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Abstract

In this paper, we document economically and statistically large differences in the cost of equity by comparing an international CAPM to a domestic CAPM. We consider fifteen countries over a nearly twenty-year period (1996 – 2015). While the application of the international version of the CAPM in cases where an international market index is used as a pricing factor would seem justified by increased capital market integration, the empirical evidence on this has been inconclusive to date. We found that the average difference in the cost of equity between the models was equal to 0.77%, which represents about 20% of the historical risk premium. Moreover, for almost 20% of the companies, this difference in cost of equity is also statistically significant. For these companies the difference in cost of equity is equal to 1.49%. We therefore conclude that the ICAPM is increasingly becoming the relevant model for cost of equity calculations.

JEL Classification: F30, G15

Keywords: CAPM, Cost of Equity, International Capital Markets, International CAPM

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The World We Live In:

Local or Global?

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Abstract

In this paper, we document economically *and* statistically large differences in the cost of equity by comparing an international CAPM to a domestic CAPM. We consider fifteen countries over a nearly twenty-year period (1996 – 2015). While the application of the international version of the CAPM in cases where an international market index is used as a pricing factor would seem justified by increased capital market integration, the empirical evidence on this has been inconclusive to date. We found that the average difference in the cost of equity between the models was equal to 0.77%, which represents about 20% of the historical risk premium. Moreover, for almost 20% of the companies, this difference in cost of equity is also statistically *significant*. For these companies the difference in cost of equity is equal to 1.49%. We therefore conclude that the ICAPM is increasingly becoming the relevant model for cost of equity calculations.

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1. Introduction

An important element in determining the cost of equity for individual companies is the capital asset pricing model (CAPM). In theory, the international version of the model, the ICAPM, should be used for integrated financial markets, since integration implies that stocks are priced similarly across the board, irrespective of where they are traded. That would make the global market index the most relevant index, and it should therefore replace the local indices used for cost of capital calculations in the traditional domestic CAPM. The underlying empirical results have, however, been inconclusive to date.

This paper presents an analysis of the cost of equity in international financial markets. It builds on Koedijk, Kool, Schotman, and Van Dijk (2002) and Stulz (1995) in the sense that it assesses whether there is a pricing error in the computation of the cost of equity when a local CAPM is used even though the ICAPM applies. This pricing error is especially interesting from a practical point of view, since the CAPM is still the benchmark model in practice for calculating the cost of equity.[1] The widespread use of the CAPM has been demonstrated by Graham and Harvey (2001) for the U.S. and Brounen, De Jong, and Koedijk (2004) for Europe.

Our paper uses the same methodology as Solnik (1974b) and Stulz (1995). Solnik (1974b) reviewed nearly 300 stocks from nine developed countries and found a difference in the cost of equity when the local CAPM was used despite the fact that the ICAPM applied for more than 50% of the companies. Stulz (1995) took this into a bit greater detail, limiting his analysis to Nestlé, and documented an economically large difference. In Koedijk et al. (2002), the approach of Solnik (1974b) and Stulz (1995) was extended by adding exchange rates as pricing factors in the model. Their sample consisted of 3,293 stocks in nine countries. Overall, Koedijk et al. (2002) found that for many companies in their sample, it did not matter whether the international or local

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[1] Acquaintances working for international investment banks told us that the CAPM is still the benchmark model for computing the cost of equity. At one bank, they always use the local CAPM model, and at another, it depends on whether the company in question operates primarily nationally or internationally. For companies operating internationally, the cost of equity is then computed with an international version of CAPM. Finally, investment banks often use Damodaran data sets (http://pages.stern.nyu.edu/~adamodar/) to find a company's beta. The definitions for the variables in those data sets state that the beta is computed using a domestic CAPM, where the index is “the most widely followed index in the market.”

CAPM was used. Applying an alternative method and focusing exclusively on the U.S., Harris, Marston, Mishra, and O'Brien (2003) also concluded that it did not matter much for the cost-of-equity computation whether the domestic or global market model had been used. Moreover, Jacquillat and Solnik (1978) had previously concluded that adding other major markets on top of the home market often does not yield any improvement in explaining the stock returns of multinational firms. While this result is consistent with the findings of Koedijk et al. (2002), it must be treated with care, since the developed markets at the time were not yet integrated and that could distort the analysis.

In sum, the empirical evidence thus far has been inconclusive. The culmination of capital market integration in developed countries in the 1990s (Bekaert, Harvey, Lundblad, & Siegel, 2011), which is a basic assumption in our model, presents us with a twenty-year time period for assessing the impact on the cost of equity of using a local instead of an international model. Moreover, the increasing capital market integration of emerging markets (Bekaert & Harvey, 2003; Carrieri, Chaieb, & Errunza, 2013) justifies extending the analysis to emerging markets. Our results show that over the entire period we focus primarily on, 1996 – 2015, the difference in cost of equity when using the local CAPM despite applicability of the ICAPM was equal to 0.77%. This represents 18% of the historical risk premium.[2] Moreover, on average for 19% of the companies in a country, this difference is also statistically significantly distinct from zero. Furthermore, this rejection rate differs considerably between countries, ranging from 1.9% for China and 63% for Switzerland. When focusing exclusively on companies for which the difference is significantly different from zero the mistake in cost of equity jumps from 0.77% to 1.49% - equal to 35% of the historical risk premium. This implies that the ICAPM increasingly becomes the model to be used in determining the cost of equity.

The previous discussion does not distinguish between an under- and overestimation of the cost of equity. The implications are, however, the exact opposite. Using the Gordon growth model, where the stock price represents the discounted stream of future dividends and the discount rate equals the `real' cost of equity (Gordon, 1962; Gordon & Shapiro, 1956; Williams, 1938), any underestimation of the cost of equity implies

[2] The equity risk premium for a U.S. investor on the global market for the period 1900-2015 is equal to 4.2% (Credit Suisse, 2016, pg. 61). Therefore, a mistake in cost of equity of 0.77% represents 0.77%/4.2%=18% of the global equity risk premium.

an overvaluation of the company. This, in turn, could result in overinvestment by that company. In our sample, this situation occurs in Switzerland. Conversely, overestimation of the cost of equity leads to the undervaluation of a company.

For fourteen of the fifteen countries we considered, it made a difference for at least 5% of the sample companies whether the ICAPM or local CAPM was used. Remarkably, this was not the case for China, where only 1.9% of the sample companies had errors that were significantly different from zero. We ascribe this to the segmentation of the Chinese capital market in general and the overrepresentation in our sample of small Chinese stocks, which are likely to be more segmented, in particular.

As a robustness check we extended the international pricing model by adding the Fama-French factors. Since we only have data on the Fama-French factors for North America and Europe, we could not perform this analysis for all countries. However, for the majority of the countries for which we did have that data, there is a slight increase in the number of companies for which the cost of equity differs significantly when the local model is used even though the global model applies when that data is added in. Therefore, we conclude that our results are robust for this more general specification.

2. Capital Market Integration and the Cost of Equity

Stulz (1995) assumes integration of capital markets throughout his analysis of the difference in cost of equity when using a local versus a global market index. He argues that the internationalization of capital markets has made the use of the local CAPM inappropriate, especially for small countries. In the twenty years that have passed since Stulz published his findings, the globalization of the world economy has only accelerated, as reflected for instance by the increasing prominence of emerging markets in the world.

There is much academic research focusing on market integration in general and the developments in the emerging markets in particular. According to Bekaert et al. (2011), the domestic markets of developed countries were integrated with global markets as of 1993, although emerging markets are still segmented. This segmentation of emerging markets persists despite an increase in capital flows to emerging markets throughout the 1990s (Bekaert & Harvey, 2003). The authors link this increase in capital flows to the liberalization of capital markets in emerging markets.

Carrieri et al. (2013) start with a theoretical approach to integration, which was developed by Errunza and Losq (1985), drawing a distinction first between integrated and segmented markets and subsequently within segmented markets between investable and non-investable securities. The former are securities in which international investors can invest, while the latter are isolated from international investors. Markets with securities shielded from foreign investors are not fully integrated with world capital markets. Therefore, these segmented securities have a global market risk premium and a local risk premium, whereas integrated securities only have a global risk premium. An example of such a situation is China, where A shares are only available to domestic investors, while B shares can be acquired by both domestic and international investors.

When they compare their model with the data, Carrieri et al. (2013) show that the markets of developed economies are integrated with international capital markets. Furthermore, in emerging markets, stocks that are accessible to all investors are integrated with capital markets and hence only have global market risk. However, stocks that are not accessible to all investors have not only global market risk, but also local market risk. Whether emerging markets in the aggregate are characterized more as integrated or segmented then depends on the relative importance of accessible versus non-accessible stocks. Nevertheless, there appears to be consensus that the segmentation of emerging markets is decreasing over time (Bekaert & Harvey, 2003; Carrieri et al., 2013).

Despite evidence that capital markets are becoming increasingly integrated, there are still barriers to integration. Bekaert and Harvey (2003) distinguish between three types of barriers: legal, indirect, and emerging-market specific. Legal barriers make it difficult or unattractive for foreign investors to invest in a country. These include such things as restrictions on foreign ownership or additional taxes for foreigners. Indirect barriers refer to differences in the level of information available to domestic and foreign investors, unfamiliar accounting standards, and limited protection for small investors. This is corroborated by Carrieri et al. (2013), who point specifically to the quality of information, the institutional environment, and corporate governance standards as factors hindering the integration of emerging markets. A theoretical exposition of how the expropriation of outsiders (including foreign investors) by corporate insiders and sovereign states leads to segmentation is provided by Stulz (2005). Finally, emerging markets have specific risks related to liquidity, political, and economic policy. In sum, it is safe to assume that financial market integration is justifiable for developed countries. For emerging markets, however, although they are increasingly integrated with world capital markets, there still remain barriers to integration. This should be kept in mind when we interpret our empirical results.

3. Methodology

Similar to Stulz (1995), we use the CAPM of Grauer, Litzenberger, and Stehle (1976), in which the market factor is the only factor in the asset pricing model. In this model, purchasing power parity is assumed and therefore exchange rate risk is not priced. It is possible to extend the model to the Solnik-Sercu model (Sercu, 1980; Solnik, 1974a), which allows for exchange rate risk to be priced. For our purposes, however, since it is unclear whether exchange rate risk is priced or not (Bekaert & Hodrick, 2009, pg. 451), we will use the simple CAPM model.[3]

Let R_i be a vector of length T of total returns in U.S. dollars on individual stocks i $\in \{1, \dots, \mathrm{N}\}$. R_G is a vector of returns on a global equity market index, measured in U.S. dollars. The ICAPM can be written as

$$E[R_i] = \alpha_{G,i} + \beta_{G,i} E[R_G]. \tag{1}$$

We choose the CAPM representation that includes the riskless interest rates in the $\alpha_{G,i}$ term. This representation of asset prices is the maintained hypothesis throughout the paper.

The local CAPM model is similar to Equation (1), with the global equity market index replaced by a domestic one, written as R_L. The local CAPM is given by

[3] Dumas and Solnik (1995) show that the exchange rate risk for Germany, the U.K., Japan, and the U.S. is priced, while Griffin and Stulz (2001) conclude that exchange rate shocks have only a small impact on stock returns. For an excellent overview of alternative asset pricing models in international financial markets, we refer readers to Karolyi and Stulz (2003).

$$E[R_i] = \alpha_{L,i} + \beta_{L,i} E[R_L]. \tag{2}$$

Similarly, $\alpha_{L,i}$ incorporates the riskless rate terms.

The empirical counterparts of Equations (1) and (2) are given by

$$R_i = \alpha_{G,i} + \beta_{G,i} R_G + \varepsilon_{G,i}. \tag{3}$$

and

$$R_i = \alpha_{L,i} + \beta_{L,i} R_L + \varepsilon_{L,i}. \tag{4}$$

respectively. Here, the ε's have been added to Equations (1) and (2).

We note that the global CAPM model should also hold for the return on the local index, R_L; that is,

$$E(R_L) = \alpha_{G,L} + \beta_{G,L} E(R_G). \tag{5}$$

Inserting the empirical counterpart of this expression into Equation (4), we get

$$\begin{aligned} R_i &= \alpha_{L,i} + \beta_{L,i}\left(\alpha_{G,L} + \beta_{G,L} R_G + \epsilon_{G,L}\right) + \varepsilon_{L,i} \\ &= \alpha_{L,i} + \beta_{L,i}\alpha_{G,L} + \beta_{L,i}\beta_{G,L} R_G + \beta_{L,i}\epsilon_{G,L} + \varepsilon_{L,i} \end{aligned} \tag{6}$$

If the CAPM holds, $\varepsilon_{G,L}$ is orthogonal to R_G and Equations (3) and (6) are equivalent if and only if the local idiosyncratic risk, $\varepsilon_{L,i}$, is orthogonal to R_G. In that case, the parameters of Equations (3) and (6) corresponding to the risk factors should be equal, such that

$$\beta_{G,i} = \beta_{L,i}\beta_{G,L}. \tag{7}$$

To test for orthogonality between $\varepsilon_{L,i}$ and R_G, we consider the following regression equation:

$$\varepsilon_{L,i} = \alpha_{\varepsilon} + \kappa_i R_G + \eta_i, \tag{8}$$

where κ_i is the parameter for the global index. In the bivariate case with only one independent variable, the regression anatomy formula presented in Angrist and Pischke (2009, pg. 27), which they ascribe to Frisch and Waugh (1933), implies:

$$\kappa_i = \frac{Cov(\varepsilon_{L,i}, R_G)}{Var(R_G)} = \frac{E(\varepsilon'_{L,i} R_G)}{Var(R_G)}, \quad (9)$$

where the second equality holds because $E(\varepsilon_{L,i}) = 0$.

When markets are integrated, $\varepsilon_{L,i}$ is orthogonal to R_G and the numerator equals 0, and so κ_i is equal to 0.

If these equations hold, the part of the return not accounted for by the local index (i.e., $\varepsilon_{L,i}$) is orthogonal to the global index, which means that the global index cannot explain the return development of asset *i* any better than the local index. This would imply that no error is made by using the local instead of the global CAPM and thus the pricing error equals zero. This is our null hypothesis.

To test for differences in the cost of equity when using the local versus the global index, we insert Equation (8) into Equation (4) to arrive at

$$R_i = \alpha_{G,L,i} + \beta_{L,i} R_L + \kappa_i R_G + \eta_i. \quad (10)$$

We use a t-test to test whether the coefficient for the global index, κ_i, is equal to zero. This will be tested per company.

The derivations above are based on the assumption that capital markets are integrated. At the end of Section 2, we concluded that this is a valid assumption for developed countries but not for developing ones. Caution is therefore advised in applying the aforementioned framework to emerging markets. Intuitively, the more segmented markets are, the more important local factors will be in explaining a firm's stock return, and hence the more likely it will be that the global factors will not add much information. Therefore, the local factor, R_L, will explain much of the firm's stock return for a company segmented from world markets. This implies that the global factor, R_G, will be less relevant and hence the corresponding coefficient κ will often be close to zero. The results are presented and discussed later in the paper, where we focus first on the statistical significance of the difference between using the local CAPM versus the ICAPM (Section 5.1), before assessing whether this difference is also economically significant (Section 5.2).

4. Data

In our sample, we consider the world's thirteen largest economies (not including Italy), plus the Netherlands and Switzerland. Italy was left out of the sample because we did not have access to the index constituents of the past, and the latter two countries were included because Dutch and Swiss multinational companies sell a large share of their products abroad (Jacquillat & Solnik, 1978). This amounts, then, to eleven developed countries and the BRIC countries. The starting point for the selection process in choosing the companies per country was the major index in that country, whereby we identified all of the constituents (i.e., every company that appeared at least once in the index from 1980 to 2015) and used this as our sample of firms.[4] In addition to our sample of firms, we also collected data on the local market indices from the sample countries and the global market index.[5] Share prices and market indices are recorded at a monthly frequency from Datastream, and dividends are reinvested. In the rest of the paper, we focus on the period from January 1996 to June 2015. Our time period starts a few years after developed markets were considered fully integrated with global markets (i.e., 1993, the date given by Bekaert et al. [2011]).

A complete overview of the data and the sources can be found in Appendix A. Data on exchange rates have been taken from either FRED[6] or Datastream.

At this point, it is important to mention that throughout this paper, we adopt the perspective of a U.S. investor. Consistency therefore requires that all returns be converted into U.S. dollar returns. It was not possible, however, to download the local MSCI index for Russia or China in U.S. dollars. To overcome this problem, we converted both of those indices, which were initially denominated in the local currencies, into U.S. dollar amounts using our exchange rate data.

[4] For Australia, we could only download the constituents for May and June 2015.
[5] The local market for Russia starts on May 1, 1996.
[6] Federal Reserve Economic Data, Federal Reserve Bank of Saint Louis, https://research.stlouisfed.org/fred2/.

Table 1 contains an overview of the stocks in our sample.

Table 1. The second column contains the number of companies per country in the raw dataset that had at least one observation in the period 1996-2015. Columns 3, 4, and 5 contain the number of companies listed for the periods 1996-2015, 1996-2005, and 2006-2015, respectively. In the third to fifth columns, companies have been excluded for which one of the following applies: 1) there are not at least 12 observations; 2) stock returns are equal to zero for more than 20% of the observations; or 3) the average annual return is over 200%.

	# sample stocks	# sample stocks 1996 – 2015	# sample stocks 1996 – 2005	# sample stocks 2006 – 2015
Australia	332	326	272	266
Canada	538	530	443	474
France	242	238	207	192
Germany	1,010	985	857	780
Japan	209	207	195	205
The Netherlands	58	57	47	52
South Korea	200	114	82	132
Spain	71	69	58	63
Switzerland	76	76	66	76
United Kingdom	1,869	1,819	1,570	1,122
United States	1,033	1,013	954	774
Brazil	111	109	69	109
Russia	90	88	30	89
India	74	74	62	74
China	1,706	1,603	567	1,596
Total	7,657	7,345	5,509	6,041

Under Column 2, we report the number of stocks per country, as determined by taking all of the companies included in the country's major stock exchange (see Column 2 of Table 6 for these indices) between 1980 and 2015 that have *also* had at least one stock return in the period 1996-2015.[7]

Next, we imposed the following restrictions on this raw dataset. First, we required that there be at least twelve monthly observations for each company. Second, over the period for which the stocks are listed, each company

[7] In the first step, we used the constituents of the index to identify companies that had at one point been listed from 1980 to 2015. We then excluded companies which had been delisted before the start of our sample period, i.e., 1996. For example, a company which was in the index in 1985 but delisted in 1988 was excluded from the sample, whereas one that was in the index in 1985 but delisted in 1997 was included.

must have had fewer than 20% zero-return observations. Third, the average annual return must not exceed 200%.[8] The number of companies satisfying these conditions is shown in Column 3 of Table 1.

In Columns 4 and 5, we restrict the full sample to stocks that had a listing in 1996-2005 and 2005-2015, respectively. The number of companies in Columns 4 and 5 is lower or equal to the number in Column 3 as a result of delistings and new listings from 1996 to 2015. The restrictions mentioned previously were also applied to the two ten-year subperiods.

We point to two patterns in Table 1. First, there were many new listings in the BRIC countries from 1996 to 2015. This can be inferred from the difference between Columns 3 and 4. Moreover, only a few companies were delisted in this period, as inferred from the difference between Column 5 and Column 3.[9] This is a reflection of the development of these countries' capital markets in this period.

Second, for the developed economies, a considerable number of companies were delisted during the first subperiod. This is particularly true for the U.K. and the U.S., where 38% and 23%, respectively, of the companies listed at one point during the 1996-2015 period were delisted. This is confirmed by the World Development Indicators (WDI) from the World Bank (see http://data.worldbank.org/indicator/CM.MKT.LDOM.NO?view=chart), which show a peak in listings in 1996 for the U.S. and in 2006 for the U.K.[10]

5. Results

The results section comprises three subsections. We first test whether there are statistical differences in the cost of equity when we use the local CAPM even though the ICAPM applies. Next, we assess how large the

[8] To arrive at the average annual return, we took the monthly mean return plus one to the power of twelve minus one, $R_{annual} = (1 + \overline{R_{month}})^{12} - 1$. In cases where this number exceeded 2 (200%), the company was excluded from the sample.
[9] A comparison of these columns does not give an exact number of new listings and delistings, due to the restrictions applied on each individual period.
[10] For a discussion about the reasons why the U.S. lags behind in terms of company listings, see Doidge, Karolyi, and Stulz (2015).

differences in the cost-of-equity levels are, whereby we make a distinction between companies with or without a statistically different cost of equity. Finally, we graphically depict the direct and indirect betas.

5.1 Difference in Cost of Equity

In this section, we assess whether the cost of equity differs significantly when we use the single factor ICAPM versus the local CAPM. In Table 2, we present the rejection rates for the single factor ICAPM per country. Rejection takes place when κ from Equation (10) is significantly different from zero. This means that in these cases, the cost of equity using the ICAPM is significantly different from that when using the local CAPM. The rejection rate is the number of rejected sample companies in a country in relation to the total number of sample companies in that same country. For each country, we consider the full time period, 1996-2015, and the two subperiods, 1996-2005 and 2006-2015, which both cover 10 years. In estimating the regression equations, we account for heteroskedasticity.

Table 2. The percentage of rejection compared to the total number of companies in our sample per country per time period for the single factor ICAPM. Rejection occurs when the coefficient of the global market in Equation (10) is significantly different from zero. A t-test is applied to test this hypothesis.

	1996 – 2015	1996 – 2005	2006 – 2015
Australia	17%	14%	16%
Canada	24%	11%	25%
France	11%	8.7%	14%
Germany	10%	10%	7.4%
Japan	34%	27%	26%
The Netherlands	26%	17%	21%
South Korea	7.0%	7.3%	16%
Spain	19%	14%	24%
Switzerland	63%	42%	49%
United Kingdom	19%	20%	15%
United States	15%	14%	15%
Brazil	22%	7.3%	19%
Russia	11%	0%	11%
India	11%	6.5%	18%
China	1.9%	3.2%	2.4%

First, focusing on the full period, we conclude that of the developed countries all have rejection rates above 5%. This means that the cost of equity changes significantly when the local CAPM is used despite applicability of the ICAPM, that is, comprising between 7.0% to 63% of companies depending on the country. Moreover, we see that the rejection rates for the subperiods are in line with the rates for the full period. The most extreme case is Switzerland, where 63% of the companies in the full period show a significant change in the cost of equity. This is consistent with the results of Jacquillat and Solnik (1978), who document a large increase in explaining Swiss stock returns when other market indices are added to the Swiss index. We must keep in mind, however, that Jacquillat and Solnik (1978) was written 40 years ago and the lack of capital market integration back then, in particular, might have had a material impact on their results. In sum, we conclude that whether or not the local CAPM is used even though the ICAPM applies often makes a difference in the computation of the cost of equity.

Second, China is an anomaly in the sense that its rejection rate is the lowest of all of the countries (both developed and emerging). Moreover, the rejection rate remains below 5.0% in the two subperiods. Comparing China to the other BRICs, we see that its rejection rates are generally lower, especially for the full period and the second subperiod. Hence, there seems to be something special about China. From the market integration section, we know that emerging markets are less integrated in general than developed markets. Although this argument applies for all emerging markets, and not just China, it is more relevant for China than for others for two reasons. First, many Chinese companies are not accessible to foreign investors, and second, these non-accessible companies are less integrated with world capital markets than the non-accessible companies of the other BRICs (Carrieri et al., 2013). For companies which are less integrated with the world market, the local index contains the most relevant information, resulting in low rejection rates (see Equation (10)).

Third, the zero rejection rate for Russia in the first subperiod is peculiar. However, we need to treat this percentage with care, because it is based on only 30 companies, for which firm-level stock returns were only available in 55% of the months on average.

Finally, the rejection rates for the full period are either in between the rates for the two subperiods or higher than both. There are two dynamics at work here. On the one hand, combining the two subperiods into one full period averages the rates over both subperiods. On the other hand, the number of observations per company is higher for the full period than for individual subperiods, leading to an increase in the power of the t-test.

Hence, for countries where the rejection rate is higher for the full period than for the subperiods, the latter effect is strongest, while for the others, the former effect dominates.[11]

5.2 Size of Difference in Cost of Equity

In the second part of this section, we want to assess the size of the difference in cost of equity when the local CAPM is used even though the ICAPM applies. To quantify the size of the mistake at issue, we rewrote Stulz's Equation (5) (1995) and inserted the parameter estimates for the betas, which yielded the following equation:

$$\frac{\hat{R}_{i,G} - \hat{R}_{i,GL}}{E(R_G) - r_f} = \hat{\beta}_{G,i} - \hat{\beta}_{L,i}\,\hat{\beta}_{G,L}, \tag{11}$$

where $E(R_G)$ is the expected return on the global index in U.S. dollars and r_f the riskless rate earned on U.S. T-bills. We use U.S. dollar returns and U.S. T-bills because we assume the perspective of a U.S. investor. In other words, $E(R_G) - r_f$ is equal to the equity risk premium (ERP) of the global index in U.S. dollar returns. Table 3 lists the absolute difference in cost of equity relative to the risk premium for each country when the local CAPM is used despite applicability of the ICAPM: in other words, the values from Equation (11). We computed this relative difference in cost of equity for both "Reject" and "Non-reject" companies. Reject companies are the ones for which the difference in cost of equity is statistically significant, while Non-reject refers to companies for which this difference is insignificant (see Section 5.1).

Table 3. The absolute average difference relative to the risk premium per country when the local CAPM is used even though the ICAPM applies. Companies for which this difference was statistically different (i.e., designated as "Reject") were considered separately from companies for which the difference was insignificant (i.e., "Non-reject"). These terms refer to rejection or non-rejection of the null hypothesis. The countries and two categories are listed in the first column. The figures presented in the second column were calculated as the

[11] This reasoning applies when the set of companies in the different time periods is the same. Since newly listed companies enter the set and delisted companies leave, the set changes. This explains how the rejection rate of South Korea and China for the full period could be lower than for either subperiod.

difference in the direct and indirect betas (see Equation 11). We used the parameter estimates for the full period, 1996-2015. The unweighted average of all the countries is presented in the bottom rows.

	Difference
Australia	
Reject	41%
	14%
Non-reject	
Canada	35%
Reject	17%
Non-reject	
France	
Reject	27%
Non-reject	10%
Germany	
Reject	37%
Non-reject	14%
Japan	
Reject	27%
Non-reject	10%
The Netherlands	
Reject	35%
Non-reject	15%
South Korea	
Reject	38%
Non-reject	15%
Spain	
Reject	36%
Non-reject	13%
Switzerland	
Reject	27%
Non-reject	9.3%
United Kingdom	
Reject	37%
Non-reject	26%
United States	
Reject	15%
Non-reject	12%
Brazil	
Reject	33%
Non-reject	9.9%
Russia	
Reject	46%
Non-reject	19%
India	
Reject	33%
Non-reject	12%
China	
Reject	63%
Non-reject	22%

Average	
Reject	35%
Non-reject	15%

Not surprisingly, we see across the table that the difference in cost of equity is larger for reject than for non-reject companies. This difference is almost 2.5 times larger, on average, for the former group compared to the latter, as can be inferred from the final rows of the table.

To quantify the mistake in cost of equity when the local CAPM is used despite applicability of the ICAPM, the numbers in Table 3 must be multiplied by the equity risk premium (ERP). Table 4 contains ERPs for three different time periods; these have been taken from the Credit Suisse Global Investment Returns Yearbook 2016 (Credit Suisse, 2016, pg. 61), updating the data composed by Dimson, Marsh, and Staunton (2009).

Table 4. The equity risk premium (ERP) on the global market portfolio for a U.S. investor for three periods.

Period	ERP
1900-2015	4.2%
1966-2015	4.1%
2000-2015	2.0%

(Source: Credit Suisse Global Investment Returns Yearbook, 2016, pg. 61)

Using the ERP for the 1900-2015 period, the average cost of equity is either under- or overestimated (because the values are absolute, we cannot distinguish between these cases in this analysis) by 35% x 4.20% = 1.49% for the reject companies and 15% x 4.20% = 0.61% for the non-reject companies. The overall under- or overestimation, that is, without taking the reject and non-reject companies into separate consideration, is equal to 18% x 4.20% = 0.77%. Since this value is much closer to the value of the non-reject companies, this reflects the larger presence of non-reject companies in our sample (see Table 2). Note that our results indicate that at the company level, for example, there is a risk of over- or underinvestment due to under- or overestimation of the cost of equity.

Finally, we would like to compare our results for Nestlé with those of Stulz (1995). The mistake he reported for Nestlé was equal to -0.60%, while in our case it is equal to between -0.27% and -0.13%, depending on which risk premium from Table 4 we use. Moreover, this difference is not significantly different from zero. We therefore conclude that for Nestlé, the overestimation of riskiness has decreased in the last twenty years.[12] This implies, for this particular case, that when the local CAPM was used, the undervaluation of the stock price was lower than before. In addition, overinvestment due to an underestimation of the discount rate has become less of a concern. In other words, the amount of risk that is diversifiable globally but not locally decreased over time in Nestlé’s case.

[12] Even if we had used the risk premium of 6.22% that Stulz (1995) uses, the difference would be -0.40%, which is still lower than the difference reported in Stulz (1995).

5.3 Illustration of Difference in Cost of Equity

To illustrate the differences in cost of equity when the local CAPM is used despite ICAPM applicability, Figure 1 graphically depicts the direct and indirect betas per company for the 1996-2015 period. The results are presented per country.

Each dot in the graph represents a company. In cases where there is no difference in the cost of equity using the ICAPM versus the local CAPM, and hence a company is not rejected, the following equality (see Equation (7)) should hold:

$$\beta_{G,i} = \beta_{L,i}\beta_{G,L}.$$

In the figures, the x-coordinate is the estimate for the direct beta (i.e., $\widehat{\beta_{G,\iota}}$) and the y-coordinate is the estimate for the indirect beta (i.e., $\widehat{\beta_{L,\iota}}\widehat{\beta_{G,L}}$). In general, a pricing error is small when a dot is close to the 45˚ line; conversely, the pricing error is large when a dot is far from the line.

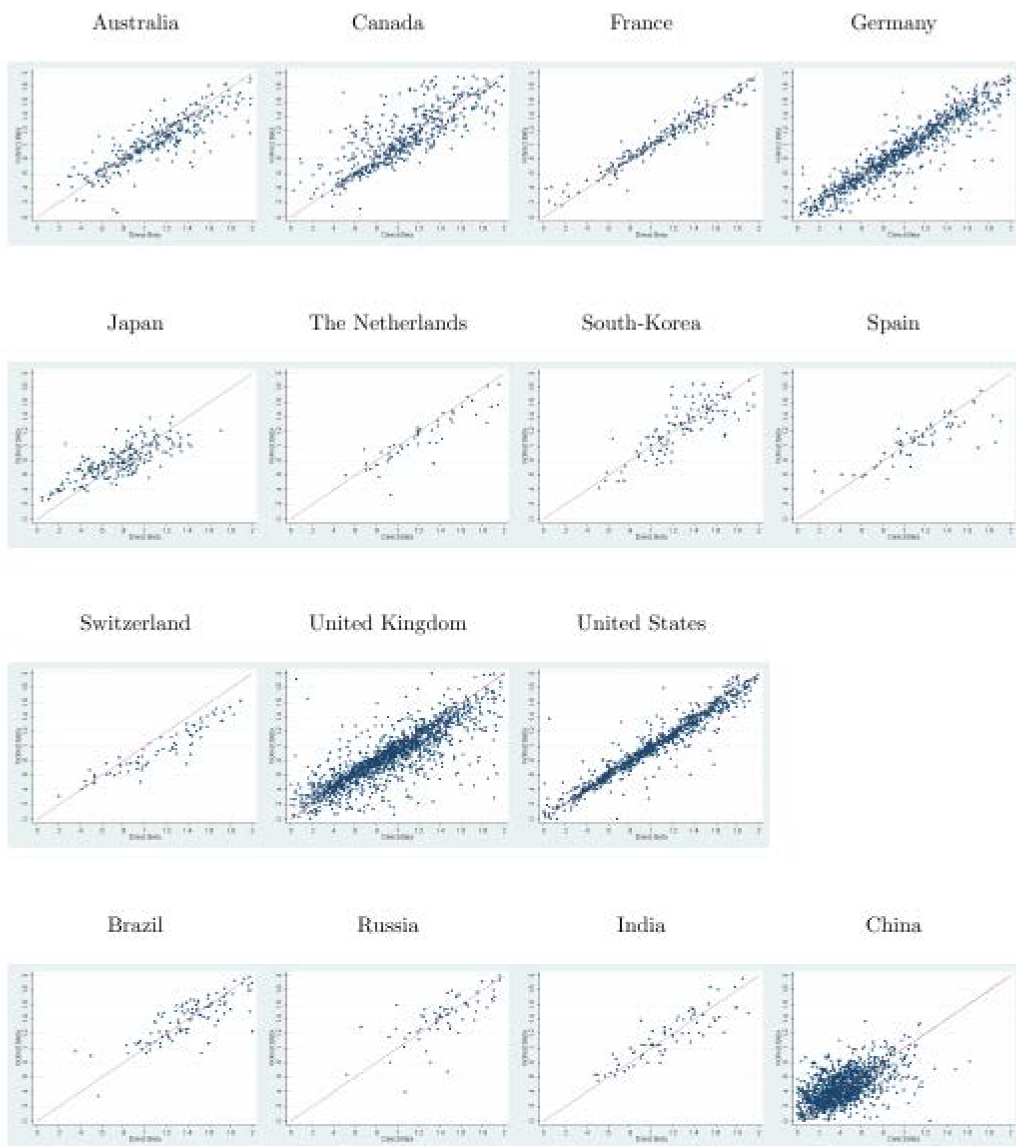

Figure 1. Graphical representation of the direct versus the indirect beta for the countries in our sample for the CAPM with the market factor only. The direct beta is the beta estimate obtained by regressing the company stock return on the global market return. The indirect beta is the product of the beta estimate obtained by regressing the company stock return on the local market return multiplied by the beta estimate obtained by regressing the local market return on the global market return. The graphs cover the 1996-2015 period.

Before discussing individual countries, we would like to first discuss how to interpret the graphs. Stulz's Equation (11) (1995) states that the market-value weighted-average difference in cost of equity when using the local CAPM versus the ICAPM equals zero. Note that this equality only holds when market indices include all stocks and their weight in the index is weighted with market value. Although the latter condition has been satisfied, since we only consider MSCI indices and those use market weighting, the former condition is violated.

Nevertheless, this does not seem to result in large distortions in our sample, since the dots in the graphs are generally well situated around the 45˚ line. Differences in cost of equity may occur for individual stocks, however, as can be concluded from the large distance to the line for some of the dots. For these companies, a large error is introduced when the local CAPM is used instead of the ICAPM. The placement of the dots above or below the line determines whether the cost of equity is over- or underestimated. Dots situated below the line have a higher cost of equity when using the ICAPM versus the local CAPM, and vice versa. In other words, for this group, risk that is diversifiable locally is not diversifiable globally. The opposite holds for dots situated above the line: risk that is diversifiable globally is not diversifiable locally. Note that overestimation—dots above the line—leads to an undervaluation of the company or to underinvestment by the company. Conversely, underestimation—dots below the line — leads to overvaluation or overinvestment by the company.

To clarify the interpretation of the graph, we discuss the case of Switzerland. The companies listed in that country are almost exclusively located below the line. This implies an underestimation of the cost of equity when the local CAPM is used even though the ICAPM applies. In other words, these companies are exposed to risk that is diversifiable locally and not globally. Knowing that the market-value weighted-average of the differences for each country should be equal to zero, the subsample of Swiss firms we consider is not representative, because the companies are all below the line. Hence, the returns of Swiss firms in our sample are more correlated with the world market than with the local market. A possible explanation for this could be that these firms are more internationally oriented and operate more globally. Alternatively, from an investment perspective, the underestimation of the cost of equity for these Swiss sample companies suggests an overvaluation of their stock. Therefore, if an investor believes in the applicability of the ICAPM and expects market participants to adopt the same belief, they should short or underweight the Swiss sample companies in their portfolio.

Second, we look at the position of the dots along the 45˚ line. We focus first on Brazil and Russia, and then on China, because the dots in these graphs are more clustered near specific beta values. The Brazilian and Russian companies are congregated in the upper right corner, while Chinese companies are grouped in the lower left corner. To explain the position of the dots in these cases, we use a company's indirect beta. This is the product of the company's beta in relation to the local market multiplied by the local market's beta in relation to the global market. Assuming that we have a representative sample of companies for a country and that the local market *index* represents the local market, we know that the companies within a country have a weighted average beta that should be around one when the company return is regressed on the local index. In that case, the clustering of indirect betas in certain regions of the graph is due to a high or low beta for the local index in relation to the world index. This beta can be written as follows:

$$\beta_{G,L} = \frac{Cov(R_L,R_G)}{Var(R_G)} = \frac{\rho_{L,G} \cdot \sigma_L}{\sigma_G}, \tag{12}$$

where L and G denote local and global, respectively, and $\rho_{L,G}$ the correlation between the return on the local and the global index. Since the volatility, σ_G, of the global market is the same for all countries, low betas are a result of either low volatility in the local index or a low correlation between the local and the global market.

For Brazil and Russia, many of the dots are clustered in the upper right corner of the graph. In Brazil's case, this can be explained by a combination of a not-so-low correlation between the Brazilian market and the world market, at 0.72 (the average for all the countries is 0.76), and a relatively high domestic volatility of 0.107 (the average for all the countries is 0.078). For Russia, the high volatility of the domestic market, by far the largest in the sample, at 0.159, explains the position of the Russian firms in the graph.

The volatility of the local Chinese market and the correlation between the local market and the world market are equal to 0.101 and 0.52, respectively. Inserting these numbers into Equation (12) produces a $\beta_{G,L}$ for China of 1.1, which is the ninth highest score of the fifteen countries we consider. Hence, this beta cannot explain the position of the dots in the bottom left corner. Recalling that the indirect beta is the product of $\beta_{G,L}$ and $\beta_{L,i}$, the explanation might be found in the latter. Using the same decomposition as in Equation (12), but now for $\beta_{L,i}$, yields:

$$\beta_{L,i} = \frac{\rho_{i,L} \cdot \sigma_i}{\sigma_L}, \tag{13}$$

where $\rho_{i,L}$ is the correlation coefficient between the return of company i and the local market and σ_i the volatility of the return of company i. The average $\rho_{i,L}$ for the Chinese companies is 0.19, which is considerably less than the average of 0.53 for the rest of the countries (i.e., excluding China). Hence, the Chinese companies in our sample are much less correlated with their local market (i.e., the MSCI China indices). The explanation for this is that the Chinese sample companies are not well represented in the MSCI China indices.[13]

6. Robustness

Up until this point, we have only used an international version of the CAPM, that is, we have only used the market index as a regressor. We now want to extend this model to include the other Fama and French (1993) factors, to wit, High Minus Low (HML) and Small Minus Big (SMB). Before presenting those results, we must first generalize the derivation from Section 3 to this setting. The International CAPM, Equation (3), then changes to

$$R_i = \alpha_{G,i} + Z_G\beta_{G,i} + \varepsilon_{G,i}, \tag{14}$$

where Z_G consists of the *global* Fama-French factors (R_G, HML_G, and SMB_G, respectively) and $\beta_{G,i}$ contains the corresponding global factor coefficients.

Analogously, the local CAPM, Equation (4), becomes

$$R_i = \alpha_{L,i} + Z_L\beta_{L,i} + \varepsilon_{L,i}, \tag{15}$$

where Z_L contains the *local* Fama-French factors (R_L, HML_L, and SMB_L, respectively) and β_{Li} the local coefficients.

We note that the International CAPM model should also hold for the return on the local index, R_L, that is,

[13] At first, we wanted to collect sample companies for all countries using the constituents of the local MSCI indices. Since we did not have access to these constituents, however, we relied on the constituents of other well-known local indices, e.g., in the case of China, the Shanghai Stock Exchange (SSE) (see Appendix A).

$$E(R_L) = \alpha_{G,L} + E(Z_G)\beta_{G,L}. \tag{16}$$

Inserting the empirical counterpart of this expression into Equation (15) and replacing Z_G and Z_L by their components (i.e., the global and local Fama-French factors) yields:

$$\begin{aligned} R_i = {} & \alpha_{L,i} + \beta_{L,i,1}\left(\alpha_{G,L} + \beta_{G,L,1}R_G + \beta_{G,L,2}HML_G + \beta_{G,L,3}SMB_G + \varepsilon_{G,L}\right) \\ & + \beta_{L,i,2}HML_L + \beta_{L,i,3}SMB_L + \varepsilon_{L,i} \\ = {} & \alpha_{L,i} + \beta_{L,i,1}\alpha_{G,L} + \beta_{L,i,1}\beta_{G,L,1}R_G + \beta_{L,i,1}\beta_{G,L,2}HML_G + \beta_{L,i,1}\beta_{G,L,3}SMB_G \\ & + \beta_{L,i,2}HML_L + \beta_{L,i,3}SMB_L + \beta_{L,i}\varepsilon_{G,L} + \varepsilon_{L,i} \end{aligned} \tag{17}$$

where $\beta_{G,L,1}$ indicates the coefficient corresponding to the first regressor, R_G, of Equation (16) and $\beta_{L,i,1}$ the coefficient corresponding to the first regressor of Equation (14), R_L.

When the model presented in Equation (14) holds, $\varepsilon_{G,L}$ is orthogonal to Z_G and Equations (14) and (17) are equivalent if and only if local idiosyncratic risk, $\varepsilon_{L,i}$, is orthogonal to the global factors, Z_G, and $\beta_{L,i,2}$ and $\beta_{L,i,3}$ are equal to zero. To test whether $\varepsilon_{L,i}$ is orthogonal to the global factors, we consider the following equation:

$$\varepsilon_{L,i} = \alpha_\varepsilon + Z_G\kappa_i + \eta_i. \tag{18}$$

Inserting Equation (18) into (15) then yields the generalization of Equation (10):

$$R_i = \alpha_{G,L,i} + Z_L\beta_{L,i} + Z_G\kappa_i + \eta_i. \tag{19}$$

Finally, we then apply an F-test per company to test whether

$$\beta_{L,i,2} = \beta_{L,i,2} = \kappa_{i,1} = \kappa_{i,2} = \kappa_{i,3} = 0, \tag{20}$$

where $\kappa_{i,1}$, for example, represents the first coefficient of the coefficient vector κ_i. When either of these coefficients differs significantly from zero, the cost of equity using the global model differs significantly from the cost of equity using the local model.

We performed this analysis for the full period, 1996-2015, for the countries for which the local Fama-French factors were available. We obtained the global and local SMB and HML factors from the website of Kenneth French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/). The results are presented in Table 5.

Table 5. Percentage of rejection from the total number of companies in our sample per country for the full time period for the international pricing model when we include Fama-French factors. Rejection occurs when one of the coefficients of Equation (19) is significantly different from zero. An F-test is applied to test this hypothesis.

	1996 – 2015
Canada	26%
France	17%
Germany	10%
The Netherlands	28%
Spain	28%
Switzerland	51%
United Kingdom	22%
United States	21%

Comparing these results with the results for the ICAPM presented in Table 2, the only decrease evident is for Switzerland, while the rejection rate for Germany remains equal. For the remaining six countries, there is an increase in rejection rates. Since we tested for five composite hypotheses in this case (see Equation (20)), compared to only one when using the ICAPM, the chances of rejection ceteris paribus increase. In short, we conclude that adding Fama-French factors most often increases the likelihood of rejection.

7. Conclusion

In this paper, we reassessed the cost of equity in international capital markets. We determined that for the 1996-2015 period, the error introduced when a local CAPM is used even though the ICAPM applies is, on average, equal to 0.77%. In terms of the historical global market risk premiums, this represents 18%. In addition to this economic significance, we document statistical significance for 19% of the companies; that is, for these companies the mistake is statistically distinct from zero. When we restrict the sample to companies for which the difference is statistically different, the error jumps to 1.49%, thereby representing 35% of the historical risk premium. Therefore, the ICAPM is increasingly becoming the relevant model to determine the cost of equity.

We discussed two implications of wrongly estimating the cost of equity: the valuation of the company and the decision to invest. Firstly, overestimation of the cost of equity implies that the rate by which dividends are discounted to arrive at stock price will be too high. The company will thus be undervalued. The opposite holds true for an underestimation of the cost of equity. Secondly, underestimation might lead a company to overinvest, since it wrongly believes that projects are profitable enough when in reality they are not. Again, conversely, overestimation leads to underinvestment.

Among the countries we consider, China presents a special case. The difference in the cost of equity between the two models is significant for only 1.9% of the Chinese companies in the full sample. We ascribe this to a lack of integration on the part of the Chinese stock market, which is predominantly relevant for the small Chinese companies we consider. The results for the other BRICs are more in line with those of the developed countries.

When we extended the model with Fama-French factors, the rejection rates increased slightly for the majority of the countries. We therefore conclude that our results are robust for this more general specification.

A. Appendix

Table 6. Data types and data sources per country. Column 2 lists the indices from which the constituents from 1980 to 2015 were selected as the stocks in our sample. Stock prices are from Datastream. Exchange rates (Column 3) are either from FRED or Datastream. The corresponding Datastream code is listed in Column 4. Local market indices are the national MSCI market indices, and the global index is the World MSCI index. The prices for all MSCI indices were obtained from Datastream.

A. Appendix

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	Stock prices		Exchange rates		Local Market Index		Global Market Index
	Index	Source	Source	Datastream Code	Index	Datastream Code	Datastream Code
Australia	ASX	Datastream	FRED		MSCI	MSAUSTL	TOTMKWD
Canada	TSX	Datastream	FRED		MSCI	MSCNDAL	TOTMKWD
France	SBF 120	Datastream	Datastream	USEURSP	MSCI	MSFRNCL	TOTMKWD
Germany	CDAX	Datastream	Datastream	USEURSP	MSCI	MSGERML	TOTMKWD
Japan	NIKKEI 225	Datastream	FRED		MSCI	MSJPANL	TOTMKWD
The Netherlands	AEX	Datastream	Datastream	USEURSP	MSCI	MSNETHL	TOTMKWD
South Korea	KOSPI 200	Datastream	Datastream	KOUSDSP	MSCI	MSKOREL	TOTMKWD
Spain	IBEX 35	Datastream	Datastream	USEURSP	MSCI	MSSPANL	TOTMKWD
Switzerland	SIP	Datastream	FRED		MSCI	MSSWITL	TOTMKWD
United Kingdom	FTSE All	Datastream	Datastream	USEURSP	MSCI	MSUTDKL	TOTMKWD
United States	S&P 500	Datastream			MSCI	MSUSAML	TOTMKWD
Brazil	BOVESPA	Datastream	Datastream	TDBRLSP	MSCI	MSBRAZL	TOTMKWD
Russia	RTS	Datastream	Datastream	CISRUB$	MSCI	MSRUSSL	TOTMKWD
India	CNX NIFTY	Datastream	FRED		MSCI	MSINDIL	TOTMKWD
China	SSE Composite	Datastream	FRED		MSCI	MSCHINL	TOTMKWD

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