1.048*** (0.00)	1.135*** (0.02)	1.142*** (0.02)	1.171*** (0.02)
Starting business procedures squared (H2a)				0.995*** (0.00)	0.994*** (0.00)	0.994*** (0.00)
Registering property cost (H2b)			0.963*** (0.01)	0.938*** (0.02)	0.897*** (0.02)	0.926*** (0.02)
Registering property cost squared (H2b)				1.002 (0.00)	1.004*** (0.00)	1.001 (0.00)
Registering property procedures (H2a)			0.955*** (0.01)	0.939* (0.03)	0.743*** (0.02)	0.901*** (0.03)
Registering property procedures squared (H2a)				1.001 (0.00)	1.024*** (0.00)	1.001 (0.00)
Paying taxes cost (H2b)			1.001 (0.00)	0.972*** (0.00)	0.962*** (0.00)	1.004 (0.01)
Paying taxes cost squared (H2b)				1.001*** (0.00)	1.001*** (0.00)	1.000 (0.00)
Models	(1)	(2)	(3)	(4)	(5)	(6)
Paying taxes procedures (H2a)			1.002*** (0.00)	1.009*** (0.00)	1.003* (0.00)	1.005*** (0.00)
Paying taxes procedures squared (H2a)				1.000*** (0.00)	0.999* (0.00)	0.999* (0.00)
Enforcing contracts cost (H2b)			1.018*** (0.00)	1.006 (0.01)	1.005 (0.00)	1.008 (0.01)
Enforcing contracts cost squared (H2b)				1.003 (0.00)	0.992 (0.01)	1.000 (0.00)
Enforcing contracts procedures (H2a)			0.999*** (0.00)	0.999* (0.00)	0.999 (0.00)	1.000 (0.00)
Enforcing contracts procedures squared (H2a)				1.000 (0.00)	1.000 (0.00)	1.000 (0.00)
Disclosure			1.101*** (0.01)	1.105*** (0.01)	1.148*** (0.01)	1.152*** (0.01)
Population density					1.000 (0.00)	1.000 (0.00)
Unemployment					0.964*** (0.00)	0.984*** (0.00)
Trade					1.001 (0.00)	1.000 (0.00)

(continued on next page)

Table 5 (continued)

Models	(1)	(2)	(3)	(4)	(5)	(6)
Domestic credit					1.001** (0.00)	1.001* (0.00)
Resources					1.019*** (0.00)	1.007** (0.00)
Spending					1.024*** (0.00)	0.951*** (0.00)
Tertiary					1.001* (0.00)	1.006*** (0.00)
GDP					0.762*** (0.05)	0.998 (0.09)
Constant	1.428*** (0.16)	1.108*** (0.13)	1.321*** (0.15)	1.708*** (0.18)	1.708*** (0.18)	2.128*** (0.35)
Industry and year controls	no	yes	yes	yes	yes	yes
Number of observations	871,241	871,241	871,241	871,241	871,241	871,241
LR test of model fit	44,572.31	28,006.36	17,478.45	12,258.96	8041.68	7107.69
Inter class correlation (ICC)	0.06	0.04	0.05	0.11	0.14	0.18
Variance of random intercept country-year	0.08	0.06	0.06	0.62	0.73	0.86
Wald chi2	67,401.02	65,420.33	65,113.11	52,564.17	56,718.37	53,004.17
Log likelihood	-190,930	-160,203	-158,716	-243,259	-260,943	-242,962

Note: Standard errors in parentheses. Significance levels: *** 1 %, ** 5 %, * 10 %; Likelihood ratio test (LRT) was conducted comparing Models using multilevel method vs. logistic model to test the significance of the multi-level modeling. Industry and year dummies were included to capture unobserved heterogeneity across time and industries and are oppressed to save space.

entrepreneurship quantity, for which we find partial support. We find an increase in costs to resolve insolvency ($\beta = 0.967$, $p < 0.01$), start a business ($\beta = 0.978$, $p < 0.01$), and register property ($\beta = 0.926$, $p < 0.01$) reduce entrepreneurship quantity (specification 6, Table 5), but costs related to paying taxes and enforcing contracts cost are not associated. This expands on the prior work of Ardagna and Lusardi (2010), van Stel et al. (2007), and Braunerhjelm et al. (2015). Countries with both low and high levels of taxes and costs to enforce contracts have on average similar entrepreneurship quantity (Table 5). We also see a flat type of relationship between the cost of paying taxes and entrepreneurship quantity (Fig. 2E), while contract costs may reduce entrepreneurship quantity if high.

We take a closer look at regulatory costs and procedures to enforce contracts. While the result is insignificant in our regression analysis, when controlling for all types of regulation the predictive margins suggest that cost may still hamper entrepreneurship quality when it is $>20\%$ of the claim value (Fig. 1E), and may hamper quantity when cost exceeds half of the value of the claim (Fig. 2E).

Overall, our results suggest regulatory procedures and costs affect entrepreneurship quality in different ways, yet we find that entrepreneurs may require some procedures to enforce contracts and start a business. We find that entrepreneurship quantity is not impeded by regulatory costs related to taxes and contracts, but is more sensitive to procedures related to resolving insolvency, paying taxes, starting a business, and registering property.

As part of the robustness check, we examine whether the four different types of regulations have a nonlinear association with entrepreneurship quality and quantity by performing a test for the U-shaped relationship (Lind and Mehlum, 2010). In addition to the U test, we perform an F-test for the joint significance of regulation, which confirms our results.

6. Discussion and conclusion

Decisions to start a new business and innovate are shaped by individual characteristics as well as the institutional context (Acs et al., 2014, 2016). We draw on the NSE approach (Autio et al., 2014), which stresses the interaction of individual and institutional-level factors in determining entrepreneurship quality and quantity.

Our study yields several insights. First, we find that the effect of regulation on entrepreneurship may depend on the type of regulation. For example, the cost of paying taxes and enforcing contracts is not associated with entrepreneurship quantity. An increase in the cost of

starting a business does not change innovation-oriented entrepreneurship, but changes to other regulatory costs can reduce entrepreneurship quality. Second, we find that costs and procedures of the same regulatory type may impose different effects on entrepreneurship. The cost of resolving insolvency reduces entrepreneurship quality; when insolvency procedures are small, we see more innovative entrepreneurs, but this effect turns negative at higher numbers of procedures.

Third, while regulatory costs often have a negative impact on entrepreneurship quality and quantity (e.g., increasing property registration costs reduce both), regulatory procedures can have an inverted U-shaped relationship with entrepreneurship quality. This indicates that excessive regulatory procedures can reduce innovation, but some procedures are still required.

Overall, our multi-level analysis demonstrates that the same regulation type can affect entrepreneurship quality and quantity differently, extending the findings of Chowdhury et al. (2019). Our findings point to effects of regulation which are in line with both the public interest and public choice views: regulation is not strictly good/bad or linear for entrepreneurship (see Audretsch et al., 2019). Entrepreneurs cannot typically choose which regulations they wish to comply with on a case-by-case basis. Rather, they face all regulations relevant to their activities once in the market (Fritsch et al., 2021) and remain locked into regulations. This means that one regulatory domain, such as tax policy, should be analyzed in the context of other domains and the surrounding economic and institutional environment. Multiple aspects of national systems could shape entrepreneur responses to regulation (Darnihamedani et al., 2018).

6.1. Implications for research and policy

Our study is relevant to research and policy. First, we address a call for more research on macro management domains (Aguinis et al., 2022) and multilevel research to explain entrepreneurship (Autio et al., 2014). We add to previous research on entrepreneurship quality (van Stel et al., 2007; Chowdhury et al., 2019) with individual decision-making incorporated in country context. Second, we expand policy knowledge by analyzing how different regulatory costs and procedures at the country level shape overall entry and innovation-oriented entrepreneurship. Third, our multilevel framework brings the theoretical basis of NSE (Autio et al., 2014) with entrepreneurial intent (Acs et al., 2014, 2016) to understand entrepreneurship outcomes. Fourth, we show the value in considering nonlinearities to avoid a generalized understanding of the relationship between regulation and entrepreneurship (Braunerhjelm

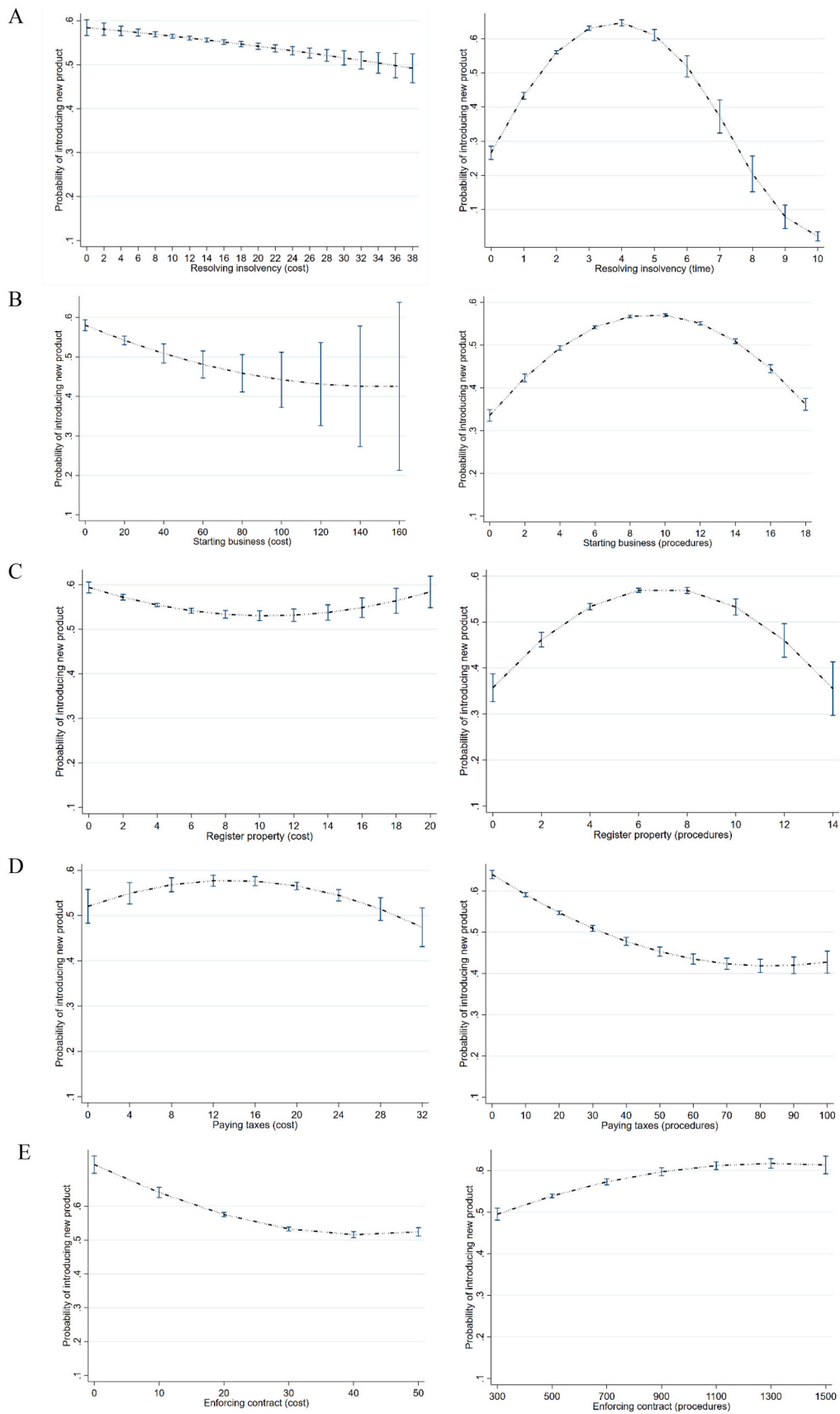


Fig. 1. Predictive margins of regulation cost (left) and procedures (rights) for entrepreneurship quality. Note: Margins fit using mixed effects panel data estimation with 76 countries and 51,330 obs. with the predictive margins at 95 % confidence intervals. Source: Authors calculation.

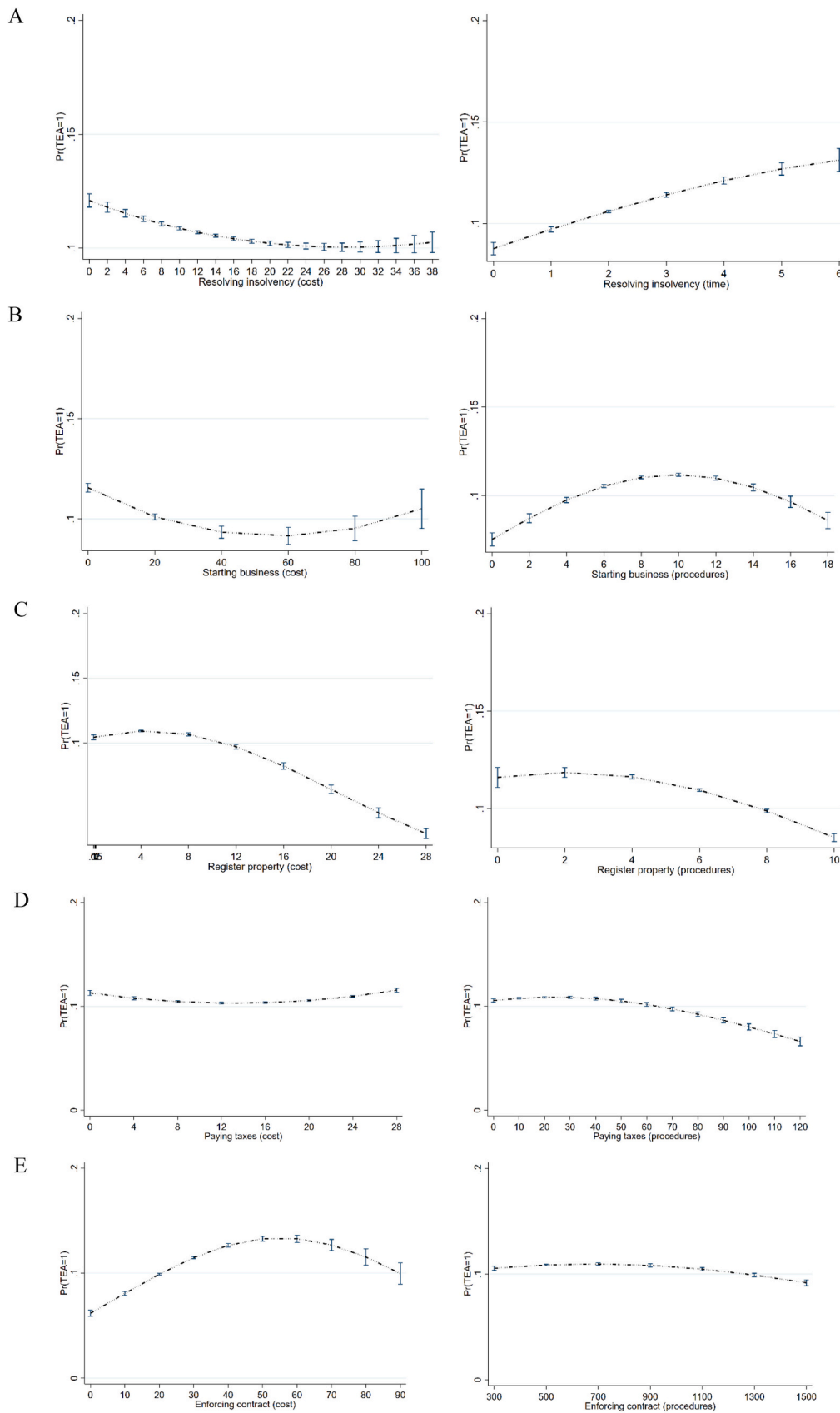


Fig. 2. Predictive margins of regulation cost (left) and procedures (rights) for entrepreneurship quantity. Note: Margins fit using mixed effects panel data estimation with 76 countries and 871,241 obs. with the predictive margins at 95 % confidence intervals. Source: Authors calculation.

et al., 2021; Mickiewicz et al., 2021). Our results reinforce findings on heterogeneity of regulation (Ardagna and Lusardi, 2010; Audretsch et al., 2019) and its complex role in shaping innovation-related activities (Speldekamp et al., 2020) or entrepreneurship quality (Xie et al., 2021).

Drawing on earlier work on regulatory efficiency (Rakoff, 2000; Ardagna and Lusardi, 2010), policymakers could target market certainty and regulatory transparency. Our findings imply that this does not necessarily equate to less regulation across the board, but could mean tuning into specific settings that maximize the desired outcome.

Controlling for country-specific effects was important in our model. For instance, the enforcement of laws is not equal everywhere. Regulation could be a tool for policymakers to facilitate trust and minimize costs. While protection for innovative entrepreneurs has a cost, very high costs are not efficient either, and innovative entrepreneurs may start avoiding protections.

Policymakers can use the findings to better understand the potential confounding effects of different types of regulation, and how choices about regulatory cost and regulatory procedures could affect entrepreneurship goals. It is important to jointly consider and evaluate various types of regulation in order to find the optimum level of each regulatory type, conditional on other types of regulation. In addition to the non-linear effects of some regulatory procedures on entrepreneurship quality, we also find a non-linear effect for the cost of specific regulatory types.

6.2. Limitations and future research

Several limitations of our study should be noted, and some also serve as future research questions. First, we try to empirically parse out entrepreneurship based on perspectives about quality and quantity. We focus on innovativeness as the core feature of quality but this is not the only way to consider entrepreneurship quality. Policymakers may choose priorities based on their goals for the use of public funds, so we expect there can be multiple ways to measure entrepreneurship quality based on their goals.

Entrepreneurship quantity can also include a range of activities that policymakers may prioritize differently, and some may be linked to quality. We focus on an innovation-centric measure of quality as well as a volume (total) measure of entrepreneurship quantity in a country. However, there are limitations in examining total entrepreneurial activity. The GEM project does not distinguish between formal and informal entry, and all entrepreneurs are included in the measured definition of early-stage entrepreneurial activities (TEA) (see Reynolds et al., 2002, 2005). Depending on the country context, policymakers may be concerned about informal entrepreneurship (Godfrey, 2011) and want to reduce barriers to formal entry. For example, they might pay attention to the process of registering a new business. Our study does not investigate this, and future research could examine how regulatory effectiveness shapes informal and formal entrepreneurship outcomes (see Bruhn, 2011). For example, future research may draw on a link between regulation and entrepreneurship quantity via informal sector channels and the competition effect between the formal and informal sectors (see Estrin and Mickiewicz, 2012).

There are drawbacks to using an innovation-centric measure of entrepreneurship. Not all entrepreneurs need to be innovative in the economy (Darnihamedani et al. (2018)). Focusing on innovativeness does not account for the motivations of entrepreneurs, and some innovative firms may be launched out of necessity. We also do not consider how a firm's legal status influences decisions about innovation, and vice versa. For example, if an entrepreneur knows they want to create a new product and needs intellectual property protection, they will likely have to formalize the business. However, another entrepreneur who knows they will not innovate and will not need intellectual property protections may not have the same need to register a new business. How do entrepreneurial motivations and legal status of the firm affect innovative entrepreneurship?

Similarly, we focus on a specific (early) stage of entrepreneurship. The effects of regulation may differ across stages of a firm's life, e.g., birth, growth, and exit (Braunerhjelm et al., 2021; van Stel et al., 2007). Firms may be indifferent to some regulations depending on the stage they are in. Future research could expand on recent efforts to understand how regulations matter across stages of business life (Audretsch et al., 2022; Young et al., 2018).

We focus on specific policy-relevant insights about regulation. Culturally embedded ways of doing business, norms and popular culture, and other informal institutions also play an important role in shaping entrepreneurship (Chowdhury et al., 2019; Estrin and Mickiewicz, 2012; Stenholm et al., 2013). Since entrepreneurs face a combination of institutional settings including culture, norms, and traditions (Fritsch and Wyrwich, 2018), further research could study how regulations interplay with culture. For example, studies could evaluate the combined effects of formal and informal institutions to advance knowledge on complex institutional contexts (Williamson, 2000; Autio et al., 2014).

Lastly, we test linear and non-linear effects of regulation at the country level. Given the role of regional conditions and agglomeration economies (Fritsch and Wyrwich, 2018), a three-way multi-level model could have individual/regional and regional/country effects to test the inter-relationships of regulations and entrepreneurs. Longer time lags could capture short- and long-term effects of regulation, adding to insight on institutional quality and entrepreneurs and regulation and innovative entrepreneurs.

CRediT authorship contribution statement

David B. Audretsch: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **Maksim Belitski:** Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – review & editing. **Farzana Chowdhury:** Conceptualization, Writing – original draft, Writing – review & editing. **Sameeksha Desai:** Conceptualization, Writing – review & editing.

Declaration of competing interest

There is no conflict of interest between authors and the editors.

Table A1
Correlation matrix for the sample on entrepreneurship quality ($N = 51,333$ obs.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Entrepreneurship quality	1																		
Age	0.01	1																	
Female	0.02*	0.01*	1																
Education	0.08*	-0.01*	-0.04*	1															
Discontinued business	-0.01	0.02*	-0.01	-0.04*	1														
Knows an entrepreneur	0.01	-0.04*	-0.06*	0.09*	0.03*	1													
Startup skills	-0.01*	0.07*	-0.04*	0.02*	0.04*	0.09*	1												
High status	-0.01*	-0.02*	-0.01*	-0.07*	0.0183*	-0.02	0.01	1											
Media attention	-0.01	0.01	0.03*	-0.09*	0.02*	0.01	0.02*	0.15*	1										
Resolving insolvency (cost)	-0.06*	-0.06*	0.05*	-0.17*	0.0563*	-0.01	0.01*	0.05*	0.08*	1									
Resolving insolvency (time)	0.10*	-0.03*	0.04*	-0.12*	0.04*	-0.04*	-0.01	-0.01	0.03*	0.30*	1								
Starting business (cost)	-0.06*	-0.08*	0.04*	-0.22*	0.08*	0.01	0.04*	0.05*	0.03*	0.33*	0.32*	1							
Starting business (procedures)	-0.01	-0.06*	0.03*	-0.11*	0.05*	-0.05*	0.03*	0.02*	0.04*	0.31*	0.39*	0.50*	1						
Register property (cost)	-0.15*	-0.01*	-0.01	-0.08*	0.01	0.03*	0.04*	0.01*	-0.02*	0.14*	-0.36*	0.14*	-0.04*	1					
Register property (procedures)	0.01	-0.06*	0.03*	-0.12*	0.04*	-0.03*	0.05*	0.03*	0.02*	0.13*	0.15*	0.42*	0.46*	-0.02*	1				
Paying taxes (cost)	0.05*	0.02*	0.05*	-0.05*	-0.01	-0.03*	0.02*	0.05*	0.06*	0.13*	-0.13*	0.10*	-0.03*	0.08*	0.16*	1			
Paying taxes (procedures)	-0.13*	-0.07*	0.02*	-0.16*	0.05*	0.02*	0.04*	0.06*	0.06*	0.19*	0.10*	0.24*	0.12*	0.21*	0.23*	-0.01*	1		
Enforcing contract (cost)	-0.01*	-0.05*	0.06*	-0.16*	0.03*	-0.02*	0.04*	0.08*	0.07*	-0.05*	0.05*	0.19*	-0.01*	0.01*	0.28*	0.25*	0.33*	1	
Enforcing contract (procedures)	0.07*	-0.08*	0.01*	-0.04*	0.01	-0.07*	0.04*	0.03*	0.02	-0.10*	0.25*	0.20*	0.28*	-0.13*	0.42*	0.05*	0.23*	0.40*	1
Disclosure	0.15*	0.04*	0.01*	0.12*	-0.02*	-0.02*	-0.05*	0.02*	0.03*	-0.23*	-0.27*	-0.35*	-0.24*	-0.10*	-0.04*	0.23*	-0.21*	0.26*	0.05*

Source: WDI= [World Bank \(2021\)](#); DB=World Bank Doing Business Statistics ([World Bank, 2022](#)); GEM = Global Entrepreneurship Monitor. Note: Significance level: ** 5 %.

Table A2
Correlation matrix for the sample on entrepreneurship quantity – total entrepreneurship activity ($N = 871,241$ obs.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Entrepreneurship quantity	1																		
Age	-0.09*	1																	
Female	-0.06*	0.02*	1																
Education	0.03*	-0.10*	-0.03*	1															
Discontinued business	0.10*	-0.01*	-0.02*	-0.02*	1														
Knows an entrepreneur	0.19*	-0.11*	-0.08*	0.09*	0.08*	1													
Startup skills	0.23*	-0.02*	-0.12*	0.08*	0.12*	0.23*	1												
High status	0.03*	-0.03*	-0.01*	-0.03*	0.02*	0.02*	0.02*	1											
Media attention	0.05*	-0.01	-0.01*	-0.04*	0.02*	0.06*	0.06*	0.17*	1										
Resolving insolvency (cost)	0.07*	-0.11*	-0.01*	-0.13*	0.06*	0.05*	0.06*	0.02*	0.06*	1									
Resolving insolvency procedures	0.10*	-0.07*	0.01*	-0.10*	0.06*	0.03*	0.07*	-0.02*	0.04*	0.35*	1								
Starting business (cost)	0.10*	-0.11*	0.01*	-0.16*	0.09*	0.06*	0.12*	0.02*	0.03*	0.39*	0.31*	1							
Starting business (procedures)	0.05*	-0.11*	-0.01*	-0.12*	0.05*	0.03*	0.08*	-0.02*	-0.01*	0.37*	0.29*	0.54*	1						
Register property (cost)	-0.05*	-0.01*	-0.03*	-0.04*	-0.01*	-0.03*	-0.01*	-0.03*	-0.06*	0.08*	-0.38*	0.12*	0.13*	1					
Register property (procedures)	0.05*	-0.09*	0.03	-0.11*	0.05*	0.02*	0.06*	0.02*	0.01*	0.11*	0.17*	0.35*	0.38*	0.07*	1				
Paying taxes (cost)	0.03*	-0.01*	0.03*	-0.04*	0.01*	0.01*	0.03*	0.05*	0.04*	0.13*	-0.14*	0.17*	-0.04*	0.07*	0.01*	1			
Paying taxes (procedures)	0.08*	-0.08*	0.03*	-0.08*	0.07*	0.07*	0.08*	0.04*	0.07*	0.19*	0.35*	0.25*	0.15*	-0.02*	0.23*	-0.05*	1		
Enforcing contract (cost)	0.10*	-0.04*	0.02*	-0.11*	0.06*	0.04*	0.08*	0.09*	0.09*	0.01*	0.09*	0.14*	-0.02*	-0.11*	0.23*	0.25*	0.27*	1	
Enforcing contract (procedures)	0.05*	-0.08*	0.01*	-0.07*	0.03*	-0.01*	0.05*	0.02*	0.02*	0.07*	0.38*	0.24*	0.23*	-0.12*	0.38*	0.03*	0.25*	0.27*	1
Disclosure	0.02*	0.04*	0.01*	0.05*	-0.02*	-0.03*	-0.05*	0.04*	0.05*	-0.11*	-0.22*	-0.29*	-0.27*	-0.07*	0.04*	0.21*	-0.11*	0.35*	-0.07*

Source: WDI= [World Bank \(2021\)](#); DB=World Bank Doing Business Statistics ([World Bank, 2022](#)); GEM = Global Entrepreneurship Monitor. Note: Significance level: ** 5 %.

Data availability

Data will be made available on request.

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