DUFF & PHELPS

Differences in Returns Between Large and Small Companies in Europe

September 2014

Research Funded by Duff & Phelps LLC

Introduction

This article consists of two parts. Part 1 is a brief synopsis of a Research Note authored by Professor Erik Peek of the Rotterdam School of Management, Erasmus University (RSM).[1] Part 2 discusses a collection of exhibits found in Professor Peek's Research Note that summarize (and may aid in the examination of) the relationships between firm size and the cost of equity capital in European equity markets. The "size effect" is based on the empirical observation that companies of smaller size are associated with greater risk and, therefore, tend to have a greater cost of capital.[2]

The Research Note's conclusions while promising, were mixed. For example, while a statistically significant "size effect" was detected in Europe, this effect was (i) limited to only the smallest of companies, and (ii) was not uniformly detected in all countries examined. Part 2 of this article includes a discussion of how the two types of risk premia developed in the Research Note might be used within the build-up method and the capital asset pricing model (CAPM). However, the Research Note's mixed findings suggest that further research is warranted prior to Duff & Phelp's recommending using the tables found herein in the development of cost of equity estimates.

This article is published as part of the ongoing research that Duff & Phelps performs and sponsors in the area cost of capital and other valuation issues. We thank Professor Peek for his expertise in exploring this important topic.

Part 1 and Part 2 Summaries

Part 1

The broad conclusions of the Research Note were as folllows:

- Over the period 1990–2013, small European stocks earned a statistically and economically significant size premium relative to large stocks, even after controlling for size-related beta differences.
- The "size effect" is observable regardless of the measure of firm size used.
- While the observed "size effect" is statistically significant only for those portfolios comprised of the smallest firms during the 1990-2013 period, this does not necessarily infer that the size effect is not present for larger companies in Europe. Studies of the size effect in countries with longer data availability, such as the United States, show that the size effect fluctuates over time. Given the short period of the current analysis of European markets (23 years, due to data constraints), a longer-term relationship could not be studied. Over time, adding more years of data to the analysis could help establish a more meaningful size relationship.

Part 2

Part 2 of this article discusses the two types of premia presented in Professor Peek's Research Note that may aid in the examination of the relationships between firm size and the cost of equity capital in the European equity markets examined in this article:

Premia Over the Risk-free Rate (RP_{m+s}): Premia over the risk-free rate (i.e., excess returns) are presented in terms of the combined effect of market risk and size risk for 16 portfolios ranked by 6 different measures of size, plus a seventh size measure that is a combination of the 6 different measures of size.[3]

Premia Over CAPM (RP_s): Premia over CAPM (i.e., size premia) in terms of size risk for 16 portfolios ranked by 6 different measures of size, plus a seventh size measure that is a combination of the 6 different measures of size.[4]

Examples of how these two types of risk premia might be used within the build-up method and the capital asset pricing model (CAPM) are provided in Part 2.[5]

We welcome comments on the analyses presented herein, as well as suggestions and ideas for further research.

1. The full Research Note "*Differences in Returns Between Large and Small Companies in Europe*", is available at http://ssrn.com/abstract=2499205. Erik Peek is the Duff & Phelps Professor of Business Analysis & Valuation at Rotterdam School of Management, Erasmus University (RSM). Professor Peek's research was completed in March 2014.
2. 2014 *Valuation Handbook* (Duff & Phelps, 2014), Chapter 4, "Basic Building Blocks of the Cost of Equity Capital – Size Premium", page 4-1.
3. For full exhibits, see Exhibits A-1 through A-7 in the original Research Note.
4. For full exhibits, see Exhibits B-1 through B-7 in the original Research Note.
5. The original Research Note also includes "Comparative Risk Characteristics", which provide additional statistics and information about the characteristics of the companies that comprised the portfolios used to calculate the "premia over the risk-free rate" and "premia over CAPM". This important information potentially enables a comparison of a subject company's fundamental risk factors to the fundamental risk factors of the companies that comprise the portfolios. For full exhibits, see Exhibits C-1 though C-7 in the original Research Note.

Table of Contents

Part 1: Synopsis of the Research Note

Part 2: Sample Exhibits

Part 1: Synopsis of the Research Note

Introduction

Numerous studies have examined U.S. equity returns and found that stocks of companies whose market capitalization is small ("small cap" stocks) tend to earn greater returns, on average, than stocks of companies whose market capitalization is large ("large cap" stocks), suggesting that small firms have a greater cost of equity capital. In fact, these studies show that depending on sample selection procedures, research period, and sorting methodology, the estimated monthly return difference between small cap and large cap stocks may range from approximately 0.4% to almost 2.5%.

Researchers have posited many explanations for the size effect, including (i) firm size proxies for differences in liquidity or, for other priced (yet unobservable) risk factors, or (ii) investor preferences or recognition depend on firm size.

To potentially assist investors to estimate the cost of equity in non-U.S. markets, some researchers have investigated the size effect in samples of non-U.S. stocks. Many of these studies, especially those focusing on a single country, may have been inhibited by a lack of data. Another potential issue has been the historic lack of integration among some or all of the stock markets in the sample, particularly with studies examining various groups of countries during the 1970s and 1980s. Moreover, it is entirely conceivable that the risk differences between small and large cap stocks in a segregated *locality* could differ significantly from the risk differences between small and large cap stocks in an *internationally* diversified portfolio. This may occur, for example, if a lack of diversification opportunities in segregated markets makes investors averse to small cap stocks' greater idiosyncratic risk.

In Professor Peek's Research Note, the existence of the size effect outside the U.S. is reassessed using a large sample of Western European stocks during the period 1990–2013, a time in which the European economies and stock exchanges were largely and increasingly integrated.[6] The size effect is examined in a "pooled" sample in which all European exchanges are treated as a *single* integrated market, and also examined by splitting the sample into potentially more homogeneous geographic regions.

This Research Note examines two issues that have appeared in the literature. First, in response to concerns raised by Berk (among others) that using stocks' market capitalization as a measure of firm size may lead to a spurious correlation between size and realized returns, testing of the size effect is also performed using "fundamental" (i.e., accounting-based) size measures, such as sales and total assets.[7] Second, to avoid the possibility that the results are driven by marginal or financially distressed small firms, these firms were excluded from the study sample.[8]

The results of the Research Note provide evidence of a *small* (yet economically significant) size effect. Specifically, the results indicate that although the average stock returns of European firms in the *first nine* size deciles do not vary (or only moderately vary) with firm size, the average returns in the *tenth* size decile (comprised of the smallest companies) are significantly greater than those in the other deciles. This finding suggests the presence of a size premium in Europe, irrespective of the size measure used. Notably, however, this size effect is present only for those portfolios comprised of the *smallest* firms.

Further, there is some evidence that suggests the size effect may be more prominent in Ireland, the United Kingdom, and the Nordic countries (Denmark, Finland, Norway, and Sweden) than it is in other European countries in terms of significance and stability over time.

6. E. Freimann, "Economic integration and country allocation in Europe," *Financial Analysts Journal*, 54(5): 32–41, 1998.

7. J.B. Berk, "A critique of size-related anomalies," *The Review of Financial Studies*, 8(2): 275–286, 1995, and J.B. Berk, "Does size really matter?" *Financial Analysts Journal*, 53(5): 12–18, 1997.

8. "Distressed" firms are identified based on accounting-based measures of profitability and revenue.

Prior Research

Overview of Prior Research

In one of the first empirical studies of the size effect, Banz demonstrated that realized returns of U.S. common stocks over the period 1926–1975 were *negatively* related to the market capitalizations of the companies (i.e., as size measured by market capitalization *decreases*, returns tend to *increase*).[9]

Early studies following Banz also suggested the existence of a size premium effect, and also documented some of its peculiarities. For example, Brown showed that during 1967–1979, the size effect is (i) *not stable* over time, and (ii) *linear* if the log of market capitalization is used as the measure of size.[10]

In other examples, Keim, and then Lamoureux and Sanger, documented that a substantial proportion of the size premium is earned in January, an effect that has come to be known as the "January Effect".[11,12]

During the three decades following Banz and his contemporaries' research, challenges to the existence of the size effect have been explored using various arguments. For example, studies have claimed that the size effect disappears (or is significantly diminished) if one attempts to control for beta risk by measuring betas using annual returns (rather than daily or monthly returns)[13,14], or if one uses betas calculated over longer periods[15], or if one uses a broader market index including debt and equity claims.[16] Similarly, some have argued that the size premium partially disappears after controlling for observable macroeconomic risk factors[17], while others argue that small firms with *low* production efficiency and *high* leverage drive the size effect.[18]

Given that small cap stocks typically have *lower* liquidity and *higher* transaction costs than large cap stocks, some studies have tested whether the return differences between small and large cap stocks reflects investors' compensation for liquidity risk and/or transaction costs. For example, Stoll and Whaley found that the size effect disappears after controlling for differences in transaction costs between small and large cap stocks.[19] Other studies indicate that *illiquidity* is *positively* associated with returns (i.e, as illiquidity increases, returns increase, and vice-versa).[20,21,22] Nonetheless, some of these studies explicitly show that firm size remains significant in explaining returns even *after* controlling for liquidity, suggesting that liquidity differences may not fully explain the size effect.[23]

Collectively, prior research on the size effect has produced mixed evidence and has stirred up much debate on the theoretical and empirical justifications for including a size premium in cost of equity estimates. The fragility of prior evidence led van Dijk to conclude that "more empirical research is needed to establish the validity of the size effect in both U.S. and international stock returns."[24]

Other researchers reasonably argue that if firm size measures and observable risk characteristics are closely correlated, empirically disentangling the effects of size and risk on returns becomes a difficult task.[25] It may be that the prescient qualification that Banz noted in his seminal 1981 paper remains quite germane, even today:

"It is not known whether size [as measured by market capitalization– ed.] per se is responsible for the effect or whether size is just a proxy for one or more true unknown factors correlated with size." – Rolf Banz (1981)

From a practical point of view, some may argue that *even if* firm size proxies for other potentially unknown or unobservable risk factors, the size effect remains important to researchers and practitioners as long as firm size is an easily accessible measure of the underlying risk construct. For example, if one were estimating the cost of equity capital for a closely-held firm, size as measured by accounting-based size metrics may be a valuable proxy for other risk factors.

Comparison to Prior Research

The Research Note differed from prior research in primarily two ways:

- **A more recent time period is examined:** A more recent time period was examined during which economic integration among European countries and exchanges has increased, and regulatory interventions aimed at facilitating cross-border investments may have improved investors' ability to diversify away size risk.
- **A broader range of firm size is examined:** The availability of return data has *improved* over time (especially for smaller firms), enabling the examination of a broader range of firm size.[26]

9. R.W. Banz, "The relationship between return and market value of common stocks," *Journal of Financial Economics*, 9: 3–18, 1981.
10. P. Brown, A.W. Kleidon, and T.A. Marsh, "New evidence on the nature of size-related anomalies in stock prices," *Journal of Financial Economics*, 12: 33–56, 1983.
11. D.B. Keim, "Size-related anomalies and stock return seasonality," *Journal of Financial Economics*, 12: 13–32, 1983.
12. C.G. Lamoureux and G.C. Sanger "Firm size and turn-of-the-year effects in the OTC/NASDAQ market," *The Journal of Finance*, 44(5): 1219–1245, 1989.
13. P. Handa, S.P. Kothari, and C. Wasley, "The relation between the return interval and betas: Implications for the size effect," *Journal of Financial Economics*, 23: 79–100, 1989.
14. *2014 Valuation Handbook – Guide to Cost of Capital*, (Duff & Phelps, 2014), pages 4–9, 4–10, 4–11.
15. K.C. Chan and N.-F. Chen, "An unconditional asset-pricing test and the role of firm size as an instrumental variable for risk," *The Journal of Finance*, 43 (2): 309–325, 1988.
16. M.F. Ferguson and R.L. Shockley, "Equilibrium anomalies," *The Journal of Finance*, 63(6): 2549–2580, 2003.
17. K.C. Chan, N.-F. Chen, and D.A. Hsieh, "An exploratory investigation of the firm size effect," *Journal of Financial Economics*, 14: 451–471, 1985.
18. K.C. Chan and N.-F. Chen, "Structural and return characteristics of small and large firms," *The Journal of Finance*, 46(4): 1467–1484, 1991.
19. H.R. Stoll and R.E. Whaley, "Transaction costs and the small firm effect," *Journal of Financial Economics*, 12: 57–79, 1983.
20. Y. Amihud and H. Mendelson, "Asset pricing and the bid-ask spread," *Journal of Financial Economics*, 17: 223–249, 1986.
21. M.J. Brennan and A. Subrahmanyam, "Market microstructure and asset pricing: on the compensation for illiquidity in stock returns," *Journal of Financial Economics*, 41: 441–464, 1996.
22. V.T. Datar, N.Y. Naik, and R. Radcliffe "Illiquidity and stock returns: An alternative test," *Journal of Financial Markets*, 1: 203–219, 1998.
23. M.A. van Dijk, "Is size dead? a review of the size effect in equity returns," *Journal of Banking and Finance*, 35: 3263–3274, 2011; see also "Liquidity as an Investment Style", R.G. Ibbotson, Z. Chen, D.Y. Kim, W.Y. Hu, *Financial Analysts Journal*, 69 (3): 30–44, 2013.
24. M.A. van Dijk. "Is size dead? a review of the size effect in equity returns," *Journal of Banking and Finance*, 35: 3263–3274, 2011.
25. N. Jegadeesh, "Does market risk really explain the size effect?" *Journal of Financial and Quantitative Analysis*, 27(3): 337–351, 1992.
26. For example, in a study published in 1999 by Heston, Rouwenhorst, and Wessels, the average market capitalization in the *tenth* size-decile (comprised of the smallest companies) is actually *greater* than the average market capitalization in the ninth size decile in the analyses presented here. See: S.L. Heston, K.G. Rouwenhorst, and R.E. Wessels, "The role of beta and size in the cross-section of European stock returns," *European Financial Management*, 5: 9–27, 1999.

Research Methodology and Data

Similar to prior research, the presence of a size effect was tested for by sorting realized returns on (beginning-of-year) firm size and comparing average annual returns across portfolios. As Berk argued, market capitalization and future returns may correlate not only because of small cap versus large cap differences in operating characteristics, but also because high discount rates negatively affect current market capitalization while positively affecting future returns.[27, 28, 29]

To examine the influence of such market effects, Professor Peek sorted returns based both upon market capitalization and an additional *composite* measure derived from market-based *and* accounting-based measures of firm size (described in more detail in the "Empirical Results" section).[30]

Countries Included

This analysis focuses on a set of 17 Western European countries (and exchanges) that have exhibited a large degree of integration during the past two decades. These countries are summarized in Exhibit 1.

Exhibit 1: Countries Included

Austria	Luxembourg
Belgium	The Netherlands
Denmark	Norway
Finland	Portugal
France	Spain
Germany	Sweden
Greece	Switzerland
Ireland	United Kingdom
Italy	

Data Sources

The sample of companies used to perform the analysis presented here comes from the intersection of the Datastream database (from which market and return data were gathered) and Worldscope database (from which fundamental or accounting-based data was gathered).

Insofar as the data needed to perform this analysis, the Worldscope and Datastream databases overlap for approximately 24% of companies in the initial sample in 1982. This overlap increases to 67% in 1990 and 87% in 2010. To mitigate selection bias (while preserving statistical power), the analysis was started in 1990, when the overlap between Datastream's return data and Worldscope's fundamental accounting-based data includes *at least* 2/3 (67%) of companies in both databases.

Companies Excluded

Companies that operate in financial service industries were excluded from the sample because the accounting-based measures of firm size have a different interpretation in those industries (e.g., "sales" at a commercial bank). Because financial services companies are excluded from the base set of companies used to develop these analyses, the information presented herein is likely not informative in regards to the cost of equity for financial services companies.

To avoid the potential for the observed size effect to be primarily driven by highly illiquid stocks or firms in the early stages of their life cycle (i.e., "turtle eggs")[31], the following were also excluded:[32]

- Firm-year observations that have trading (i.e., non-zero returns) on less than 5% of the maximum number of trading days during a calendar year.
- Firm-year observations that lack 3 years of publicly traded price history, or have sales below €1 million in any of the previous three fiscal years.

Finally, to improve the practical relevance of the research, and avoid that an observed size effect is driven primarily by marginal firms (Chan and Chen, 1991), high-financial-risk firm-years were identified using the following criteria:

- Firm-year observations with negative book equity in any of the previous three fiscal years.
- Firm-year observations with negative 3-year-average EBITDA (earnings before interest, taxes, depreciation and amortization), operating profit, or net income in the previous three fiscal years.

These "high-financial-risk" firm-years are *excluded* from the main sample, but are examined separately.[33]

These exclusions, in sum, help to ensure that this analysis addresses whether a size premium is present (or not present) when dealing with non-start-up, financially "healthy" companies – the typical type of company in most investment portfolios.

27. J.B. Berk. "A critique of size-related anomalies," *The Review of Financial Studies*, 8(2): 275–286, 1995.
28. J.B. Berk. "Does size really matter?" *Financial Analysts Journal*, 53(5): 12–18, 1997.
29. This concept is also proffered by Shannon P. Pratt and Roger J. Grabowski in *Cost of Capital: Applications and Examples*, 5th ed. (Wiley, 2014), page 359: "*…some companies will not be risky (high discount rate) because they are small but instead will be small (low market value) because they are risky".*
30. Part 2 of this article ("Sample Exhibits") provides exhibits for each of six size measures (market capitalization, market value of invested capital (MVIC), book value of equity, total assets, sales, and employees), plus an exhibit for the "composite" measure of size, which is a *combination* of the other six measures.
31. P.J. Knez and M.J. Ready, "On the robustness of size and book-to-market in cross-sectional regressions," *The Journal of Finance*, 52(4): 1355–1382, 1997.
32. The cut-off points used in filtering the sample are unavoidably *arbitrary*. The conclusions are nonetheless robust to moderate changes in cut-off points. Further, because the sample is filtered based on information known to investors at the *beginning* of the return window, the deletion of firms does not introduce selection bias. That is, the exclusion of firms or categorization as high-financial risk is based on *past* financial performance or trading history as of the date that portfolios are formed for any given year, and therefore *not* based on any unusual foresight on the part of hypothetical investors in these portfolios.
33. With the exception of descriptive statistics, analysis of the high-financial-risk sample is not presented here. However, analysis of the high-financial-risk sample is available in the full version of the Research Note available at http://ssrn.com/abstract=2499205.

Currency and Return Considerations

Market capitalization and all financial statement data were translated from local currencies to euros. To ensure consistency over time, around the time of introduction of the euro and the determination of fixed euro conversion rates, all amounts (e.g., market cap, accounting data) were translated from the perspective of a German investor. This implies that in the years *prior* to the euro introduction, local currencies are translated to Deutschmarks (DM) *first*, and *then* translated from Deutschmarks to euros using the fixed DM-euro exchange rate.[34, 35]

The stock returns presented here are annual buy-and-hold returns, measured as the sum of (i) the annual percentage change in stock price plus (ii) dividend yield.[36, 37] Stock returns are also calculated from the perspective of a German investor. That is, in the years prior to the euro adoption year, all local returns are translated to Deutschmark returns.[38]

To mitigate a potential delisting bias in portfolio returns, a 30% loss is imputed in the month of delisting for all delistings that are possibly performance-related. A delisting is classified as performance-related when (i) Datastream identifies the reason for delisting as unrelated to a merger or acquisition or as unknown and (ii) the firm reported a net loss in the year prior to the delisting.[39]

Descriptive Statistics of Sample

Exhibit 2 displays the effect of the various sample selection criteria on sample size. In the period 1990–2013, the intersection of Datastream and Worldscope contains 79,773 annual return observations. The requirement that firms included in the sample are not start-up firms (i.e., firms listed for less than three years or having sales below €1 million in any of the three prior years) reduces the sample size by more than one-fourth (21,699 observations), while firms excluded due to thin trading reduces the sample slightly (1,295 observations). Finally, performance-related selection criteria, aimed at excluding (and then separately examining) marginal or financially distressed firms, reduce the sample size by close to one-fifth (15,993 observations).

The final (low-financial-risk) sample contains 40,786 observations, which are broken out by country in Exhibit 3 (next page). Most of these observations (59%) come from the United Kingdom, France, and Germany.

Exhibit 2: Sample Composition – Intersection of Datastream and Worldscope Databases*

	1990–1995	1996–2001	2002–2007	2008–2013	All years 1990–2013
Firm-years with return and accounting data	14,392	20,223	23,098	22,060	79,773
Minus: Firm-years of start-up firms	3,784	6,056	6,255	5,604	21,699
Minus: Firm-years with thin trading	246	487	327	235	1,295
Minus: "High-financial-risk" firm-years	2,386	3,201	5,444	4,962	15,993
Total number of firm-years in the "low-financial-risk" sample	7,976	10,479	11,072	11,259	40,786

Exhibit 2 notes: Start-up firms are firms that have been listed on a European exchange for less than 3 years at the start of the calendar year or have sales below €1 million in any of the previous three fiscal years; firm-years with thin trading are firm-years with non-zero returns on less than 5 percent of all trading days; high-financial-risk firm-years are firm-years with (a) negative book equity in any of the previous three fiscal years or (b) negative 3-year-average EBITDA (earnings before interest, taxes, depreciation and amortization), operating profit, or net income in the previous three fiscal years.

* In this and all subsequent exhibits, we use the American convention to display numbers: (i) commas are used to separate thousands; and (ii) periods are use to separate decimal points.

34. The euro introduction date is January 1999. The fixed DM-euro exchange rate is €1 = DM1.95583 (see e.g., http://www.ecb.int/euro/intro/html/index.en.html).
35. The conclusions herein remain unchanged if local returns are translated into European Conversion Units (ECU) prior to 1999.
36. Using annual buy-and-hold returns (rather than short-window returns) helps to mitigate the risk that bid-ask effects as described by Blume and Stambaugh upwardly bias the estimated size effect. See M.E. Blume and R.F. Stambaugh. "Biases in computed returns: An application to the size effect," *Journal of Financial Economics*, 12: 387–404, 1983.
37. To reduce the influence of obvious data errors in Datastream on stock returns, the following procedure was used: First, observations were identified for which the current annual logarithmic return exceeds 1 and the previous annual logarithmic return is less than -1 (or vice versa). Second, assuming that return reversals of such magnitude are the consequence of data errors, returns for these two firm-years are replaced with their average value. See O.S. Ince and R.B. Porter, "Individual equity return data from Thomson Datastream: Handle with care!" *The Journal of Financial Research*, 29(4): 463–479, 2006.
38. Given that the choice to calculate all returns from the perspective of a German investor is arbitrary, the analyses presented here were replicated after calculating the returns from the perspective of a U.K. investor (i.e., translating all local returns into British Pound returns and using returns on a UK long-term government bond index to calculate the risk-free rate). The results of this sensitivity check indicate that the choice between the German and the U.K. perspective does not significantly influence the main conclusions. Also, it is common to use the German bund as the risk-free rate (free of default risk) in estimating the cost of equity capital for euro-zone companies.
39. The imputed 30% loss is based on Shumway's estimate of average delisting returns. Note that this affects only a small fraction of the firms in the study sample. Given the absence of detailed information about delisting (returns) in Datastream, more sophisticated corrections are difficult to make. See T. Shumway, "The delisting bias in CRSP data," *The Journal of Finance*, 52(1): 327–340, 1997.

Exhibit 3: Number of Firm-year Observations by Country and Period Low-Financial-Risk Sample

	1990–1995	1996–2001	2002–2007	2008–2013	All years 1990–2013
United Kingdom	3,886	3,911	2,866	2,685	13,348
France	939	1,501	1,983	1,992	6,415
Germany	575	899	1,310	1,690	4,474
Switzerland	358	501	581	608	2,048
Sweden	200	394	580	758	1,932
Italy	437	340	476	569	1,822
Netherlands	442	565	426	342	1,775
Greece	75	409	752	524	1,760
Denmark	216	430	375	338	1,359
Spain	173	375	406	355	1,309
Finland	64	246	396	390	1,096
Norway	138	255	260	331	984
Belgium	172	205	262	301	940
Austria	107	164	152	173	596
Ireland	118	127	118	83	446
Portugal	76	141	109	106	432
Luxembourg	0	16	20	14	50
Total	**7,976**	**10,479**	**11,072**	**11,259**	**40,786**

Exhibit 4 and Exhibit 5 provide descriptive statistics for the low-financial-risk sample and the high-financial-risk sample, respectively. The statistics include annual buy-and-hold returns at the top, and, at the bottom, statistics describing the six measures of firm size used in the analyses presented in Part 2 of this article (sample exhibits).

Annual returns in the high-financial-risk sample are *less*, on average, and more volatile than the annual returns in the low-financial risk sample. For example, the average annual return (i.e., mean) in the low-financial-risk sample is 15.0% (see Exhibit 4, left-most column in gray). This implies an average premium of 7.6% (=15.0% – 7.4%) over the average risk-free rate. Alternatively, the average annual return in the high-financial-risk sample is 11.8% (see Exhibit 5), which implies an average premium of 4.6% (=11.8% – 7.2%) over the average risk-free rate.[40, 41]

Firms in the low-financial-risk sample are, on average, *larger* than firms in the high-financial-risk sample, irrespective of the size measure chosen. For example, the average (mean) market capitalization in the low-financial-risk sample and high-financial risk sample is €2,295.4 million and €576.6 million, respectively. Alternatively, average sales in the low-financial-risk sample is €2,732.3 million, while in the high-financial risk sample average sales is €1,124.5 million.

There is also a large *intra*-sample variation in firm size. To illustrate, the interquartile range of market capitalization is €784.5 million (=€836.8 – €52.3) in the low-financial-risk sample (see Exhibit 4, right-most two columns, in gray). Conversely, in the high-financial-risk sample (see Exhibit 5), the interquartile range of market capitalization is €150.4 million (=€164.7 – €14.3). Similarly, the interquartile range of total assets is €1,141.5 million (=€1,223.2 – €81.7) in the low-financial-risk sample, and €369.7 million (=€403.3 – €33.6) in the high-financial-risk sample.

Exhibit 4: Descriptive statistics of returns and firm size measures: low-financial-risk sample

Return Statistics

	Mean	Median	Std Dev	Quartile 1	Quartile 3
Annual return (%)	15.0%	9.3%	52.9%	(13.2%)	35.4%
Currency return (%)	0.2%	0.0%	5.7%	0.0%	0.1%
Risk-free return (%)	7.4%	8.5%	6.7%	2.9%	13.7%

Size Measure Statistics

	Mean	Median	Std Dev	Quartile 1	Quartile 3
Market capitalization (in € millions)	2,295.4	196.2	10,090.3	52.3	836.8
MV of invested capital (in € millions)	3,172.9	273.4	12,825.2	76.2	1,187.9
Book equity (in € millions)	1,109.3	114.9	5,072.5	35.6	452.2
Total assets (in € millions)	3,262.8	278.6	13,762.7	81.7	1,223.2
Sales (in € millions)	2,732.3	303.7	11,821.2	93.9	1,251.2
Employees	10,517	1,431	35,647	442	5,751

Exhibit 5: Descriptive statistics of returns and firm size measures: high-financial-risk sample

Return Statistics

	Mean	Median	Std Dev	Quartile 1	Quartile 3
Annual return (%)	11.8%	1.0%	72.4%	(26.1%)	33.5%
Currency return (%)	0.1%	0.0%	4.7%	0.0%	0.0%
Risk-free return (%)	7.2%	8.1%	6.5%	2.9%	11.1%

Size Measure Statistics

	Mean	Median	Std Dev	Quartile 1	Quartile 3
Market capitalization (in € millions)	576.6	41.5	4,495.4	14.3	164.7
MV of invested capital (in € millions)	953.4	78.6	6,277.7	25.8	294.5
Book equity (in € millions)	376.7	33.3	4,578.6	11.2	120.0
Total assets (in € millions)	1,358.5	107.2	8,357.3	33.6	403.3
Sales (in € millions)	1,124.5	102.2	4,769.8	30.4	381.0
Employees	5,400	588	21,592	185	2,180

Exhibit 4 and Exhibit 5 notes: The number of observations is 40,786 in the low-financial-risk sample and 15,993 in the high-financial-risk sample. All monetary amounts are in € millions and inflation-adjusted using the German Consumer Price Index. The variables have the following definitions:
Annual return: Annual buy-and-hold return, measured as the sum of (i) the annual percentage change in euro-denominated share price plus (ii) dividend yield.
Currency return: Difference between the annual buy-and-hold return in local currency and the annual buy-and-hold return in euro.
Risk-free return: Based on the annual return on the Citigroup German long-term (5 year +) government bond index.
Market capitalization: Number of common shares outstanding times share price at the beginning of the calendar year.
MV of invested capital: Market capitalization of equity at the beginning of the calendar year plus the book value of debt of the most recent fiscal year prior to the calendar year.
Book equity: Ending book value of equity of the most recent fiscal year prior to the calendar year.
Total assets: Ending book value of total assets of the most recent fiscal year prior to the calendar year.
Sales: Total revenues of the most recent fiscal year prior to the calendar year.
Employees: Number of employees at the end of the most recent fiscal year prior to the calendar year.

40. The average risk-free rate is based upon the annual return on the Citigroup German long-term (5 year +) government bond index during the period 1990–2013.

41. In Exhibit 4 and Exhibit 5, the average risk-free return in the low financial risk sample is different from that in the high financial risk sample. The 40,786 and 15,993 observations from, respectively, the low financial risk sample and high financial risk sample are distributed *differently* across years in the sample period, and thus cause the average risk-free returns to differ between the two samples.

Risk Premia and Size Premia

In the following sections, "risk premia over the risk-free rate" (i.e., excess returns) and "premia over CAPM" (i.e., size premia) for the full sample and the low-financial-risk sample are calculated in the following ways:[42]

- Using market capitalization portfolios (i.e., firms are assigned to portfolios based on their market capitalization)
- Using "size factor" portfolios (i.e., firms are assigned to portfolios based on their size factor).

Market capitalization portfolios are used in the examples in this section because market capitalization has been a traditional measure of size used by researchers. The concepts discussed in this section are, however, applicable to the other measures of size analyzed in this article as well. In Part 2 of this article (sample exhibits), risk premia over the risk-free rate and size premia are calculated for *each* of the six measures of firm size analyzed here (including market capitalization), plus the seventh measure, the aggregate "size factor" which is a *combination* of the six other size measures.[43]

To address the concern that the association between beginning-of-year market capitalization and subsequent returns may be spurious (because market capitalization depends on the discount rate), "size factor" portfolios are also discussed in this section. The reported returns for both the market capitalization portfolios and "size factor" portfolios are *equal-weighted*.[44]

Premia Calculated Using Market Capitalization Portfolios

Exhibit 6 and Exhibit 7 display the arithmetic average annual premiums of 10 equal-weighted market capitalization portfolios (and their sum betas) for the full sample and the low-financial-risk sample, respectively.

To create ten equal-sized portfolios Professor Peek sorted all stocks in the full sample by market capitalization at the beginning of the calendar year. The breakpoints determined in the full sample are also used to create firm size portfolios in the low-financial-risk sample.[45]

Equal-weighted returns (rather than market capitalization-weighted returns) are reported in Exhibits 6 and 7. Average portfolio returns are calculated by *first* averaging returns (equal weighted) across stocks within a year and *then* averaging annual portfolio returns (equal weighted) across years. This procedure ensures that later years in the sample, which have relatively many observations, do not receive more weight than earlier years.[46]

At the end of the sample period (2013), Portfolio 10 (comprised of the smallest companies) in the full sample contains 253 firm-year observations (see Exhibit 6, second column from left, in gray). Financial risk tends to be negatively correlated with firm size (i.e., as size decreases, financial risk tends to increase, and vice-versa). Because of this, relatively few of these 253 firm-year observations (70) are assigned to the low-financial-risk sample, while the remaining majority of 183 firm-year observations (=253 – 70) are assigned to the high-financial-risk sample.[47, 48]

42. Analysis of the high-financial-risk sample is not presented here. Analysis of the high-financial-risk sample is available in the full version of the Research Note available at http://ssrn.com/abstract=2499205.
43. The six size measures analyzed in this article are (i) market capitalization, (ii) market value of invested capital (MVIC), (iii) book value of equity, (iv) total assets, (v) sales, and (vi) number of employees.
44. In the full version of the Research Note, excess returns and size premia are also calculated using "*beta-risk-weighted*" portfolios. The results of these alternative tests suggest that the size effect is present in European stock returns, even *after* controlling for beta differences between size portfolios.
45. Portfolios were formed from independent sorts on financial risk and firm size to preserve the variation in firm size in both the low-financial-risk and high-financial-risk samples (the high-financial-risk sample is not shown here, but is included in the full version of the Research Note available at http://ssrn.com/abstract=2499205).
46. Note that this procedure also implies that the pooled-sample excess returns displayed in Exhibit 6, Exhibit 7, Exhibit 10, and Exhibit 11 may slightly deviate from excess returns displayed in Exhibit 4 and Exhibit 5, where all firm-year observations receive equal weight.
47. Analysis of the high-financial-risk sample is not presented here, but is available in the full version of the Research Note.
48. The negative correlation of financial risk and firm size is suggested by, for example, Chan and Chen (1991). The relationship between firm size and financial risk is also examined in Chapters 9 and 10 of the *2014 Valuation Handbook – Guide to Cost of Capital*, (Duff & Phelps, 2014).

Exhibit 6: Arithmetic Average Annual Premiums of 10 Equal-weighted Size Portfolios, and their Sum Betas (size measured by market capitalization): full sample

Size portfolio	Upper bound in 2013 (€ in millions)	N in 2013	Premium over Rf (RP*m+s*)	Portfolio Sum Beta	Premium over CAPM (Size Premium, RP*s*)
1 (big)	161,452	253	4.05%	0.94	0.00%
2	3,838	254	5.48%	1.07	0.87%
3	1,262	254	5.39%	1.10	0.65%
4	505	254	5.14%	1.08	0.49%
5	227	253	5.72%	1.07	1.11%
6	120	254	5.21%	1.05	0.69%
7	67	254	5.62%	1.04	1.14%
8	37	254	5.16%	1.09	0.46%
9	19	254	5.97%	1.12	1.14%
10 (small)	8	253	11.45%	1.16	6.45%
Pooled	–	2,537	5.92%	1.07	1.31%

Exhibit 7: Arithmetic Average Annual Premiums of 10 Equal-weighted Size Portfolios, and their Sum Betas (size measured by market capitalization): low-financial-risk sample

Size portfolio	Upper bound in 2013 (€ in millions)	N in 2013	Premium over Rf (RP*m+s*)	Portfolio Sum Beta	Premium over CAPM (Size Premium, RP*s*)
1 (big)	161,452	239	4.53%	0.92	0.57%
2	3,838	236	5.88%	1.05	1.36%
3	1,262	221	5.82%	1.09	1.12%
4	505	203	6.38%	1.05	1.86%
5	227	188	6.44%	1.03	2.00%
6	120	174	6.92%	1.00	2.61%
7	67	168	8.08%	0.97	3.90%
8	37	139	7.51%	1.04	3.03%
9	19	110	10.11%	1.04	5.63%
10 (small)	8	70	16.49%	1.25	11.10%
Pooled	–	1,748	7.19%	1.03	2.75%

Exhibits 6 and 7 notes: These tables displays average annual excess returns over the risk-free rate of portfolios sorted by market capitalization. Portfolios in the full sample are equal-sized. Breakpoints determined in the full sample have been used to create portfolios in the other samples. Portfolio betas are post-ranking betas calculated as the sum of the slopes in a regression of monthly returns on contemporaneous and once-lagged index returns. Premiums over CAPM are calculated as excess returns minus beta times the market risk premium, which has been assumed equal to the excess return in the top size portfolio of the full sample.

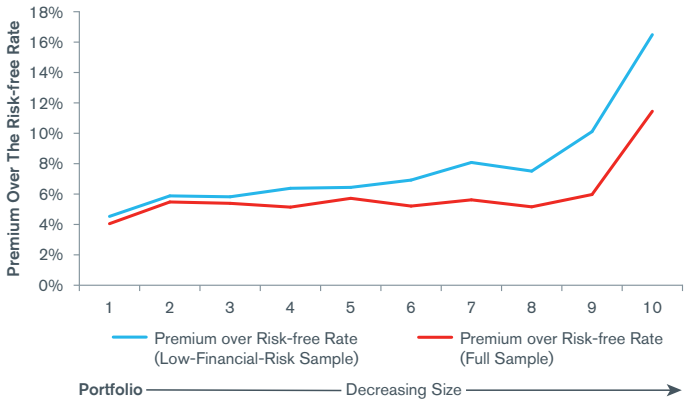
Premia Over the Risk-Free Rate

In the full sample, the average excess return (i.e., premium over the risk-free rate, or notationally RP_{m+s}) is 5.92% when all firm-year observations are "pooled" into a *single* portfolio (see bottom row of Exhibit 6). Breaking the observations in the pooled portfolio of the full sample into 10 equally-populated portfolios ranked by market capitalization reveals that average excess returns increase, albeit non-monotonically, from 4.05% in Portfolio 1 (comprised of the *largest* companies) to 11.45% in Portfolio 10 (comprised of the *smallest* companies).[49, 50] This represents an excess return difference between Portfolio 10 and Portfolio 1 of 7.40% (=11.45% – 4.05%), and provides initial support for the idea that the firm size effect is present in the European sample.

To control for the possibility that marginal, financially distressed firms in the sample drive the observed firm size effect, Professor Peek also calculated average excess returns for a low-financial-risk sample which *excluded* company firm-years that were identified as high-financial-risk. In the low-financial-risk sample (see Exhibit 7) the excess return differential between Portfolio 10 and Portfolio 1 is 11.96% (=16.49% – 4.53%) versus 7.40% in the full sample, suggesting that the effect of firm size on excess returns in the European sample is likely not attributable (or at least not *fully* attributable) to financial risk.[51]

As illustrated in Exhibit 8, in both the full sample and in the low-financial-risk sample the relationship between firm size and premia over the risk-free rate is *non-linear.* Notably, the size effect is significant *only* in the portfolios comprised of the *smallest* companies (i.e., those included in Portfolio 10).

Exhibit 8: Premia Over the Risk-free Rate (RP_{m+s}) by Size Portfolio: Full Sample and Low-Financial-Risk Sample (size measured by market capitalization)



Premia Over CAPM (Size Premia)

Because regressions of portfolio returns on firm size and beta may not accurately separate the beta effect from the firm size effect[52], three alternative methods are used here to control for beta. One method is to calculate "premiums over CAPM" (i.e., commonly referred to as a size premia, or notationally RP_s) as the difference between the average equal-weighted excess portfolio return and beta times the market risk premium.[53]

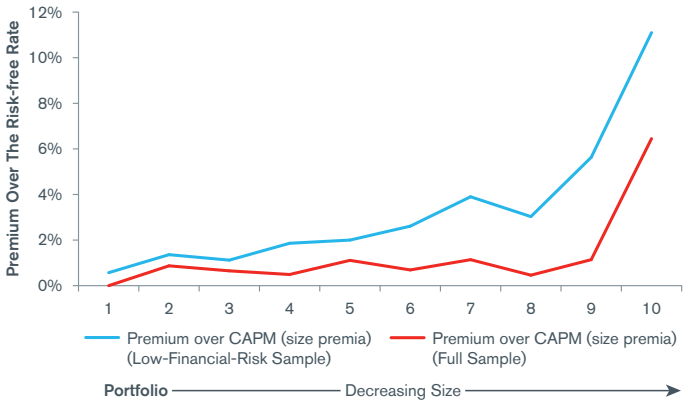
Exhibit 6 and Exhibit 7 report post-ranking portfolio sum betas, which are calculated as the "sum" of the slopes in a regression of monthly portfolio returns on lagged and unlagged monthly MSCI Europe index returns.[54, 55] Consistent with prior U.S. evidence, portfolio betas tend to *increase* as firm size *decreases*.

Breaking the observations in the pooled portfolio of the full sample into 10 equally-populated portfolios ranked by market capitalization reveals that average excess returns increase, although non-monotonically, from 0.00% in Portfolio 1 (comprised of the *largest* companies) to 6.45% in Portfolio 10 (comprised of the *smallest* companies).[56,57] This represents an excess return difference between Portfolio 10 and Portfolio 1 of 6.45% (=6.45% – 0.00%), and provides initial support for the idea that the firm size effect is present in the European sample.

49. There are 2,537 firm-year observations in the "pooled" portfolio. Dividing this number into 10 "equally-populated" portfolios of 253.7 (=2,537 ÷ 10) firm-year observations is not possible. Portfolios 2–9 are therefore comprised of 254 firm-year observations, while portfolios 1, 5, and 10 are comprised of only 253 firm-year observations.
50. "Non-monotonically" in this sense means that the excess returns of the 10 portfolios do not always increase as size decreases. For example, excess returns are 4.05% in Portfolio 1, and 5.48% in Portfolio 2 (an *increase*), but are then 5.39% in Portfolio 3 (a *decrease*).
51. This return spread (Portfolio 10 – Portfolio 1) is statistically significant at the 1% significance level based on a (non-tabulated) standard t-test that uses the standard deviation in 24 annual return differences to calculate standard errors. The observation that excess returns of high-financial-risk firms are smaller, on average, than those of low-financial-risk firms goes against the idea that riskier firms should generate higher returns but is consistent with recent evidence demonstrating a negative relationship between default risk and realized stock returns in US stock markets after 1980. See J.Y. Campbell, J. Hilscher, and J. Szilagyi, "In search of distress-risk", *The Journal of Finance*, 63(6): 2899–2939, 2008, and S. Chava and A. Purnanandam, "Is default risk negatively related to stock returns?", *Review of Financial Studies*, 23(6): 2523–2559, 2010.
52. N. Jegadeesh. "Does market risk really explain the size effect?" *Journal of Financial and Quantitative Analysis*, 27(3): 337–351, 1992.
53. As convention, the Research Note uses a market risk premium (i.e., equity risk premium) equal to the beta-adjusted excess return of Portfolio 1 for purposes of computing size premia over CAPM. In Exhibits 6 and 7 the beta-adjusted excess return of Portfolio 1 of the full sample (4.31% = 4.05% excess return ÷ 0.94 beta) is then used to derive the Premium over CAPM for all other Portfolios in both the full and the low-financial-risk samples.
54. The betas presented here are thus denoted as "sum" betas. Smaller companies generally trade more infrequently and exhibit more of a "lagged" price reaction (relative to the market) than do large stocks. One of the ways of capturing this lag movement is called sum beta. See R.G. Ibbotson, P.D. Kaplan, and J.D. Pearson. "Estimates of Small-Stock Betas Are Much Too Low," *Journal of Portfolio Management*, Summer 1997. Also see Chapter 11, "Beta: Differing Definitions and Estimates", in Shannon P. Pratt and Roger J. Grabowski in *Cost of Capital: Applications and Examples*, 5th ed. (Wiley, 2014).
55. cf. Fama and French, 1992.
56. There are 2,537 firm-year observations in the "pooled" portfolio. Dividing this number into 10 "equally-populated" portfolios of 253.7 (=2,537 ÷ 10) firm-year observations is not possible. Portfolios 2–9 are therefore comprised of 254 firm-year observations, while portfolios 1, 5, and 10 are comprised of only 253 firm-year observations.
57. "Non-monotonically" in this sense means that the excess returns of the 10 portfolios do not *always* increase as size decreases. While excess returns do *generally* increase as size decreases, this is not necessarily true in any individual case. For example, excess returns are 4.05% in Portfolio 1, and 5.48% in Portfolio 2 (an *increase*), but are then 5.39% in Portfolio 3 (a *decrease*).

As illustrated in Exhibit 9, in both the full sample and in the low-financial-risk sample the relationship between firm size and premia over CAPM, or size premia, is *non-linear*. The results in Exhibit 9 suggest that beta does not fully explain excess returns. Notably (again), the size effect is significant only in the portfolios comprised of the *smallest* companies(i.e., those included in Portfolio 10).

Exhibit 9: Premium Over CAPM (i.e. Size Premium) by Size Portfolio: Full Sample and Low-Financial-Risk Sample (size measured by market capitalization)



Premia Calculated Using "Size Factor" Portfolios

Prior research has suggested that the association between beginning-of-year market capitalization and subsequent returns may be spurious because market capitalization depends on the discount rate.[58]

In response to this concern, portfolios were constructed using an alternative measure of firm size ("size factor") which is a *combination* of the six measures of firm size analyzed in the Research Note (market capitalization, market value of invested capital (MVIC), book value of equity, total assets, sales, and number of employees).[59] The idea underlying this alternative measure is that the principal component of market capitalization and non-market variables, such as the book value of assets or sales, accurately reflects firm size without being dependent on investors' discount rate.[60]

Risk Premia and Size Premia

Exhibit 10 and Exhibit 11 display the arithmetic average excess returns of 10 equal-weighted "size factor" portfolios. As was done in previous tables, all stocks are sorted in the full sample by size factor at the *beginning* of the calendar year, and then the breakpoints determined in the full sample are also used to create size portfolios in the low-financial-risk portfolios.

In the full sample (Exhibit 10), the average excess return (i.e., premium over the risk-free rate, or notationally RP_{m+s}) increases non-monotonically from 4.75% in Portfolio 1 (comprised of the largest companies) to 10.23% in Portfolio 10 (comprised of the smallest companies). In the low-financial-risk sample (Exhibit 11), the average premium over the risk-free rate increases non-monotonically from 5.03% in Portfolio 1 to 13.93 % in Portfolio 10.

Alternatively, in both the full sample and the low-financial-risk sample, the difference in premium over CAPM (size premium, *RPs*) between Portfolio 10 and Portfolio 1 is positive, at 4.82% (=4.82% – 0.00%) and 7.62% (=8.04% – 0.42%), respectively. This again suggests that the smallest firms in the sample earn a premium relative to the largest firms. Once again, however, the size effect is only statistically significant for the smallest of companies (i.e., those included in Portfolio 10).

58. See J.B. Berk, "A critique of size-related anomalies," *The Review of Financial Studies*, 8(2): 275–286, 1995, and J.B. Berk, "Does size really matter?" *Financial Analysts Journal*, 53(5): 12–18, 1997.

59. The Research Note provides detailed exhibits for excess returns and size premia (and various other statistics) for *each* of these six measures of firm size, plus the seventh measure, the aggregate "Size Factor". Part 2 of this article provides samples of such exhibits.

60. A principal component analysis of the annual (beginning-of-year) values of the six firm size measures produces the following factor score equation, where all variables are as defined in Exhibit 4 and Exhibit 5: Size Factor = (–2.559 + 0.082 × ln(*Market capitalization*) + 0.086 × ln(*MV of invested capital*) + 0.088 × ln(*Book equity*) + 0.088 × ln(*Total assets*) + 0.076 × ln(*Sales*) + 0.078 × ln(*Employees*). The principal components analysis yields one factor with an eigenvalue greater than one.

Exhibit 10: Average Annual Returns and Premiums of 10 Equal-Weighted "Size Factor" Portfolios: full sample

Size portfolio	Upper bound in 2013	N in 2013	Premium over Rf (*RPm+s*)	Portfolio beta	Premium over CAPM (Size Premium, *RPs*)
1 (big)	3.4	253	4.75%	1.00	0.00%
2	1.5	254	7.46%	1.09	2.28%
3	1.0	254	5.80%	1.08	0.67%
4	0.6	254	4.94%	1.08	(0.19%)
5	0.2	253	3.86%	1.09	(1.32%)
6	(0.1)	254	4.68%	1.03	(0.21%)
7	(0.4)	254	5.45%	1.06	0.41%
8	(0.7)	254	5.93%	1.04	0.99%
9	(1.0)	254	6.10%	1.09	0.92%
10 (small)	(1.4)	253	10.23%	1.14	4.82%
Pooled	–	2,537	5.92%	1.07	0.84%

Exhibit 11: Average Annual Returns and Premiums of 10 Equal-Weighted "Size Factor" Portfolios: low-financial-risk sample

Size portfolio	Upper bound in 2013	N in 2013	Premium over Rf (*RPm+s*)	Portfolio beta	Premium over CAPM (Size Premium, *RPs*)
1 (big)	3.4	233	5.03%	0.97	0.42%
2	1.5	222	7.34%	1.06	2.31%
3	1.0	212	6.59%	1.06	1.56%
4	0.6	205	6.17%	1.06	1.13%
5	0.2	196	5.11%	1.05	0.12%
6	(0.1)	168	6.83%	0.99	2.13%
7	(0.4)	161	7.26%	1.00	2.51%
8	(0.7)	144	8.50%	0.96	3.94%
9	(1.0)	124	8.27%	1.02	3.43%
10 (small)	(1.4)	83	13.93%	1.24	8.04%
Pooled	–	1,748	7.19%	1.03	2.30%

Exhibit 10 and 11 notes: These tables display average annual excess returns over the risk-free rate of portfolios sorted on size factor, which is the factor score of a principal component analysis of the natural logs of the following firm size measures: market capitalization, market value of invested capital, book value of equity, book value of total assets, sales, and number of employees (as defined in Exhibit 4 and Exhibit 5). Portfolios in the full sample are equal-sized. Breakpoints determined in the full sample have been used to create portfolios in the other samples. Portfolio betas are post-ranking betas calculated as the sum of the slopes in a regression of monthly returns on contemporaneous and once-lagged index returns. Premiums over CAPM are calculated as excess returns minus beta times the market risk premium, which has been assumed equal to the excess return in the top size portfolio of the full sample.

Regional Differences

Prior country-specific studies on the firm size effect have produced mixed evidence, leading some researchers and practitioners to conclude that the effect does not exist in some non-U.S. countries.[61] To shed some light on differences in the significance of the size effect across economic regions and their potential origin, the low-financial-risk sample was split into groups of geographically proximate and economically integrated countries and the differences between returns for portfolios comprised of the largest and smallest companies were again analyzed, with the data being subdivided into quartiles (rather than 10 portfolios).[62, 63, 64] Finally, to control for beta risk differences across portfolios, the regional analyses relies on *beta-risk-weighted* portfolio returns, rather than *equal-weighted* portfolios (which had been used in *previous* examples).

To calculate beta-risk-weighted portfolio returns, a quadratic optimization procedure is employed.[65] This procedure is fully described in the Research Note.[66]

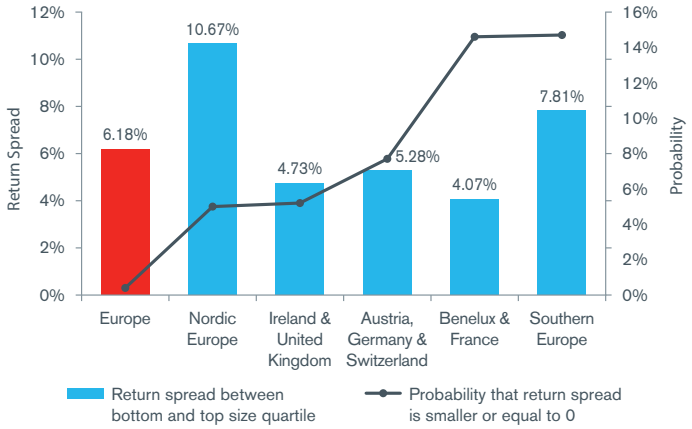
Regional Differences Using Market Capitalization Portfolios

Exhibit 12 displays the average portfolio return spreads between the bottom quartile portfolio (comprised of the *smallest* companies as measured by market capitalization) and the top quartile portfolio (comprised of the *largest* companies as measured by market capitalization) for Europe as a whole (as defined by the 17 countries listed in Exhibit 1), and then broken out into the following five regions:

- Nordic Europe (Denmark, Finland, Norway, and Sweden)
- Ireland and the United Kingdom
- Austria, Germany, and Switzerland
- Benelux (Belgium, Netherlands, and Luxembourg) and France
- Southern Europe (Greece, Italy, Spain, and Portugal)

The regional return spreads are presented in order of significance, measured as the (one-sided) probability that the differential (i.e., the size premium) is positive.[67] While the reader is cautioned to interpret the observed regional differences with care (especially because splitting up the sample unavoidably affects statistical power), the patterns in Exhibit 12 provide interesting exploratory evidence on how country factors affect the size premium. Specifically, Exhibit 12 suggests that the size premium is *positive* in every economic region considered; however, the economic and statistical significance of the return spreads varies considerably. Return spreads are economically and statistically significant (at the 10% significance level) in the Anglo-Saxon countries (Ireland and the United Kingdom), Nordic countries (Denmark, Finland, Norway, and Sweden), and Germanic countries (Austria, Germany, and Switzerland). In contrast, the return spreads in the other two regions are not significantly different from zero.

Exhibit 12: Average Annual Return Spreads between Top and Bottom Market Capitalization Quartiles by Country or Region



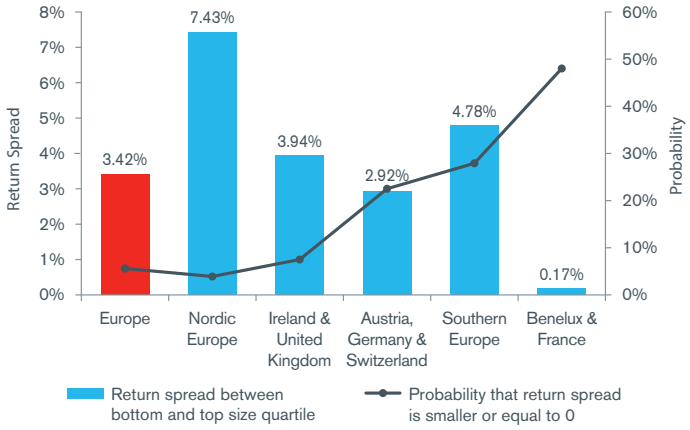
61. For example, some studies of the German equity market conclude that in recent decades stock returns of small German firms have not significantly exceeded stock returns of German large firms (see e.g., Schulz, 2009). With their view seemingly supported by these findings, the German Institute of Public Auditors ('Institut der Wirtschaftsprüfer ') recommends in its (nationally authoritative) Principles for the Performance of Business Valuations not to add size premiums to cost of capital estimates.
62. If the analysis is performed on the full (rather than the low-financial-risk) sample, the conclusions remain qualitatively similar.
63. In this analysis Professor Peek sorted stocks into four (instead of ten) equal-sized portfolios to preserve statistical power.
64. Similar to previous examples, firm size breakpoints are *first* determined in the full European sample, and *then* these same breakpoints are used to construct portfolios in the regional samples (thus ensuring that size portfolios are consistently defined across samples).
65. See N. Jegadeesh, "Does market risk really explain the size effect?" *Journal of Financial and Quantitative Analysis*, 27(3): 337–351, 1992.
66. The full version of the Research Note is available at http://ssrn.com/abstract=2499205.
67. We estimate the standard error of return differentials based on 24 annual return differentials (measured during the years 1990 and 2013).

Regional Differences Using "Size Factor" Portfolios

Exhibit 13 shows the average portfolio return spreads between the bottom quartile portfolio (comprised of the *smallest* companies as measured by size factor) and the top quartile portfolio (comprised of the *largest* companies as measured by size factor) sorted on size factor (i.e., the composite of six firm size measures).

In Exhibit 13 return spreads and probabilities have been calculated in the same way as in Exhibit 12, again presented in order of significance. When using "size factors" to construct portfolios, the return spreads between the bottom and top portfolios are significantly different from zero in the Anglo-Saxon and Nordic countries, (at the 10% and 5% significance level respectively). The return spreads in the other three regions are *positive*, though not significantly different from zero. In fact, there is close to a 50% probability (right y-axis on Exhibit 13) that the return spread is zero or negative in the Benelux and France regions. The return spreads displayed in Exhibit 13 suggest that the significance of the size effect varies across European regions, regardless of the size measure used.

Exhibit 13: Average Annual Return Spreads between Top and Bottom Size Factor Quartiles by Country or Region



Overall, the evidence in Exhibit 12 and Exhibit 13 suggests a distinction between Anglo-Saxon and Nordic countries with *significant* and relatively stable size premiums, and Benelux, Germanic and Southern European countries with *insignificant* or volatile size premiums.

Given prior studies on determinants of expected returns, a few potential explanations can be offered for this distinction. Professor Peek offers three possible arguments that could help us understand differences across geographic regions, which can be synthesized as follows:

(i) Prior research has indicated that the firm value discount associated with corporate diversification increases with the development of external capital markets. 68 During the past two decades, public equity markets in bank-oriented economies, such as those in the Benelux, Germanic and Southern European regions, have rapidly developed, thus potentially reducing the net benefits of diversification in these economies. If during this period the unwinding of corporate conglomerates lagged behind the development of public equity markets, temporary increases in (typically large) conglomerates' required returns may have acted to narrow the return spread between the largest- and smallest-size portfolios in the Benelux, Germanic and Southern European regions.

(ii) Because the very small (low financial risk) firms—those belonging to the smallest 10 percent of all European firms—have a relatively strong influence on the firm size-return relationship, differences in firm size distributions across the economic regions could help explain the differences in return spreads. The Anglo-Saxon and Nordic countries have a greater proportion of observations in the bottom market capitalization quartile attributable to such very small firms relative to the other regions.

(iii) The relationship between firm size and potential determinants of returns, such as (idiosyncratic) operating risk, financial leverage, share liquidity and default risk, may differ across regions. In particular, liquidity differences between bottom quartile and top quartile observations are significantly smaller for the Benelux, Germanic and Southern European countries. Given prior research findings that liquidity may be priced in stock returns, liquidity differences between small and large firms might help explain the return differential across European countries.

A more detailed explanation of these arguments is included in the Research Note.

Conclusion

Part 1 of this article reports the findings of Professor Erik Peek's Research Note, which examines whether the realized stock returns of small European firms have exceeded those of large firms during the period 1990–2013. Using various measures of firm size, the Research Note's findings suggest that small cap stocks have likely outperformed large cap stocks, on average, suggesting that in Europe investors perceive small firms as more risky and thus demand a size premium. The evidence also indicates that the relationship between firm size and returns is strongly non-linear, and that the size premium is significant only for the *smallest* companies.

Breaking the European sample into regional and country subsamples, the Research Note's findings suggest that the relationship between firm size and returns varies across regions. In particular, he finds that the firm size effect is strongest in the Anglo-Saxon and Nordic countries in the sample.

While the size premium shown here is not significant in some European regions, the reader need not automatically conclude from it that firm size does not matter for cost of capital estimation in some countries. Splitting up the sample unavoidably affects the statistical power of the study's tests and tends to reduce statistical significance in at least some of the subsamples, by default. Leaving aside statistical significance, the Research Note's findings suggest that the average return spread between small and large firms is positive in each of the examined regional subsamples, and that size and liquidity distributions likely *differ* across regions. As Professor Peek posits, such differences may potentially explain why the size effect appears strong in some regions but less strong in others.

68. L. Fauver, J. Houston, and A. Naranjo, "Capital market development, international integration, legal systems, and the value of corporate diversification: a cross-country analysis," Journal of Financial and Quantitative Analysis, 38: 135–157, 2003.

Part 2: Sample Exhibits

Introduction

In the Part 1, "risk premia over the risk-free rate" (i.e., excess returns) and "premia over CAPM" (i.e., size premia) were calculated using market capitalization portfolios and "Size Factor" portfolios. In Part 2, sample exhibits for excess returns and size premia (and various other statistics) are provided for each of the six measures of firm size, plus the seventh measure, the aggregate "Size Factor".[69] The full set of data exhibits can be found in the Research Note.[70] The seven measures of size are summarized in Exhibit 14.

Exhibit 14: Six Alternative Measures of Size, plus "Size Factor" (a combination of the other six measures)

Market Capitalization	Number of common shares outstanding times share price at the beginning of the calendar year.
Market Value of Invested Capital	Market capitalization of equity at the beginning of the calendar year plus the book value of debt of the most recent fiscal year prior to the calendar year.
Book Equity	Ending book value of equity of the most recent fiscal year prior to the calendar year.
Total Assets	Ending book value of total assets of the most recent fiscal year prior to the calendar year.
Sales	Total revenues of the most recent fiscal year prior to the calendar year.
Number of Employees	Number of employees at the end of the most recent fiscal year prior to the calendar year.
Size Factor	A combination of the other six size measures.

Market capitalization has been a traditional way "size" is measured by researchers. The other measures of size (including the "Size Factor", which is a combination of the 6 measures of firm size) are analyzed to address the concern that the association between beginning-of-year market capitalization and subsequent returns may be *spurious* because market capitalization depends on the discount rate.[71] In other words, some companies might be small because they are risky (high discount rate), rather than risky because they are small (low market capitalization). One simple example of this could be a company with a *large* asset base, but a *small* market capitalization as a result of high leverage or depressed earnings.

Other reasons that alternative measures of size (in addition to market capitalization) are analyzed here includes the following practical aspect: while market capitalization, at least for a closely held firm, is not available, other size measures, such as assets or sales, are available. Also, when doing analysis of any kind, it is generally prudent to approach things from multiple directions if at all possible. This is good practice for several reasons, with the most important being that it has the potential of *strengthening* the conclusions of the analysis, or, alternatively, *uncovering weaknesses* in the analysis.

A summary of methodologies and type of data used to create the exhibits in the original Research Note is summarized in Exhibit 15.[72,73]

Exhibit 15: Summary of Methodologies and Data Used to Create the Exhibits

Countries Included	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom
Time Period Analyzed	1990–2013
Data Sources	The intersection of the Datastream and Worldscope databases
"Company Types *Excluded* from Analysis"	• Financial services companies • Financially-distressed companies • Companies with illiquid shares • Companies in the early stages of their life cycle
"Company Types *Included* in Analysis"	Non start-up, financially healthy companies – the typical company in most investment portfolios (i.e., "Low-Financial-Risk" companies).
Currency	€ Euro
Portfolios	• In Part 1: 10 portfolios (equal-weighted returns). • In Part 2, Exhibits: Further split into 16 portfolios (equal-weighted returns).
Beta Calculation Type	Sum Beta

69. The *derivation* of Size Factor is presented in the "Firm Size Measures" section.

70 The full version of the Research Note is available at http://ssrn.com/abstract=2499205.

71. See J.B. Berk, "A critique of size-related anomalies," *The Review of Financial Studies*, 8(2): 275–286, 1995, and J.B. Berk, "Does size really matter?" *Financial Analysts Journal*, 53(5): 12–18, 1997.

72. The definitions of the accounting variables follow the definitions as used by Worldscope. These definitions are provided in the Research Note.

73. Please refer to the section entitled "*Research Methodology and Data*" in Part 1 for a more detailed description of the methodologies utilized to create the Exhibits.

Risk Premia, Size Premia, and Comparative Risk Exhibits

Three Types of Data

The data exhibits in Professor Peek's Research Note summarize (and may aid in the examination of) the relationships between firm size and the cost of equity capital in European equity markets. These exhibits presented three different types of data: "premia over the risk-free rate", "premia over CAPM", and "comparative risk statistics (in Exhibits A-1 through A-7, Exhibits B-1 through B-7 , and exhibits C-1 though C-7,respectively), as summarized in Exhibit 16.

Exhibit 16: Summary of the Three Types of Exhibits and General Type of Information Found in Each

Firm Size Measure	Premia Over the Risk-free Rate (i.e., excess returns)	Premia Over CAPM (i.e., size premia)	Comparative Risk Statistics
Market Capitalization	Exhibit A-1	Exhibit B-1	Exhibit C-1
Book Equity	Exhibit A-2	Exhibit B-2	Exhibit C-2
MV of Invested Capital	Exhibit A-3	Exhibit B-3	Exhibit C-3
Total Assets	Exhibit A-4	Exhibit B-4	Exhibit C-4
Sales	Exhibit A-5	Exhibit B-5	Exhibit C-5
Number of employees	Exhibit A-6	Exhibit B-6	Exhibit C-6
Size Factor	Exhibit A-7	Exhibit B-7	Exhibit C-7

Premia Over the Risk-free Rate (RP_{m+s}): Exhibits A-1 through A-7 provide "premia over the risk-free rate" (i.e., excess returns) in terms of the combined effect of *market risk* and *size risk* for 16 portfolios ranked by 6 different measures of size, plus a seventh size measure that is a combination of the 6 different measures of size.

Premia Over CAPM (*RPs*): Exhibits B-1 through B-7 provide "premia over CAPM" (i.e., size premia) in terms of *size risk* for 16 portfolios ranked by 6 different measures of size, plus a seventh size measure that is a combination of the 6 different measures of size.

Comparative Risk Characteristics: Exhibits C-1 through C-7 provide additional statistics and information about the characteristics of the companies that were used to form the portfolios in the "A" and "B" exhibits.

The Difference Between the "A" Exhibits and the "B" Exhibits

The main difference between the premia in the "A" and "B" exhibits is the risks they are intended to measure, which in turn determines how these types of premia could ultimately be used within the context of various cost of equity capital estimation models. For example, a basic "buildup" model of cost of equity capital estimation could be written as:

$$E(R_i) = R_f + RP_m + RP_s + RP_c$$

where:

$E(R_i)$ = Expected rate of return on security *i*

R_f = Yield on risk-free security as of the valuation date

RP_m = Equity risk premium for the "market"

RP_s = Risk premium for smaller size

RP_c = Risk premium attributable to the specific company *i* or to the industry.

Utilizing a premium from the "A" exhibits within the context of the buildup model may be appropriate, because Exhibits A-1 through A-7 provide "premia over the risk-free rate" which combines the effect of *market risk* and *size risk*, and would simply substitute for the term "$RP_m + RP_s$". In this context, the basic buildup equation could be re-written as:

$$E(R_i) = R_f + RP_{m+s} + RP_c$$

Where the term "RP_{m+s}" represents the ERP estimate *plus* a risk premium for size.

Rather than a build-up method, one can use a modified CAPM which can be written as:[74]

$$E(R_i) = R_f + (b \times RP_m) + RP_s + RP_c$$

where:

b = Beta estimate for security *i*

and the other variables are defined above.

Utilizing a premium from the "A" exhibits within the context of the CAPM would likely, in essence, *double-count* the term "$(b \times RP_m) + RP_s$", because Exhibits A-1 through A-7 provide "premia over the risk-free rate", i.e. the combined effect of *market* risk and *size* risk. Utilizing a premium from the "B" exhibits within the context of the CAPM would likely be more appropriate, because Exhibits B-1 through B-7 provide beta-adjusted size premia, and would simply substitute for the term "RP_s" in the modified CAPM equation.

Of course, another potential use for beta-adjusted size premia of the type provided in Exhibits B-1 through B-7 is within the context of a buildup model in which the ERP and size premia inputs are added *individually.* In this case, the analyst provides his or her own ERP estimate (i.e., "RP_m"), and then adds a size premia (RP_s) in the basic buildup equation:

$$E(R_i) = R_f + RP_m + RP_s + RP_c$$

74. The pure CAPM is $E(R_i) = R_f + (b \times RP_m)$. A "modified" CAPM typically signifies that additional adjustments are considered (in this case, the additional adjustments are for "size" and "company-specific" risks).

Risk Premia Over the Risk-free Rate

Statistics Presented

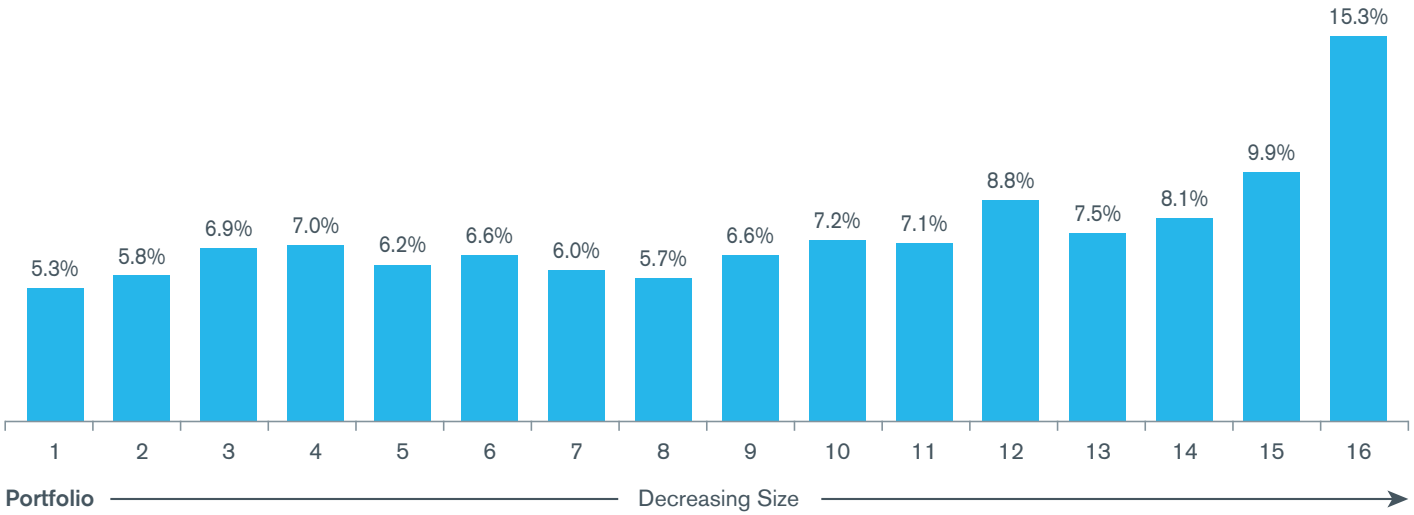
Exhibits A-1 through A-7 report calculations of premia over the risk-free rate (i.e., excess returns) in addition to other statistics for *each* portfolio for *each* of the seven measures of firm size. The statistics reported in the "A" exhibits are summarized in Exhibit 17.

Exhibit 17: Statistics Reported for 16 Size-Ranked Portfolios in Exhibits A-1 through A-7

Portfolio rank	Firms are ranked from largest to smallest.
Avg. size	The portfolio average of the size measure (used to construct the portfolios) at the beginning of the latest sample year (i.e., 2013).
Log of size	The natural logarithm of the average size variable.
N as of 2013	The number of firm-year observations in the portfolio in the latest sample year (i.e., 2013).
Sum beta	The sum of the slopes in a regression of monthly portfolio returns on contemporaneous and lagged monthly MSCI Europe index returns (post-ranking).
Standard deviation of returns	The standard deviation of 24 annual portfolio returns (between 1990 and 2013).
Geometric average return	Geometric average of 24 annual portfolio returns (between 1990 and 2013).
Arithmetic average return	Arithmetic average of 24 annual portfolio returns (between 1990 and 2013).
Arithmetic average risk premium	The difference between the arithmetic average portfolio return and arithmetic average return on annual return on the Citigroup German long-term (5 year +) government bond index.
t-Value of arithmetic avg. risk premium	t-Value indicating the statistical significance of the difference between a portfolio's arithmetic average risk premium and the arithmetic average risk premium in the top size portfolio.
Smoothed avg. risk premium	The fitted premium from a 3rd order polynomial regression with the arithmetic average risk premium as the dependent variable and the logarithm of the average classification measure as well as its squared and cubic values as independent variables.

In Exhibit 18, the simple average of all "arithmetic average risk premia" from Exhibits A-1 through A-7 from the original Research Note are shown. Exhibit 18 suggests that "risk premia over the risk-free rate" generally increase as size decreases (and vice versa), albeit non-monotonically.[75] Again, this suggests that the "firm size effect" on the cost of equity is present in the European sample, although it seems to be fairly concentrated in the smallest companies.

Exhibit 18: Composite Average of "Arithmetic Avg. Risk Premium": Exhibits A-1 through A-7



75. This pattern generally exists in each of the seven "A" exhibits.

Analysis of Results

Exhibits A-1 through A-7 also display t-values indicating the statistical significance of the difference between a portfolio's arithmetic average risk premium and the arithmetic average premium in *each* exhibit's Portfolio 1 (Portfolio 1 is comprised of the *largest* companies).

Given the degrees of freedom (23), the one-tailed t-value thresholds are 1.319 (for significance at the 10% level), 1.714 (5% level), and 2.500 (1% level). The results suggest that the greater premiums in Portfolios 15 and 16 relative to Portfolio 1 are statistically significant when using the following firm size metrics: market capitalization, book equity, market value of invested capital, and the size factor. In Exhibits A-1 (market capitalization), A-3 (market value of invested capital), and A-4 (total assets) the average risk premiums in portfolio 14 are also significantly different from those in portfolio 1. These results are summarized in Exhibit 19 (risk premia differences displayed in gray are significant at the 10 percent significance level (one-tailed)).

Exhibit 19: Summary of Exhibits A1 through A7: Differences in Risk Premium Over the Risk-free Rate Between Portfolios Comprised of Smallest Companies (13, 14, 15, 16) and Portfolio 1 (comprised of largest companies) (gray = significant at 10% level, one-tailed test)

Portfolios	Market Capitalization	Book Equity	MV of Invested Capital	Total Assets	Sales	Number of Employees	Size Factor
13 vs 1	3.49%	2.08%	2.90%	1.94%	1.69%	1.81%	1.82%
14 vs 1	6.54%	1.23%	4.69%	2.91%	1.63%	2.43%	0.59%
15 vs 1	6.13%	3.46%	7.26%	3.15%	2.55%	3.22%	6.61%
16 vs 1	16.74%	9.59%	12.56%	9.49%	7.75%	3.22%	11.11%

These findings broadly suggest that the portfolios comprised of the smallest companies have greater risk premiums than portfolios comprised of the largest companies, and that these results are statistically significant.

Risk Premia over CAPM (Size Premia)

Statistics Presented

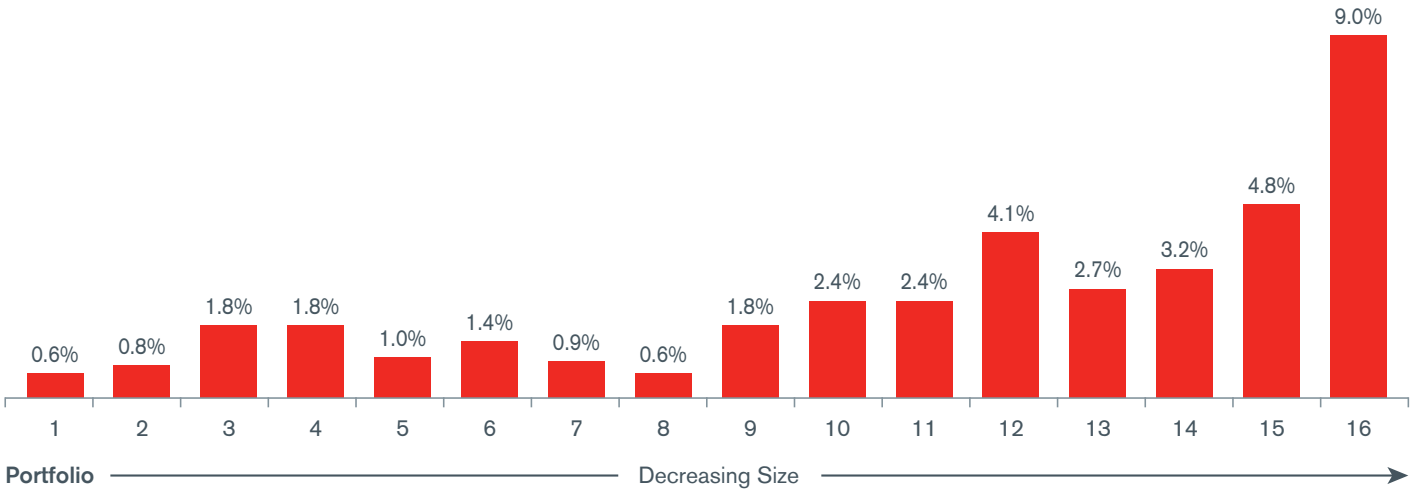
Exhibits B-1 through B-7 from the original Research Note report calculations of premia over CAPM (i.e., size premia) in addition to other statistics for *each* portfolio for *each* of the seven measures of firm size. The statistics reported in the "B" exhibits are summarized in Exhibit 20.

Exhibit 20: Statistics Reported for 16 Size-Ranked Portfolios: Exhibits B-1 through B-7

Portfolio rank.	Firms are ranked from largest to smallest.
Average size.	The portfolio average of the size measure (used to construct the portfolios) at the beginning of the latest sample year (i.e., 2013).
Log of size.	The natural logarithm of the average size variable.
Sum beta.	The sum of the slopes in a regression of monthly portfolio returns on contemporaneous and lagged monthly MSCI Europe index returns (post-ranking).
Arithmetic average risk premium.	The difference between the arithmetic average portfolio return and arithmetic average return on annual return on the Citigroup German long-term (5 year +) government bond index.
t-Value premium over CAPM (sum beta).	t-Value indicating the statistical significance of the difference between a portfolio's premium over CAPM (based on sum beta) and the premium over CAPM in the top size portfolio.
Indicated CAPM premium (sum beta).	The product of the portfolio (sum) beta and the average market risk premium, where the average market risk premium has been set equal to the equity risk premium of market capitalization portfolio 1 (largest firms) divided by the (sum) beta of market capitalization portfolio 1.
Premium over CAPM (sum beta).	The difference between the arithmetic average risk premium and the indicated CAPM premium (based on sum beta).
Smoothed premium over CAPM (sum beta).	The fitted premium from a 3rd order polynomial regression with the premium over CAPM (based on sum beta) as dependent variable and the logarithm of the average classification measure as well as its squared and cubic values as independent variables.

In Exhibit 21, the simple average of all "premia over CAPM" from Exhibits B-1 through B-7 from the original Research Note are shown. Exhibit 21 suggests that size premia generally *increase* as size *decreases* (and vice versa), albeit *non-monotonically*.[76] Again, this suggests that the "firm size effect" on the cost of equity is present in the European sample, although it seems to be fairly concentrated in the smallest companies.

Exhibit 21: Average of "Premia Over CAPM" (Size Premia): Exhibits B-1 through B-7



Consistent with prior U.S. evidence, the results indicate that portfolio betas tend to *increase* as firm size *decreases*. Consequently, portfolio differences in beta may explain (at least in part) why risk premia differ across firm-size portfolios. An abbreviated version of Exhibit B-1 from the original Research Note (see Exhibit 22) will be used in the following example to illustrate the calculation of premia over CAPM, or size premia, using sum betas.[77, 78]

76. This pattern generally exists in each of the seven "B" exhibits.

77. For the purposes of this example, Exhibit B-1 is used. This same set of calculations can be used to derive the size premium for any of the 16 portfolios in any of the "B" exhibits (B-1 through B-7).

78. In this example, "sum" betas were used to calculate size premia. In the full version of the Research Note, size premia calculated using "annual" betas are also examined.

Exhibit 22: Calculations for Premia Over CAPM (Size Premia): Companies Ranked by Market Capitalization
Historical Equity Risk Premium: Average Since 1990 through December 31, 2013

Companies Ranked by Market Capitalization				Premia over CAPM (Size Premia, RPs)				
Historical Equity Risk Premium: Average Since 1990 Market Cap Data for Year Ending December 31, 2013								
Portfolio Rank by Size	Avg. Mkt Cap (in € millions)	Log of Avg. Mkt Cap	Beta (Sum Beta) Since '90	Arithmetic Avg. Risk Premium	Indicated CAPM Premium	Premium over CAPM	t-Value Premium over CAPM	*Smoothed Premium over* CAPM
1 (big)	28,874	10.27	0.90	4.35%	4.35%	0.00%	–	*-0.35%*
2	4,430	8.40	0.99	5.45%	4.79%	0.67%	0.458	*1.17%*
▪	▪	▪	▪	▪	▪	▪	▪	▪
▪	▪	▪	▪	▪	▪	▪	▪	▪
▪	▪	▪	▪	▪	▪	▪	▪	▪
16 (small)	4	1.24	1.46	21.09%	7.06%	14.03%	2.402	*12.23%*

1. The beta in Portfolio 16 (comprised of the smallest firms) of exhibit B-1 equals 1.46. (A)
2. The average risk premium in Portfolio 16 equals 21.09%. (B)
3. The average market risk premium during the sample period (1990–2013) is assumed to be equal to the arithmetic average risk premium of Portfolio 1 (largest firms) divided by the beta of market capitalization Portfolio 1 (4.35% ÷ 0.90 = 4.83%). This essentially ramps up the arithmetic average risk premium of Portfolio 1 to what it would be if we assumed the overall market's beta of 1.00. (C)
4. The indicated CAPM premium of Portfolio 16 is 7.06% (A x C = 1.46 x 4.83%). (D)
5. The premium over CAPM, or size premium, is 14.03% (B – D = 21.09% – 7.06%)

Analysis of Results

The results presented in Exhibits B-1 through B-7 show that the premiums over CAPM, or size premia, *increase* as size *decreases* in a *non-monotonic* and *non-linear* fashion. To illustrate, when using market capitalization to measure firm size, premiums over CAPM are economically and statistically significant in portfolios 14 through 16, but *not* in the other portfolios.

Exhibit 23 reports the differences between size premia in portfolios 13 through 16 and premia over CAPM in portfolio 1 for all firm size metrics, as taken from Exhibits B-1 through B -7. Premium-over-CAPM differences that are displayed in gray are significant at (at least) the 10% alpha level.

Exhibit 23: Summary of Exhibits B1 through B2: Differences in Premia Over CAPM (Size Premia) Between Portfolios Comprised of Smallest Companies (13, 14, 15, 16) and Portfolio 1 (comprised of largest companies) (gray = significant at 10% level, one-tailed test)

Portfolios	Market Capitalization	Book Equity	MV of Invested Capital	Total Assets	Sales	Number of Employees	Size Factor
13 vs 1	2.81%	1.93%	2.70%	1.89%	1.64%	1.96%	1.63%
14 vs 1	5.86%	0.75%	4.20%	2.67%	1.58%	2.58%	0.25%
15 vs 1	5.36%	2.98%	6.92%	2.91%	2.31%	2.50%	6.03%
16 vs 1	14.03%	7.51%	10.48%	7.99%	5.96%	3.32%	9.37%

The results suggest that the relationship between firm size and premiums over CAPM is *weaker* than the relationship between firm size and premiums over the risk-free rate (as presented in Exhibit 19), both in terms of economic magnitude and statistical significance.

For example, when using the sum-beta approach to calculate the indicated CAPM premium, premiums over CAPM in portfolio 15 are statistically distinguishable from premiums in portfolio 1 only for three size metrics: market capitalization, the market value of invested capital, and size factor (see Exhibit 23). This observation indicates that systematic (beta) risk explains (at least partly) why smaller firms have greater equity risk premiums on average. Nonetheless, while the economic magnitude and statistical significance of premiums over CAPM vary across size metrics, the results broadly indicate that investors demand a size premium for the *smallest* 12.5 percent of European (public) firms (portfolios 15 and 16).

Exhibit 24, which is an extract from the exhibits in the original Research Note, summarizes the size characteristics for Portfolio 1 (comprised of the largest companies) and Portfolios 14, 15, and 16 (comprised of the smallest companies) for each of the six size measures studied in the Research Note's "A" exhibits and the "B" exhibits.[79] Exhibit 24 helps to understand the relative sizes of the companies that comprise the portfolios formed to calculate the various risk premia estimated in the study.

While the A exhibits and the B exhibits present different types of risk premia, the A and B exhibits are:

- Comprised of the same set of companies, and
- Ranked by the same six alternative measures of size.[80]

This was done for a specific reason: It helps to ensure that the "risk premia over the risk free rate" that are published in the A exhibits and used in the buildup method are "apples to apples" when compared to the "risk premia over CAPM" (also known as "size premia") that are published in the B exhibits.

Exhibit 24: Summary of Average Company Size of Largest (Portfolio 1) and Smallest Companies (Portfolios 14, 15, 16)

Portfolios	Market Capitalization (in € millions)	Book Equity (in € millions)	MV of Invested Capital (in € millions)	Total Assets (in € millions)	Sales (in € millions)	Number of Employees
1 (big)	28,874	18,082	42,803	52,823	40,718	123,257
▪	▪	▪	▪	▪	▪	▪
14	14	14	24	31	28	131
15	8	8	14	17	15	74
16 (small)	**4**	**3**	**5**	**7**	**7**	**31**

Conclusion

Part 2 of this article discusses how the two types of risk premia developed in the original Research Note might be used within the build-up method and the capital asset pricing model (CAPM). The Research Note's conclusions while promising, were mixed, but likely do suggest that further research is warranted.

79. Portolios 2 through 13 not shown.

80. The seventh measure of size (simply called "Size Factor" in the original Research Note) is a combination of the other six size measures, and is not shown here.

DUFF & PHELPS

Contacts

France

Yann Magnan
Managing Director
+33 (0) 1 40 06 40 23
yann.magnan@duffandphelps.com

Germany

Andreas Stoecklin
Managing Director
+49 (0)89 388 884 120
andreas.stoecklin@duffandphelps.com

Netherlands

Henk Oosterhout
Managing Director
+31 02 08515154
henk.oosterhout@duffandphelps.com

Spain

Javier Zoido
Managing Director
+34 655 865 065
javier.zoido@duffandphelps.com

United Kingdom

Mathias Schumacher
Managing Director
+44 20 7089 4720
mathias.schumacher@duffandphelps.com

United States

Paul Barnes
Managing Director
+1 215 430 6025
paul.barnes@duffandphelps.com

For more information please visit:
www.duffandphelps.com

About Duff & Phelps
Duff & Phelps is the premier global valuation and corporate finance advisor with expertise in complex valuation, dispute consulting, M&A and restructuring. The firm's more than 1,000 employees serve a diverse range of clients from offices in North America, Europe and Asia. For more information, visit www.duffandphelps.com.

M&A advisory, capital raising and restructuring services in the United States are provided by Duff & Phelps Securities, LLC. Member FINRA/SIPC. Pagemill Partners is a Division of Duff & Phelps Securities, LLC. M&A advisory and capital raising services in the United Kingdom and Germany are provided by Duff & Phelps Securities Ltd., which is authorised and regulated by the Financial Conduct Authority.

Contributors

Prof. Erik Peek
Roger Grabowski
James Harrington
Carla Nunes
Niel Patel
Gary Roland