# The Marginal Benefit of Diversification in Commercial Real Estate Portfolios

**Stephen L. Lee**

***Centre for Real Estate Research (CRER)***
***The University of Reading***
***School of Business,***
***Reading, RG6 6AW***
***England***

**Phone: +44 118 378 6338, Fax: +44 118 378 8172, E-mail: S.L.Lee@reading.ac.uk**

**Abstract**

The number of properties to hold to achieve a well-diversified real estate property portfolio presents a puzzle, as the estimated number is considerably higher than that seen in actual portfolios. However, Statman (1987) argues that investors should only increase the number of holdings as long as the marginal benefits of diversification exceed their costs. Using this idea we find that the marginal benefits of diversification in real estate portfolios are so small that investors are probably rational in holding small portfolios, at least as far as the reduction in standard deviation is concerned.

**Keywords**: *Naïve Diversification, Marginal benefit, Real Estate Portfolios*

# The Marginal Benefit of Diversification in Property Portfolios: A Note

## 1. Introduction

Byrne and Lee (2000) among others suggest that the number of properties to hold to achieve a well-diversified real estate portfolio is hundreds if not thousands. This estimation presents a puzzle, as the actual number of properties held is usually much smaller. For instance, the median number of properties held by a sample of 136 intuitional investors in the UK was only 45 over the 11-years from 1989-1999 (Byrne and Lee, 2003). Why is this? One possible answer is that investors recognise that they "face a daunting task of implementing and maintaining a well-diversified portfolio" (Goetzmann and Kumar, 2001). In other words, real estate investors forego some of the benefits of diversification because diversified real estate portfolios are difficult to construct and manage. In particular, Statman (1987) argues that while reduction of risk is always a benefit in mean-variance portfolio theory the actual number of investments to hold should only be increased as long as the marginal benefits (as measured by risk reduction) exceed the marginal costs (as measured by management costs). Thus, given the high costs typically associated with managing a real estate portfolio it maybe that investors are in fact acting rationally in holding such a small number of properties. This paper set out to test this proposition using the methodology of Statman and data from the UK.

The remainder of the paper is organised as follows. The next section discusses the previous studies on the benefits of diversification on portfolio risk. Section 3 discusses the approach of Statman (1987) to derive the marginal benefits of diversification. Section 4 concludes the paper.

## 2. Diversification Benefits

The number of investments to hold to achieve a well diversified is one continual interest to investors. The answer typically presented in studies in the equity market is very few. In particular, Newbould and Poon (1993) who survey a number of U.S. investment textbooks and academic studies find that by and large there is a great deal of uniformity in the studies that a portfolio consisting of 8 to 20 stocks are generally considered well diversified. The influential paper by Evans and Archer (1968) for instance questioned the economic advisability of increasing the portfolio size beyond 10 stocks. Fisher and Lorie (1970) concluded that the potential for reducing risk by increasing portfolio size exhausts rather rapidly. For example, they noted that about 80% of potential risk reduction could be accomplished by holding a portfolio of just 8 stocks. Bloomfield et al (1977) find that a portfolio of 20 stocks "attains a large fraction of the total benefits of diversification." Asset sizes of between 20 and 40 properties have also been suggested in studies of real estate portfolios, see *inter alia*, Jones Lang Wootton (1986), Brown (1988, 1991) and Brown and Matysiak (2001).

All these conclusions are usually arrived at by plotting the standard deviation (or variance) of portfolio returns against the number of assets in a portfolio. This plot is generally shown to be a "smooth" asymptotic curve meant to present the basic message of reduction of unsystematic risk (and thus total risk) through diversification and the impact of the number of holdings in a portfolio on its risk. For instance, the diagrams in Jones Lang Wootton (1986), Brown (1988, 1991) and Brown and

Matysiak (2001) all demonstrate a profound decline in risk when the portfolio size was increased from 1 to 20 properties.

A few authors have warned about the pitfalls in jumping to conclusions when interpreting the portfolio risk-size diagrams. In particular, Tole (1982) cautions against the misleading nature of the "averaging effect" of the findings reported in several studies. In particular, Tole (1982) points out that when portfolios contain only a handful of securities, the variability around the average is very large. In other words, an investor cannot be confident that if he is holding a specific number of investments he will achieve the implied reduction in risk indicated by the average. Byrne and Lee (2000) report similar findings for real estate in the UK, i.e. although the average risk declines quite rapidly, the variability around the average declines at a much slower rate. The authors concluding that "an individual investor who follows the advice contained in previous studies which are based on the results of average portfolios may be exposing themselves to greater risk than they intended" …. and that …. "the previous recommendations that 20-40 assets are needed to achieve a satisfactory level of risk reduction would seem to underestimate the actual number of assets needed."

Statman (1987) takes a different approach, arguing that investors who follow the rules of mean-variance portfolio theory will only increase the number of holdings as long as the marginal benefits of diversification exceed their costs. For example, using an expected correlation of 0.08, (Campbell et al, 2001), an equity premium of 8.79%, based on realised returns during 1926-2001, and a current expense ratio of 0.20% (Vanguard Total Stock Market Index fund) Statman (2004) finds that the optimal level of diversification is greater than 300 stocks. However, the optimal level of diversification declines to 120 stocks if the equity premium was set to the Fama and French (2002) estimate of 3.44%, while keeping the correlation at 0.08. Similarly, only 70 stocks are optimal when the correlation is 0.28, equal to Campbell et al's (2001) estimate of the realised correlation in the early 1960s. The marginal benefits of diversification therefore depend on the expected correlation among individual securities and the expected risk premium.

## 3. The Marginal Benefit from Diversification

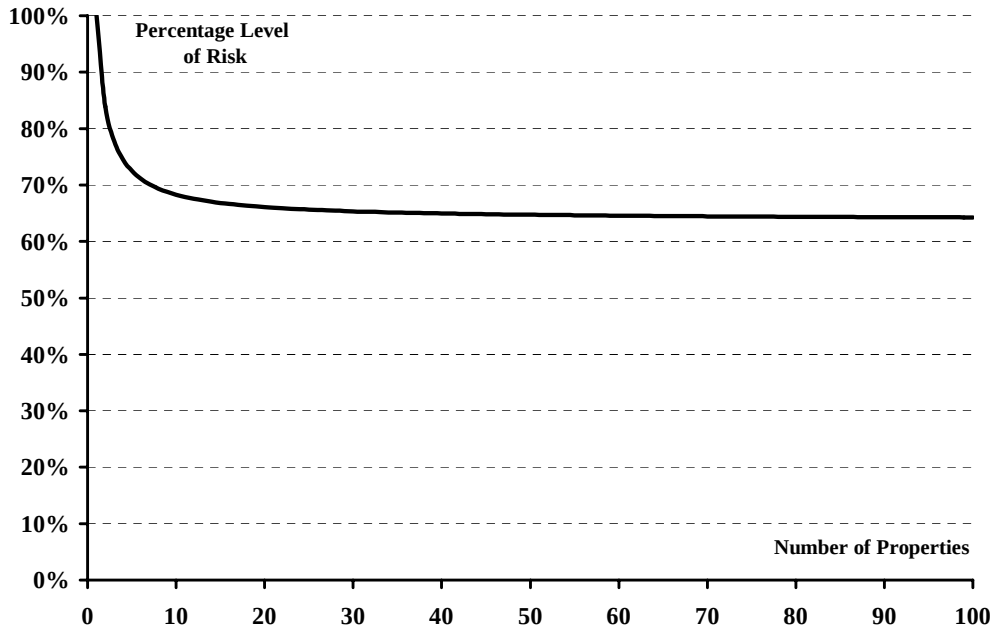
Assume that all properties have an identical expected return, R, identical expected standard deviations, $\sigma$, and that each pair of properties has an identical expected correlation, $\rho$. Consider a portfolio of *n* randomly chosen and equally weighted properties. The expected return of the portfolio is equal to R, the expected return of a single stock. The expected standard deviation of an *n*-property portfolio is:

$$\sigma_n = \sigma\sqrt{\frac{1}{n} + \frac{n-1}{n}\rho} \qquad (1)$$

Equation 1 shows that the expected standard deviation of the portfolio declines when the number of properties in the portfolio increases. For example, assuming that the correlation between all properties is 0.407, the estimated annual correlation for commercial real estate for 1987-1996 (Brown and Matysiak, 2001), the standard deviation of a 10-property portfolio is 32% of the standard deviation of a 1-property

portfolio (See Figure 1). For a 70-property portfolio the reduction in risk is still only 36% and there are no further gains to be made. Such a limited amount of risk reduction is typical of previous studies in the real estate market; see Byrne and Lee (2000) for a review. However, a 10- or even a 70-property portfolio is not necessarily optimal even if it attains a large fraction of the total benefits of diversification. According to Statman the optimal level of diversification is determined by marginal analysis; the number of properties held should only be increased as long as the marginal benefits exceed the marginal costs.

**Figure 1: Risk Reduction and Portfolio Size: Annual Data 1987-1996**




Compare a portfolio of *n*-properties to a portfolio with a larger number of properties, *m*. We set m to be various values from 2-100. If investors can borrow and lend at a common rate of $R_f$, they can lever a portfolio of m stocks such that the expected standard deviation of the levered m-property portfolio is equal to $\sigma_n$, the expected standard deviation of an *n*-property portfolio. The expected return of the levered *m*-property portfolio is:

$$R_{nm} = R_f + \frac{\sigma_n}{\sigma_m} RP \qquad (2)$$

Where $\sigma_m$ is the expected standard deviation of an m-property portfolio, and RP, the expected equity premium, is the difference between R and $R_f$.

The difference between the expected return of an n-property portfolio, R, and the expected return of its corresponding levered m-property portfolio, $R_{nm,}$ is the benefit of increased diversification from n to m properties, expressed in basis points.

$$B_{nm} = R_{nm} - R \tag{3}$$

$$= [\, R_f + \frac{\sigma_n}{\sigma_m} RP \,] - [\, R_f + RP \,] \tag{4}$$

$$= \left( \frac{\sigma_n}{\sigma_m} - 1 \right) RP \tag{5}$$

$$= \left[ \sqrt{\frac{\frac{1}{n} + \frac{n-1}{n}\rho}{\frac{1}{m} + \frac{m-1}{m}\rho}} - 1 \right] RP \tag{6}$$

Using equation 6 therefore the expected marginal benefit of increased diversification in the real estate portfolio can be estimated given the value of the average correlation between properties and an expected risk premium for real estate. Again, consider the case where the correlation between any pair of properties is 0.407 (Brown and Matysiak, 2001) and where the expected equity premium is 2.2%, the mean realised risk premium during 1971-2003. The expected annualised benefit of increasing the number of properties from 1 to 10 is 98 bps and 117 bps from 1 to 100 properties, i.e. only about 1% per annum (See Table 1). The results for the Retail, Office and Industrial sectors show similar results (Tables 2 to 4). The position is even worse for the median real estate portfolio, as the expected annualised benefit is only 2 bps when the number of properties is increased from 45 to 100 properties. The position is worse still if the average correlation of 0.608 found by Byrne and Lee (2003) is taken, as the expected annualised benefit of increasing diversification only 51 bps (1 to 10 properties), 58 bps (1 to 100 properties) and no more than 1 bp for the median portfolio (45 to 100 properties). Such a low marginal benefit is clearly insufficient to cover the high management cost associated typically with purchasing and managing a real estate portfolio. Because the marginal benefits of diversification are insignificant for most real estate portfolios investors are probably acting rationally in limiting their property holdings to much lower levels than that suggested by the tenets of mean-variance analysis.

## 4. Conclusion

Starting with Evans and Archer (1968), the financial literature demonstrates on an empirical basis that naive diversification results in the reduction of portfolio risk when the number of assets included is increased. However, a number of studies in the real estate market show that the number of properties needed to achieve a well-diversified real estate portfolio is hundreds if not thousands. This estimation presents a puzzle, as the estimated number is considerably higher than that seen in actual portfolios. Statman (1987), however, argues that investors should only increase the number of holdings as long as the marginal benefits of diversification exceed their costs. Using this idea we find that the marginal benefits of diversification in real estate portfolios are so small that investors are probably rational in holding small portfolios, at least as far as the reduction in standard deviation is concerned.

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**Table 1: Marginal Benefit of Increased Diversification in the UK Property Market: Bps**

| From to | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 40 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 60 | 17 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 72 | 26 | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 80 | 33 | 15 | 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 85 | 38 | 20 | 10 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 89 | 41 | 23 | 13 | 7 | 3 | | | | | | | | | | | | | | | | | | | | | |
| 8 | 93 | 44 | 25 | 16 | 9 | 5 | 2 | | | | | | | | | | | | | | | | | | | | |
| 9 | 95 | 46 | 27 | 18 | 11 | 7 | 4 | 2 | | | | | | | | | | | | | | | | | | | |
| 10 | 98 | 48 | 29 | 19 | 13 | 9 | 6 | 3 | 1 | | | | | | | | | | | | | | | | | | |
| 15 | 104 | 54 | 34 | 24 | 18 | 14 | 10 | 8 | 6 | 5 | | | | | | | | | | | | | | | | | |
| 20 | 108 | 57 | 37 | 27 | 20 | 16 | 13 | 10 | 9 | 7 | 2 | | | | | | | | | | | | | | | | |
| 25 | 110 | 58 | 39 | 28 | 22 | 18 | 14 | 12 | 10 | 9 | 4 | 1 | | | | | | | | | | | | | | | |
| 30 | 111 | 60 | 40 | 30 | 23 | 19 | 15 | 13 | 11 | 10 | 5 | 2 | 1 | | | | | | | | | | | | | | |
| 35 | 113 | 61 | 41 | 30 | 24 | 19 | 16 | 14 | 12 | 10 | 6 | 3 | 2 | 1 | | | | | | | | | | | | | |
| 40 | 113 | 61 | 41 | 31 | 24 | 20 | 17 | 14 | 12 | 11 | 6 | 4 | 2 | 1 | 1 | | | | | | | | | | | | |
| 45 | 114 | 62 | 42 | 31 | 25 | 20 | 17 | 15 | 13 | 11 | 6 | 4 | 3 | 2 | 1 | 0 | | | | | | | | | | | |
| 50 | 114 | 62 | 42 | 32 | 25 | 21 | 18 | 15 | 13 | 12 | 7 | 4 | 3 | 2 | 1 | 1 | 0 | | | | | | | | | | |
| 55 | 115 | 63 | 43 | 32 | 26 | 21 | 18 | 15 | 13 | 12 | 7 | 5 | 3 | 2 | 2 | 1 | 1 | 0 | | | | | | | | | |
| 60 | 115 | 63 | 43 | 32 | 26 | 21 | 18 | 16 | 14 | 12 | 7 | 5 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | | | | | | | | |
| 65 | 116 | 63 | 43 | 33 | 26 | 22 | 18 | 16 | 14 | 12 | 8 | 5 | 4 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | | |
| 70 | 116 | 63 | 43 | 33 | 26 | 22 | 18 | 16 | 14 | 12 | 8 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | |
| 75 | 116 | 63 | 44 | 33 | 26 | 22 | 19 | 16 | 14 | 13 | 8 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | |
| 80 | 116 | 64 | 44 | 33 | 26 | 22 | 19 | 16 | 14 | 13 | 8 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | |
| 85 | 116 | 64 | 44 | 33 | 27 | 22 | 19 | 16 | 14 | 13 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | |
| 90 | 117 | 64 | 44 | 33 | 27 | 22 | 19 | 16 | 15 | 13 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | |
| 95 | 117 | 64 | 44 | 33 | 27 | 22 | 19 | 17 | 15 | 13 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | |
| 100 | 117 | 64 | 44 | 34 | 27 | 22 | 19 | 17 | 15 | 13 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

## Table 2: Marginal Benefit of Increased Diversification in the Retail Sector: Bps

| From to | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 41 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 62 | 17 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 74 | 27 | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 82 | 34 | 16 | 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 88 | 39 | 20 | 10 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 93 | 43 | 24 | 14 | 7 | 3 | | | | | | | | | | | | | | | | | | | | | |
| 8 | 96 | 46 | 26 | 16 | 10 | 6 | 2 | | | | | | | | | | | | | | | | | | | | |
| 9 | 99 | 48 | 29 | 18 | 12 | 8 | 4 | 2 | | | | | | | | | | | | | | | | | | | |
| 10 | 101 | 50 | 30 | 20 | 14 | 9 | 6 | 3 | 2 | | | | | | | | | | | | | | | | | | |
| 15 | 108 | 56 | 36 | 25 | 19 | 14 | 11 | 8 | 6 | 5 | | | | | | | | | | | | | | | | | |
| 20 | 112 | 59 | 39 | 28 | 21 | 17 | 13 | 11 | 9 | 7 | 2 | | | | | | | | | | | | | | | | |
| 25 | 114 | 61 | 41 | 30 | 23 | 18 | 15 | 13 | 11 | 9 | 4 | 2 | | | | | | | | | | | | | | | |
| 30 | 116 | 62 | 42 | 31 | 24 | 19 | 16 | 14 | 12 | 10 | 5 | 3 | 1 | | | | | | | | | | | | | | |
| 35 | 117 | 63 | 43 | 32 | 25 | 20 | 17 | 14 | 12 | 11 | 6 | 3 | 2 | 1 | | | | | | | | | | | | | |
| 40 | 118 | 64 | 43 | 32 | 26 | 21 | 18 | 15 | 13 | 11 | 6 | 4 | 2 | 1 | 1 | | | | | | | | | | | | |
| 45 | 119 | 64 | 44 | 33 | 26 | 21 | 18 | 15 | 13 | 12 | 7 | 4 | 3 | 2 | 1 | 0 | | | | | | | | | | | |
| 50 | 119 | 65 | 44 | 33 | 26 | 22 | 18 | 16 | 14 | 12 | 7 | 5 | 3 | 2 | 1 | 1 | 0 | | | | | | | | | | |
| 55 | 120 | 65 | 45 | 34 | 27 | 22 | 19 | 16 | 14 | 12 | 7 | 5 | 3 | 2 | 2 | 1 | 1 | 0 | | | | | | | | | |
| 60 | 120 | 66 | 45 | 34 | 27 | 22 | 19 | 16 | 14 | 13 | 8 | 5 | 4 | 3 | 2 | 1 | 1 | 1 | 0 | | | | | | | | |
| 65 | 120 | 66 | 45 | 34 | 27 | 23 | 19 | 17 | 15 | 13 | 8 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | | | | | | | |
| 70 | 121 | 66 | 45 | 34 | 27 | 23 | 19 | 17 | 15 | 13 | 8 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | |
| 75 | 121 | 66 | 46 | 34 | 28 | 23 | 20 | 17 | 15 | 13 | 8 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | | | | | |
| 80 | 121 | 66 | 46 | 35 | 28 | 23 | 20 | 17 | 15 | 13 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | | | | |
| 85 | 121 | 67 | 46 | 35 | 28 | 23 | 20 | 17 | 15 | 14 | 9 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | |
| 90 | 121 | 67 | 46 | 35 | 28 | 23 | 20 | 17 | 15 | 14 | 9 | 6 | 5 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | |
| 95 | 121 | 67 | 46 | 35 | 28 | 23 | 20 | 17 | 15 | 14 | 9 | 6 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | |
| 100 | 122 | 67 | 46 | 35 | 28 | 24 | 20 | 17 | 15 | 14 | 9 | 6 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

## Table 3: Marginal Benefit of Increased Diversification in the Office Sector: Bps

| From to | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 39 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 57 | 16 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 68 | 25 | 9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 76 | 31 | 14 | 6 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 81 | 36 | 19 | 9 | 4 | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 85 | 39 | 22 | 12 | 7 | 3 | | | | | | | | | | | | | | | | | | | | | |
| 8 | 88 | 41 | 24 | 15 | 9 | 5 | 2 | | | | | | | | | | | | | | | | | | | | |
| 9 | 90 | 44 | 26 | 17 | 11 | 7 | 4 | 2 | | | | | | | | | | | | | | | | | | | |
| 10 | 92 | 45 | 27 | 18 | 12 | 8 | 5 | 3 | 1 | | | | | | | | | | | | | | | | | | |
| 15 | 99 | 50 | 32 | 23 | 17 | 13 | 10 | 7 | 6 | 4 | | | | | | | | | | | | | | | | | |
| 20 | 102 | 53 | 35 | 25 | 19 | 15 | 12 | 10 | 8 | 7 | 2 | | | | | | | | | | | | | | | | |
| 25 | 104 | 55 | 36 | 27 | 21 | 16 | 13 | 11 | 9 | 8 | 4 | 1 | | | | | | | | | | | | | | | |
| 30 | 105 | 56 | 37 | 28 | 22 | 17 | 14 | 12 | 10 | 9 | 4 | 2 | 1 | | | | | | | | | | | | | | |
| 35 | 106 | 57 | 38 | 28 | 22 | 18 | 15 | 13 | 11 | 10 | 5 | 3 | 2 | 1 | | | | | | | | | | | | | |
| 40 | 107 | 57 | 39 | 29 | 23 | 19 | 16 | 13 | 12 | 10 | 6 | 3 | 2 | 1 | 0 | | | | | | | | | | | | |
| 45 | 107 | 58 | 39 | 29 | 23 | 19 | 16 | 14 | 12 | 10 | 6 | 4 | 2 | 2 | 1 | 0 | | | | | | | | | | | |
| 50 | 108 | 58 | 40 | 30 | 24 | 19 | 16 | 14 | 12 | 11 | 6 | 4 | 3 | 2 | 1 | 1 | 0 | | | | | | | | | | |
| 55 | 108 | 59 | 40 | 30 | 24 | 20 | 17 | 14 | 13 | 11 | 7 | 4 | 3 | 2 | 1 | 1 | 1 | 0 | | | | | | | | | |
| 60 | 109 | 59 | 40 | 30 | 24 | 20 | 17 | 15 | 13 | 11 | 7 | 5 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | | | | | | | | |
| 65 | 109 | 59 | 40 | 30 | 24 | 20 | 17 | 15 | 13 | 11 | 7 | 5 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | | |
| 70 | 109 | 59 | 41 | 31 | 24 | 20 | 17 | 15 | 13 | 12 | 7 | 5 | 4 | 3 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | | | | | | |
| 75 | 109 | 59 | 41 | 31 | 25 | 20 | 17 | 15 | 13 | 12 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | |
| 80 | 109 | 60 | 41 | 31 | 25 | 21 | 17 | 15 | 13 | 12 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | |
| 85 | 110 | 60 | 41 | 31 | 25 | 21 | 18 | 15 | 13 | 12 | 8 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | |
| 90 | 110 | 60 | 41 | 31 | 25 | 21 | 18 | 15 | 14 | 12 | 8 | 5 | 4 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | |
| 95 | 110 | 60 | 41 | 31 | 25 | 21 | 18 | 15 | 14 | 12 | 8 | 5 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | |
| 100 | 110 | 60 | 41 | 31 | 25 | 21 | 18 | 16 | 14 | 12 | 8 | 6 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |

## Table 4: Marginal Benefit of Increased Diversification in the Industrial Sector: Bps

| From to | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 36 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 52 | 14 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 62 | 22 | 8 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 68 | 28 | 13 | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | 73 | 32 | 16 | 8 | 3 | | | | | | | | | | | | | | | | | | | | | | |
| 7 | 76 | 34 | 19 | 11 | 6 | 2 | | | | | | | | | | | | | | | | | | | | | |
| 8 | 78 | 37 | 21 | 13 | 8 | 4 | 2 | | | | | | | | | | | | | | | | | | | | |
| 9 | 80 | 38 | 23 | 14 | 9 | 6 | 3 | 1 | | | | | | | | | | | | | | | | | | | |
| 10 | 82 | 40 | 24 | 16 | 11 | 7 | 5 | 3 | 1 | | | | | | | | | | | | | | | | | | |
| 15 | 87 | 44 | 28 | 20 | 15 | 11 | 8 | 6 | 5 | 4 | | | | | | | | | | | | | | | | | |
| 20 | 90 | 47 | 30 | 22 | 17 | 13 | 10 | 8 | 7 | 6 | 2 | | | | | | | | | | | | | | | | |
| 25 | 92 | 48 | 32 | 23 | 18 | 14 | 12 | 10 | 8 | 7 | 3 | 1 | | | | | | | | | | | | | | | |
| 30 | 93 | 49 | 33 | 24 | 19 | 15 | 12 | 10 | 9 | 8 | 4 | 2 | 1 | | | | | | | | | | | | | | |
| 35 | 94 | 50 | 33 | 25 | 19 | 16 | 13 | 11 | 10 | 8 | 4 | 3 | 1 | 1 | | | | | | | | | | | | | |
| 40 | 94 | 50 | 34 | 25 | 20 | 16 | 14 | 12 | 10 | 9 | 5 | 3 | 2 | 1 | 0 | | | | | | | | | | | | |
| 45 | 95 | 51 | 34 | 25 | 20 | 17 | 14 | 12 | 10 | 9 | 5 | 3 | 2 | 1 | 1 | 0 | | | | | | | | | | | |
| 50 | 95 | 51 | 34 | 26 | 20 | 17 | 14 | 12 | 11 | 9 | 5 | 4 | 2 | 2 | 1 | 1 | 0 | | | | | | | | | | |
| 55 | 95 | 51 | 35 | 26 | 21 | 17 | 14 | 12 | 11 | 10 | 6 | 4 | 3 | 2 | 1 | 1 | 0 | 0 | | | | | | | | | |
| 60 | 96 | 51 | 35 | 26 | 21 | 17 | 15 | 13 | 11 | 10 | 6 | 4 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | | | |
| 65 | 96 | 52 | 35 | 26 | 21 | 17 | 15 | 13 | 11 | 10 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | | | | | | | |
| 70 | 96 | 52 | 35 | 27 | 21 | 18 | 15 | 13 | 11 | 10 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | | |
| 75 | 96 | 52 | 35 | 27 | 21 | 18 | 15 | 13 | 11 | 10 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | | | | |
| 80 | 96 | 52 | 36 | 27 | 21 | 18 | 15 | 13 | 12 | 10 | 6 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | | | |
| 85 | 97 | 52 | 36 | 27 | 22 | 18 | 15 | 13 | 12 | 10 | 6 | 5 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | | |
| 90 | 97 | 52 | 36 | 27 | 22 | 18 | 15 | 13 | 12 | 10 | 7 | 5 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | |
| 95 | 97 | 52 | 36 | 27 | 22 | 18 | 15 | 13 | 12 | 11 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | |
| 100 | 97 | 52 | 36 | 27 | 22 | 18 | 15 | 13 | 12 | 11 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |