Vol. 53 No. 1 (Dec, 2016), 111–147

LAJE
LATIN AMERICAN JOURNAL OF ECONOMICS

COST OF CAPITAL IN EMERGING MARKETS: BRIDGING GAPS BETWEEN THEORY AND PRACTICE*

Eduardo Walker**

An important parameter for asset and project valuation is the opportunity cost of the capital invested, which depends on the systematic risks assumed. Having many angles, the existing literature has not fully resolved the issue for emerging markets. The evidence reviewed in this article suggests that we should at least consider exposure to market risk and country credit risk factors. After reviewing the theoretical and applied literature on cost of capital determination and international asset pricing models, the paper identifies and applies methodologies to determine discount rates applicable to emerging markets for different countries and currencies and develops methodologies for empirically measuring exposure to the country credit risk factor.

JEL classifications: G31, G32, G12, G15, G24

Keywords: Cost of capital, emerging markets, market risk, credit risk, currency risk

1. Introduction

This paper studies and develops a methodology consistent with the academic literature and usual practice to estimate the cost of capital for companies and industries based in emerging markets. This issue has not been adequately addressed in literature. For example, there are several international asset pricing models that calculate the returns required for various asset classes (Bekaert *et al.*, 2011), and academic models do not account for the experience of *practitioners* (Abuaf, 2011). Due to this gap, *ad hoc* models are frequently used to determine the additional risk premium that an investor would require in order to invest in emerging markets.

This paper begins by presenting a review of the literature on international asset pricing models, offering also a summary of specific "frequent"

* The author is grateful for the support of CONICYT through the Anillo SOC-04 project. He is especially grateful for the help of Marcos Antonio Cruz Sanhueza on tax issues, the comments of Salvador Valdés, and the comments of two anonymous referees. Any potential errors are purely the author's responsibility.

** School of Management, Pontificia Universidad Católica de Chile, 4860 Vicuña Mackenna, Santiago, Chile. Email: ewalker@uc.cl.

doi 10.7764/LAJE.53.1.111

practices, then develops a method for estimating the exposure to a second risk factor that relates to country risk, in addition to the estimating exposure to the traditional market risk factor or Beta. In some practical applications, sensitivity to a global risk factor is "imported" from sensitivities to similar industries in developed countries. We discuss the method to be used in such applications.

This paper also tackles several closely related issues, such as determining the orders of magnitude of global risk premia, the relevance of using geometric *versus* arithmetic means to estimate such premia from historical data, the effect of taxation regimes in both emerging countries and the investor's own country on how to calculate the tax advantage of debt (or equity in certain cases), and how to convert discount rates between currencies. These issues are illustrated by applying our methodology to several countries and currencies.

2. International asset pricing models: theory and practice

Here we present a review of the financial literature, followed by a discussion of the relevance of using conditional and unconditional models, and then with a review of methods used by "practitioners."

2.1 Academic literature review on international asset pricing

The literature on international asset pricing is extensive, starting with Sercu (1980) and Adler and Dumas (1983). This literature in general extends the CAPM proposed by Sharpe (1964), Lintner (1965), and Mossin (1966) by replacing the local market portfolio with a global one. A partial review of this literature follows, with an emphasis on emerging markets.[1]

The most appropriate pricing models will depend on the extent to which international financial markets are integrated. This will depend, in turn, on the openness of these markets, their transaction costs, and their political stability. Integration implies using a single asset pricing model to determine the cost of capital regardless of the country where the capital asset is priced. We expect the relative importance of local

1. For example, Keck *et al.* (1998) have reviewed the previous literature.

risk factors to have decreased over time, since recent evidence reveals that capital markets are becoming increasingly integrated (Carrieri *et al.*, 2007; Bekaert *et al.*, 2011; Avramov *et al.*, 2012).[2]

For example, Bekaert *et al.* (2011) measured integration as the average difference between the local and global earnings-price ratio for each industry. Using a sample of 20 developed and 49 emerging countries, they found that segmentation declined over time. The *local* segmentation determinants are capital flow restrictions, political risk, and the development of the local stock market. The investment-grade corporate bond spreads in the United States are a *global* segmentation determinant.[3] Meanwhile, Hau (2011) studied integration using a revision of the MSCI ACWI index (in December 2000), as changing the reference index changed the Betas. Assets whose Betas increase (fall) suffer price drops (increases) because the required returns or discount rates change. This study provides direct or causal evidence of integration, showing that it is important to use a global equity portfolio return as the first risk factor.

Previous studies find local risk factors to be relatively more important.[4] In any case, according to Bansal and Dahlquist (2002), these studies would be subject to a "*peso* problem" bias, that could be caused by a lack of credibility with regard to their commitment to keep markets open (or to expropriation risk). After adjusting for this bias, the systematic risk of the international CAPM model (with a single Beta) would explain the differences between countries' expected returns.

Avramov *et al.* (2012) determined that, in addition to exposure to a global market portfolio, exposure to a global credit risk factor (measured as the difference between the equity returns for countries with low and high risk ratings) is significant for explaining the dispersion of

2. Note that integration is not the same as correlation with a global market portfolio. Correlation relates two variables and loses its meaning when there is more than one risk factor. See Pukthuanthong and Roll (2009).

3. A segmentation ranking from highest to lowest for the period 2001–2005 found that Chile is at position 47, for example (from a total of 69, with the United States in the 69th place). Its earnings-price ratio is 1.7 percentage points above that of the U.S., 0.4 percentage points above the average for developed countries, and 1.9 percentage points below the average for emerging countries. Other countries are Argentina (16), Brazil (15), Colombia (31), Ecuador (24), Korea (22), Mexico (45), Peru (30), and Venezuela (3).

4. Rowenhorst (1999) found that risk factors in emerging markets are qualitatively similar to those in developed countries but with a bias toward local factors. Fama and French (1998) found that the return on a global portfolio and a value premium would explain the international cross-section of returns, but Griffin (2001) argued that the explanatory power of the second factor is due to its local component. Karolyi and Stulz (2003) found that using local or international models only implies significant differences for emerging economies. Erb *et al.* (1996) only used an aggregate country credit risk indicator to explain the observed returns. Furthermore, the change in country risk premia would be partially predictable using conditional models for the covariance with the global portfolio return (Ferson and Harvey, 1994; Harvey, 1995).

returns among countries, reducing the errors in international asset pricing models, and underlining the importance of local factors.

Therefore, most of the studies reviewed have identified country credit risk directly or indirectly as a second risk factor. Nevertheless, some studies used exchange rate risk as a second factor.

Indeed, Hodrick and Zhang (2001) and Dahlquist and Sallstrom (2001) found that exposure to exchange rate risks and the global portfolio return explain the cross-section of returns. Zhang (2006) believed that the exchange rate risk premia for developed countries are significant, that there is evidence of integration and that the conditional international CAPM augmented with exchange rate risk shows the best performance. Antell and Vaihekoski (2007) studied Finland against the United States for the period 1970–2004. They found that the global and local risk premia vary over time, with the latter being relevant only for Finland, and that there is a premium for exchange rate risk. Meanwhile, Chaieb and Errunza (2007) found that the deviations with respect to purchasing power parity (PPP) and segmentation are remunerated sources of risk.

In summary, given the evidence of increasing integration, it would be appropriate to use international asset pricing models to determine the cost of capital, with the first risk factor given by the exposure to global equity risk. A second factor should be associated with exchange rate risk or country credit risk.

2.2 Conditional *vs.* unconditional models

Conditional models allow the various parameters used to determine discount rates to vary predictably over time, as do many of the papers summarized above, whereas unconditional models involve relatively constant parameters.

Conditional models have advantages: estimated Betas are not constant and depend on the economic cycle (Zang, 2006); they better capture structural changes in the risk premium (for example, Lettau *et al.*, 2008); the aggregate risk premium would be partially predictable (for example, Lettau and Ludvigson, 2001; Cochrane, 2008; and Campbell and Thompson, 2008), which can only be captured with conditional models; reference interest (risk-free) rates clearly vary over time.

However, according to Simin (2008), there are two very different questions in the literature: one is whether the average returns on the various assets conform to a risk-return model and another is whether these models have out-of-sample predictive power. In order to estimate discount rates, it seems reasonable to conclude that the second question is more important.

Simin (2008) studied the out-of-sample performance of various models using U.S. data, comparing them with simple prediction benchmarks. Specific in-sample conditional models provide the best model fits. However, out-of-sample predictions using these conditional models are weak. He concluded that simple and "parsimonious" models would provide better out-of-sample predictions. The best predictor over one- to five-year time horizons for various portfolios and for all industries is the conditional return of the market portfolio. The best predictor over periods longer than five years is usually the historical simple average. Nevertheless, predicting the risk premium remains a topic for discussion (for example, see Campbell and Thomson, 2008 *vs.* Welch and Goyal, 2008).

2.3 Applied approaches

Damodaran

Damodaran (2003, 2012, 2015) is a standard reference for valuing companies and projects. Therefore, his methods are explained in some detail here.

He argued that if the marginal investor is global (local), the reference portfolio should be global (local). Also, according to this author, the Beta associated with a global portfolio (which is the only relevant risk measure according to the Capital Asset Pricing Model, CAPM) would not be a sufficient parameter for determining asset or project risk in the context of emerging markets. He argued that the total Equity Risk Premium (ERP) for a country is the sum of the risk premium for a Mature Market Risk Premium country (MMERP) plus an additional risk Country Risk Premium (CRP). He recommended using the his so-called "Implied Premium" for the MMERP, which is a conditional estimate based on various *ad hoc* assumptions. The additional CRP does not necessarily correspond to the spread of the corresponding sovereign bonds. A dilemma is how to appropriately estimate the CRP and the exposure of projects to this risk factor.

Damodaran (2015) argued that the CRP can be estimated from the country's Default Spread, from its corresponding Credit Default

Swap (CDS),[5] or from a "synthetic spread" for bonds with a risk rating equal to that of the country where the project or company is located. The CRP value can be obtained by multiplying the spread by any of the following three "loadings": (1) the relative volatility of the country's equity compared to the volatility of the S&P 500 Index; (2) the relative volatility of local equity compared to the volatility of local bonds; (3) the relative volatility of local equity compared to the volatility of the CDS.

Therefore, based on this intuition, Damodaran (2003) proposed a model using an *ad hoc* two factor model:

$$\text{Required Return} = R_f + \beta\ MMERP + \lambda\ CRP \tag{1}$$

Here R_f is the long-term risk-free rate for a developed country, β is the exposure to market risk,[6] and λ is the company or sector's exposure to country risk.[7] The author considered several possible measurements of λ, recommending the relative volatility of the local stock market compared to the volatility of local bonds. Therefore, he recommended estimating the cost of equity capital using the following formula:

$$\begin{aligned} \text{Required Return} = \quad & R_f + \beta\ MMERP \\ & + \lambda(\sigma_{Equity}/\sigma_{Bonds})\ CDS \end{aligned} \tag{2}$$

$\sigma_{Equity}/\sigma_{Bonds}$ is the relative volatility of a country's equity returns relative to its bond returns, and CDS is the Credit Default Swap for that country.

Finally, a weighted average cost of capital (WACC) is used to calculate the discount rate for future cash flows (Modigliani and Miller, 1958, 1963), which is the average of the cost of equity capital (obtained from equation (2)) and the cost of debt.[8] The cost of debt is taken

5. For example, towards the end of 2013 the ten-year CDS for Chile and Brazil were 100 and 230 basis points, respectively (Bloomberg).

6. The covariance between the return of the industry or project and the market return, divided by the variance of the market return.

7. The discount rate is expressed in the same currency as R_f.

8. For example, if the cost of equity capital is 8% and the cost of debt is 4%, and the company finances its assets using 50% debt and 50% equity, the WACC is 6%.

as the interest rate for issuers with a similar credit risk. The possible tax advantages of using debt are discussed below, which reduce the WACC, if they exist.

MacKinsey

Another important practical reference could be MacKinsey and Company, as this is a global consultancy company with international influence.[9] Koller *et al.* (2010) presented their views and practices.

With a diversified global investor as a reference starting point, they proposed using one of two alternative approaches: (1) modeling future cash-flow scenarios, valuing each scenario, and then weighting them according to the proabability assigned to each (in this case, they argue that discount rates should not be adjusted for country risk or exchange-rate risk); (2) the "business as usual" approach, with a single sequence of expected cash flows. In this case, they would add additional premia to the discount rate.

Koller *et al.* recommended using the CAPM model to calculate the cost of equity capital in emerging markets (chapter 33). They used the long-term United States bond yields as the risk-free rate, adding projected inflation differences (or differences in interest rates between currencies) to get the discount rate in local currency. They estimated the Betas directly against a global index in U.S. dollars, with five years of monthly data. They considered the risk premium for a developed market and recommended taking the cost of debt in local currency, adding the "systematic part of the credit spread," which relates to the credit risk of the issuer with respect to the risk-free rate in U.S. dollars or euros. In the absence of local references, they used an international credit spread with the same credit rating and then added the inflation differential. Finally, for the "business as usual" approach, they recommended adding the country credit risk spread to the weighted average cost of capital (WACC).

Abuaf (2011, 2015)

The final "applied" reference considered here is Abuaf (2011, 2015). This author identified the "industry standard" as the CAPM, using the

9. http://www.mckinsey.com/.

S&P 500 Index as a reference. The two risk factors used for emerging markets are market and credit risk. He proposed adjusting for country risk using the CDS, given the depth of that market (US$60 trillion). The cost of equity capital must be estimated as in equation (1), using the CDS as a second risk factor. Abuaf estimated the parameters in a multiple return regression measured in U.S. dollars against the return on the S&P 500 Index and the CDS rate (Abuaf, 2011). Later he used changes in the CDS and not its level as a second explanatory variable (Abuaf, 2015).

2.4 The asset pricing model proposed in this paper

Although there is no general consensus, for emerging markets most of the literature reviewed identified the need not only for a global factor, but for a second factor that reflects an additional source of risk. Karolyi and Stulz (2003), Zhang (2006), Chaieb and Errunza (2007), and Antel and Vaihekoski (2007) believed that the second factor is linked to exchange rate risk, although Koller *et al.* (2010) argued that this is not necessary, since it is already incorporated into the local currency-denominated interest rate. Erb *et al.* (1996), Bansal and Dahlquist (2002), Damodaran (2003), Abuaf (2011, 2015), and Avramov *et al.* (2012) considered that the second risk factor is linked to the country credit risk. Koller *et al.* (2010) proposed adding a country credit risk spread to the WACC in the "business as usual" method.

Bekaert *et al.* (2011) found that during high credit risk periods in the United States, there are greater differences in earnings-price ratios for the same industries in different countries. They interpret this result as segmentation. However, this may precisely reflect a second risk factor that makes earnings-price ratios differ between countries due to a second source of risk and not due to segmentation, since U.S. credit risk spreads are highly correlated with credit default swap rates in emerging countries, all of which are also highly correlated with each other.

The applied approaches studied do not explicitly consider exchange risk as a second risk factor, using credit risk instead. It seems unlikely that that those who don't consider the exchange rate risk as the second risk implicitly assume that this risk is diversifiable, given the evidence analyzed above. It seems more likely that the reason for not considering it is practical, since in principle it would be easier to measure and verify the exposure to credit risk (through the CDS, for example), than to measure the exposure to exchange rate risk.

But this does not necessarily imply that they assume that there is no exchange risk premium. It is tantamount to assuming that market and credit risk *span* at least the same risk-return dimensions as market and exchange rate risk. In fact, this paper presents estimates of the possible magnitudes of the exchange rate risk premia for various countries (Table 7).

Damodaran (2013, 2003) estimated the exposure to a second risk factor using an *ad hoc* model. Avramov *et al.* (2012) provided a replicable method, but their credit risk factor has not been updated and is difficult to replicate. Therefore, it is useful and consistent with the literature reviewed above to initially use each country's credit risk as a second factor. The equation for the cost of equity capital would have the following form:

$$k_e = R_f + \beta_e \, MMERP + \lambda_e CDS \tag{3}$$

Here k_e is the cost of equity capital, R_f is the risk-free reference rate in a developed country, $MMERP$ is the mature market equity risk premium, β_e is the exposure to market risk, CDS is the country credit default swap rate, and λ_e is the exposure to this risk factor. Beyond differences in leverage, it is reasonable to expect that β_e and λ_e depend on the industry to which the project or company belong.

As explained, Abuaf (2011) used the CDS level as a second risk factor for estimating λ_e, but in order to adequately estimate the sensitivity of returns to this risk factor, it is necessary to correlate it with some multiple of the changes in the CDS spread and not with its level.[10] This is partially corrected in Abuaf (2015), where he used the resulting estimate for λ_e to categorize the industries into "low," "medium," and "high" exposure to country risk, assigning values to λ_e of 0.35, 0.70, and 1.0, respectively. These values do not have an explicit justification. One contribution this paper makes is to propose a specific method for estimating exposure to the second risk factor, λ_e.

When the regression (3) is estimated with changes in the CDS, it is incorrect to interpret the second regression coefficient as the multiple

10. For example, to empirically determine a bond duration, we should regress the proportional change in the bond price against changes in its yield and not against the yield level.

(λ_e) that should multiply the CDS spread or level. In fact, estimated in this way the parameter should be negative, as an increase in country risk would result in falling asset values. This point is explored below, and we exploit the "replicating portfolio" concept in order to transform in a consistent and useful way the sensitivity to changes in the CDS spread into an additional risk premium.

3. The risk-free rate, the risk premia, and the weighted average cost of capital

In this section, we discuss how to select the appropriate parameters to estimate the cost of capital. First, we consider the risk-free rate. Second, we discuss the market risk premium and the distinction between arithmetic and geometric means. Third, we go on to measure the credit risk premium. Fourth, we discuss the weighted average cost of capital under different tax regimes.

Later, in section four, we study how to estimate the sensitivities to these risk factors and also how to apply the proposed model.

3.1 The risk-free rate

The CAPM is a one-period model that does not address what the relevant reference risk-free interest rate should be. Damodaran (2015) recommended using a 20- or 30-year U.S. Treasury Bond's nominal interest rate (yield) in U.S. dollars. Koller *et al.* (2010) and Abuaf (2011) proposed using a similar interest rate, but for a 10-year bond. They justify using this rate as this bond is traded in significantly more liquid markets than longer-term bonds. Curiously, Abuaf (2015) changed his mind and proposed using a longer-term rate because it would be "more realistic."[11]

Conceptually, when we value a project or a company we should use the spot interest rate and not an historical average, because the spot rate reflects the opportunity cost for a risk-free project and incorporates market expectations with regard to future interest rates. The Efficient Market Hypothesis indicates that we should not expect a particular

11. "[The risk-free rate used is] ... slightly higher than the current 30-Year Treasury bond, yet closer to the long-term equilibrium rate that should theoretically approach growth rate of nominal GDP," p. 76.

analyst's opinion to be systematically better than that of a deep market, which incorporates the available information.

The specific maturity for the reference interest rate would be rather arbitrary. Intuitively, it seems reasonable to consider a bond yield whose maturity is consistent with the life of the asset being valued, for example, equating durations. However, changing the reference asset may also require an adjustment to the risk premium, since risk premia already exist in the structure of interest rates.[12] In any case, this problem may be more closely associated with selecting the appropriate pricing model, considering all the risk factors, rather than the reference rate maturity. For example, it is possible that a 30-year bond is correctly priced using a three-factor model, including the 10-year bond return (e.g. this instrument's risk may be spanned by the other risk factors).

The approaches discussed generally discount future cash flows projected in nominal U.S. dollars. This is the most common practice. Another possibility is to consider a real interest rate in U.S. dollars as a reference, such as U.S. TIPs, if the expected cash flows to be discounted are adjusted for inflation. This is not normal practice in developed markets. A problem with this approach is that TIP interest rates incorporate a significant illiquidity premium (Pflueger and Viceira, 2011), which would result in inflation-adjusted discount rates being overestimated, if no other adjustments were made.

We follow Koller *et al.* (2010) and Abuaf (2011) using a 10-year nominal U.S. dollar (adjusted) yield as our reference risk-free rate for convenience and comparability, although the use of interest rates of bonds with different maturities would not cause any major practical complications.

3.2 Global risk premia (MMERP)

A source traditionally used for the equity risk premium has been the Ibbotson and Associates Yearbook, which for certain periods has estimated this premium (historical, since 1926) for the United States at more than 8 (6) percentage points with respect to short-term (long-term) fixed income.

12. See Cochrane and Piazzesi (2005), Ludvigson (2009), and Dimson *et al.* (2015) for conditional and long-term estimates, respectively.

There is some consensus that the expected future value of the global equity risk premium is overestimated, if we consider the past 50 years or more to estimate it. Valuation multiples (such as price-earnings or market-to-book ratios) have increased, and they cannot be assumed to have a trend. Fama and French (2002) provided a milestone by recognizing this, concluding that the expected risk premium is less than half the historical average.

Koller *et al.* (2010) recommended using a premium with respect to long-term bonds of between 4.5% and 5.5%. In their opinion, this parameter is stable. To prove this, they transformed the median price-earnings ratio of the firms within the S&P 500 Index into an expected return by assuming a real long-term growth rate of 3.5% and a real return on book equity of 13.5%, obtaining an inflation-adjusted average return of 7%, which proves to be stable. This result obviously depends on the assumptions for growth and the return on book equity.

Since 2001, there has been another important source of information which is regularly updated. Dimson *et al.* (2015) incorporated 23 countries for the period 1900–2014 (115 years). They found a historical geometric risk premium with respect to bills (bonds) for a global portfolio of 4.3% (3.2%). The historical risk premium of long-term bonds over short-term bonds is 0.9%. Dimson *et al.* (2013) arrived at the premia presented in Table 1 after adjusting for expanding multiples and other non-repeatable events.

Table 1. Risk premia

	With respect to bills	With respect to bonds
Geometric	3.0 to 3.5%	2.2 to 2.7%
Arithmetic	4.5 to 5.0%	3.7 to 4.2%

Source: Dimson *et al.* (2013).

A Chartered Financial Analysts (CFA) Institute publication (Hammond *et al.*, 2011) collected the estimates of 11 authors, academics, and “practitioners.” The importance of this source is that it summarizes the opinions of authors with a long history of publications on the subject. They tend to agree that risk premia are lower than the historical averages, but not in its absolute magnitude. Table 2 presents numerical estimates from this publication.

Table 2. Risk premia according to various authors

Author	Estimate	Source explanation	Premium with respect to long-term bonds*
Asness	4% real	Total expected return on the S&P 500 Index	2 to 3%
Grinold *et al.*	3.6%	Geometric, over 10-year Treasury bonds	3.6%
Arnott	2.5 to 3%	Geometric, with respect to T-Bills	1.5 to 2%
Ilmanen	3%	Geometric, with respect to T-Bills, assuming a 1% real return on T-Bills	2%
Chen	3.34%	Geometric, with respect to long-term T-bonds	3.34%
Siegel	5 to 6%	Over 10-year Treasury bonds	5 to 6%

Source: Hammond *et al.* (2011).
*Implies a risk premium of long-term state bonds over short-term state bonds of 1%

A discussion about the use of conditional or unconditional models also involves the risk premium, since it would be partially predictable based on indicators such as the ratio of aggregate dividends to stock market capitalization (Cochrane, 2008; Campbell and Thompson, 2008). However, Welch and Goyal (2008) argued that this evidence is not conclusive.

Damodaran (2015) argued that there are several reasonable methods, but that his *implied equity premium* (a conditional estimate whose foundation is intuitive) would be preferable as it is "market neutral" (p. 105) and his estimator is correlated with future returns,[13] unlike Koller *et al.* (2010), who recommended a constant premium of between 4.5% and 5.5%.

Simin (2008) found that the best predictor is the conditional market return over terms of up to five years, and for longer terms, the best predictor is constant. Therefore, the potential benefits of using conditional predictions for the risk premium would be moderate, when used for valuing assets with long-term cash flows.

3.3 Arithmetic *vs.* geometric averages

The relationship between arithmetic and geometric means is approximately

$$\mathbf{r}_{\text{Arithmetic}} = \mathbf{r}_{\text{Geometric}} + \tfrac{1}{2} \text{ the return variance} \qquad (4)$$

13. This correlation with future returns is probably based on overlapping returns and is biased upward. See Ferson *et al.* (2003).

For example, the standard deviation of the Dimson *et al.* (2013) global equity portfolio return is 17.3%. This implies a difference between arithmetic and geometric means of 1.5%.

Given the estimated risk premia found above (Tables 1 and 2), a question is whether to use geometric or arithmetic means. This question is technically complex. For example, Jacquier *et al.* (2003) proposed using the following formula:

$$E(r) = \mathbf{r}_{\text{Arithmetic}}(1\text{-}H/T) + \mathbf{r}_{\text{Geometric}}(H/T) \quad (5)$$

Here $E(r)$ is the expected return, H is the investment term, and T the length of the sample used in the estimate. Koller *et al.* (2010) used a similar method, based on Blume (1974). However, Jacquier *et al.* recognized that this estimator is appropriate when estimating an expected cumulative return, which is technically different from identifying an unbiased estimator for the discount rate.[14]

Cooper (1996) found that even if returns are not independent over time and including possible estimation errors, the arithmetic mean is still the less biased estimator for the discount rate. Fama (1996) indicated that if a project has constant expected flows, its value is obtained by discounting the expected future cash flows with the arithmetic mean, although this implies that the implicit probability distribution of future cash flows will be increasingly biased to the right.

Therefore, there are no obviously better estimators for discount rates than those based on arithmetic means. Damodaran (2015) justified using geometric means, but the arguments of Cooper (1996) and Fama (1996) do not appear to technically justify this practice. The same objection applies to Koller *et al.* (2010).

If we use an equity premium with respect to long-term bonds, consistency requires that the expected reference bond return for a given horizon should be estimated using the bond yield and then adding one-half of its return variance, in the same way as with equity returns.

14. In the first case, the potential estimation error is found in the numerator, and in the second case, in the denominator.

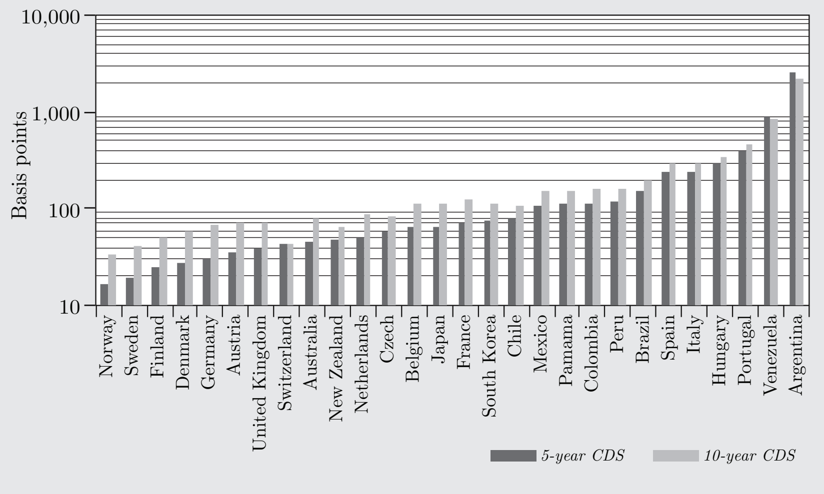
3.4 The second risk factor

The second risk factor is, in principle, each country's credit risk. The credit risk can be measured as the spread between the interest rate of a sovereign bond in U.S. dollars (or Euros) and a reference interest rate for a low-risk country, such as the United States or Germany. It can also be measured using Credit Default Swaps (CDS). Both alternatives (sovereign spreads and CDS) should give similar results due to arbitrage considerations, as argued below. However, in practice these approaches can give different results. The main reason is that the CDS market is significantly more liquid than the sovereign bonds market. A second reason may be the absence of sovereign bonds for the term sought, such as 10 years.

Given the greater liquidity and availability, we also measure the second risk factor building upon the CDS of an individual country or upon an average of several countries.

Figure 1 displays CDSs for various countries. It is the premium paid by the purchaser of insurance that protects against an insolvency event or issuer default. In the absence of transaction costs, selling such insurance is equivalent to a long position in a risky bond financed with a short position in a risk-free bond.

Figure 1. Credit default swaps (CDS)



Source: Bloomberg, December 10, 2013.

3.5 Weighted average cost of capital (WACC)

The weighted average cost of capital is obtained from the cost of debt and the cost of equity for companies within a specific industry. The objective is to obtain a discount rate for future expected asset cash flows using the cost of debt and equity. Modigliani and Miller (1958, 1963) showed that in the absence of taxes and transaction cost the absence of arbitrage implies that the weighted average cost, of capital should be independent of the financing structure (leverage) of a company or project.

The WACC can be calculated by: (1) averaging previously estimated discount rates for debt and equity; or (2) first estimating the asset sensitivity to each risk factor, which is the weighted average of the sensitivities for debt and equity, and then using the asset sensitivities in the pricing model to obtain the cost of capital. Both alternatives would give similar results if the same pricing model were valid for pricing debt and equity. Which method to choose would thus only be a matter of convenience. However, in principle the first alternative is more eclectic, as it does not require that the same pricing model be applicable to debt and equity. This is the approach taken by Damodaran (2003) and Koller *et al.* (2010), for example.

The usual formula to estimate the weighted average cost of capital based on Modigliani and Miller is the following:

$$WACC = k_d(1-\tau_C)\frac{D}{D+E} + k_e\frac{E}{D+E} \tag{6}$$

Where k_d is the expected return on debt, k_e the expected return on equity, $D/(D+E)$ is the relative importance of debt in the financing structure at market prices, and τ_C is the corporate income tax rate. This formula is frequently found in finance textbooks, but its dependence on the tax regimes is often overlooked. Indeed, the formula not only assumes that interest is deducted from taxable income, but also that the company that uses more debt in its financing structure (*ceteris paribus*) will increase the value of its assets. This is correct only under the assumption of double taxation.

The assumption is wrong in various countries for different reasons. For instance, corporate income tax in Chile is treated as a tax credit paid on behalf of (downstream) companies or individuals who receive dividends (Hernandez and Walker, 1993, Table 2).[15] Australia has adopted a similar scheme to mitigate the tax incentives on debt (Alexander *et al.*, 2000). Corporate earnings are subject to corporate income tax in Brazil, Colombia, and Peru, but dividends are not subject to personal taxes.[16] However, in all such cases, debt interest that has not paid taxes upstream would be subject to personal marginal tax rates on taxable income.[17]

A formula that includes the partial tax credit on dividends is as follows (Alexander *et al.*, 2000):

$$WACC = k_d(1-\tau_C(1-\gamma))\frac{D}{D+E} + k_e\frac{E}{D+E} \quad (7)$$

Here, γ is the fraction of the marginal investors that have the right to a tax credit. In Chile, these were all investors except pension funds, until 2013. In the other countries mentioned above, γ is close to 1, because there are no new personal taxes (or downstream taxes) on income from equity capital, whereas there are taxes on income from debt.

3.6 Bond yields *vs.* expected returns

One last point that deserves discussion in order to implement equation (7) is the difference between the bond yield and its expected return. One

15. The Chilean tax reform introduced in 2014 means that this does not change when companies are owned by other (investment) companies, but individual investors may only use 65% of the corresponding corporate income tax as a credit for their personal taxes. (See note 17).

16. The tax codes for each country can be found here, www.sii.cl (Chile); www.afip.gov.ar (Argentina); www.receita.fazenda.gov.br (Brazil); www.dian.gov.co (Colombia); www.sunat.gob.pe (Peru). I appreciate the help of tax expert Marcos Antonio Cruz Sanhueza for this point.

17. When there are corporate taxes (τ_C) in addition to personal taxes (or downstream taxes) on capital gains (τ_{PS}) and income from owning company debt (τ_{PD}), Miller (1977) shows that the value of a company with debt is equal to the value of a company without debt, plus the tax advantages arising from the debt as follows: $G_L = [1 - ((1 - \tau_C)(1 - \tau_{PS})/(1 - \tau_{PD}))]D$. For example, if $\tau_{PS} = \tau_{PD}$ we are back to the original formula (6), which justifies the use of the formula even when there are personal taxes. But if τ_C is a tax credit on behalf of τ_{PS}, as in Chile and Australia, then τ_C disappears from the formula. In addition, if $\tau_{PS} = \tau_{PD}$, there is no tax advantage for using debt, and the asset's discount rate should not be reduced with leverage. If taxable income is subject to tax only once, as in Brazil, then $\tau_{PS} = 0$. In addition, if the marginal tax rate for companies and individuals is similar, once again using debt creates no tax advantages. After the Chilean tax reform of 2014, there will be double taxation on 35% of corporate taxable income, and as $\tau_{PS} = \tau_{PD}$, the expression for the tax advantage of using debt is $G_L = [0.35\tau_C/(1 - \tau_{PD})]D$. As the maximum personal income tax rate will be 35% and the corporate income tax rate 27%, the tax advantage will be 14.54% of the amount of debt. But if net income is not distributed to individuals but to investment companies, the tax advantage from using debt will continue to be nil.

reason for such difference is the default probability. For example, taking a Credit Default Swap of 200 basis points for an investment-grade instrument (Baa) as a reference, using Moody's (2008) non-payment statistics, with a recovery rate of 37% over an investment term of five years, the bond risk premium is 176 basis points, which is 24 basis points less than the CDS. For example, if the WACC assumes 50% debt, the difference between the bond yield and its expected return on debt is only 12 basis points. So, for investment-grade debt, the difference between the CDS and the risk premium may be unimportant. However, these results may be very different for non-investment-grade bonds. For example, Koller *et al.* (2010) reported that this adjustment is only important for low-grade investment bonds.

4. Estimates and applications of the two risk-factor model

The proposed method to estimate the coefficients β and λ for the risk factors in equation (3) are as follows, along with applications for this model.

The returns on local asset classes are measured in U.S. dollars (USD), from a global investor's perspective. We use weekly data in order to estimate the parameters based on a recent period with sufficient degrees of freedom. This is also consistent with industry practices (Abuaf, 2011, 2015; Damodaran, 2003).[18]

4.1 First risk factor

The first risk factor is the weekly return on the S&P 500 Index in excess of the return (Holding Period Return, HPR) of investing in 10-year U.S. bonds. This factor is called market risk (MR). The correlation between the S&P 500 Index and the MSCI All Country World Index is typically greater than 0.95, with similar volatilities, so estimates should be similar if we used the latter index as reference.

Measuring the excess returns over the HPR on 10-year bonds does not generate significant differences in the estimated Betas compared with using total returns (and not excess returns) instead. However, this is important for the interpretation presented below.

18. The professional computer terminal and services provided by Bloomberg by default use the same settings.

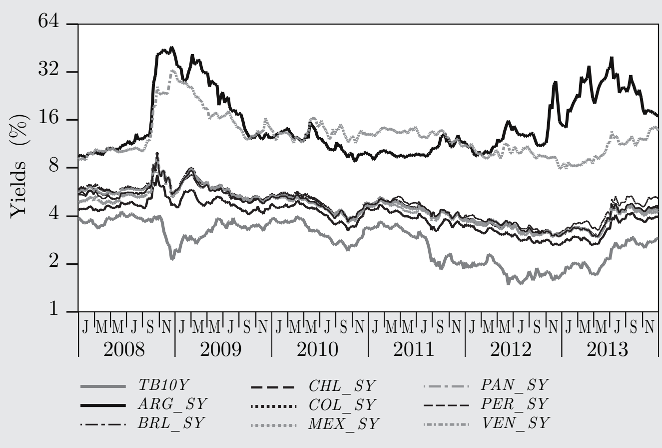
4.2 Second risk factor

The second risk factor is the credit risk factor (CRF). It is constructed as follows.

In the absence of transaction costs, by arbitrage a CDS is equivalent to a short position in a risk-free bond that finances a long position in a risky bond (both in the same currency). Therefore, the reverse path is followed: the yield of the 10-year U.S. Treasury bond (TB10Y) is taken as a basis, plus the 10-year CDS for each country, resulting in the yield for synthetic 10-year bond in U.S. dollars, with the same credit risk as the country analyzed. As explained, this yield should be similar to that of the corresponding sovereign bond in U.S. dollars, but there may be differences due to liquidity. The equivalent investment strategy is to buy a 10-year Treasury bond and sell the country credit risk insurance, receiving the spread in the absence of default.

Figure 2 shows the yields of our synthetic bonds for several countries together with the yield for 10-year U.S. Treasury bonds.

Figure 2. Yields for synthetic bonds (SY) versus 10-year U.S. Treasury bonds (TB10Y)



Source: Based on the author's calculations with CDS and Treasury Yields from Bloomberg.

The synthetic yield in U.S. dollars is transformed into returns (Holding Period Returns, HPR), assuming a strategy of buying and selling the synthetic bond after a week. Then, we repurchase a newly issued synthetic bond and so on. This is very similar to estimating the return as the change in the yield multiplied by the duration of the 10-year bond. The weekly HPR of investing in 10-year U.S. Treasury bonds is subtracted from that series of returns, resulting in a difference or excess return. This excess return is the credit risk factor (CRF_k) for each country (k). Part A of Table 3 shows variances, co-variances, and correlations between the estimated CRF for various countries.

These CRFs are highly correlated between countries, especially among those with less risk. As presumed, the resulting CRF is almost identical to minus the change in the CDS multiplied by a constant, which is similar to the (Macaulay) duration of our synthetic bonds. Therefore, if instead of using the country's CRF as a second risk factor we use the change in its CDS, the results will be qualitatively identical.

The estimated multiples are presented in Part B of Table 3. Table 3B shows the result of using the change in the average CDS of each country in the sample, in addition to the average that excludes Argentina and Venezuela. Using the latter measure gives virtually the same results (in terms of correlation, not in the magnitude of the coefficients) compared to using the country's own CDS, which suggests the existence of a second risk factor that is common to all countries in the sample.

Table 4 shows the sensitivity of each country's CRF to the average CRF for the countries included in the sample. We observe that the constants are not significant and that the explanatory power of the average CRF is significant in all cases, with lower explanatory power for Argentina and Venezuela.

Results not shown indicate that each country's CDS is very similar to multiplying its sensitivity to changes in the average CRF (third row of Table 4A) with the average CDS. The greatest difference occurs with Argentina, which may reflect that the CDS is a poor risk premium indicator for countries with high credit risk.

Table 3A. CRF variances. co-variances. and correlations between countries

		ARG_FRC	BRL_FRC	CHL_FRC	COL_FRC	MEX_FRC	PAN_FRC	PER_FRC	VEN_FRC
ARG_FRC	Cov	0.0060							
	Corr	1.00							
BRL_FRC	Cov	0.0006	0.0004						
	Corr	0.38	1.00						
CHL_FRC	Cov	0.0004	0.0002	0.0002					
	Corr	0.41	0.90	1.00					
COL_FRC	Cov	0.0006	0.0004	0.0002	0.0004				
	Corr	0.39	0.97	0.89	1.00				
MEX_FRC	Cov	0.0007	0.0004	0.0002	0.0004	0.0005			
	Corr	0.39	0.97	0.89	0.98	1.00			
PAN_FRC	Cov	0.0006	0.0004	0.0002	0.0004	0.0004	0.0004		
	Corr	0.39	0.97	0.89	0.98	0.98	1.00		
PER_FRC	Cov	0.0006	0.0004	0.0002	0.0004	0.0005	0.0004	0.0004	
	Corr	0.39	0.97	0.88	0.97	0.97	0.98	1.00	
VEN_FRC	Cov	0.0019	0.0005	0.0003	0.0005	0.0005	0.0005	0.0005	0.0019
	Corr	0.56	0.55	0.63	0.56	0.54	0.54	0.55	1.00

Table 3B Sensitivity of each country's CRF to changes in its CDS

	ARG_FRC	BRL_FRC	CHL_FRC	COL_FRC	MEX_FRC	PAN_FRC	PER_FRC	VEN_FRC
D(ARG_CDS)	-3.5	-0.4	-0.2	-0.4	-0.4	-0.4	-0.4	-1.1
D(BRL_CDS)	-9.9	-7.1	-3.9	-7.0	-7.4	-6.9	-7.1	-8.0
D(CHL_CDS)	-18.8	-11.5	-7.7	-11.6	-12.2	-11.3	-11.6	-16.5
D(COL_CDS)	-9.9	-6.8	-3.7	-7.0	-7.3	-6.7	-7.0	-8.0
D(MEX_CDS)	-9.5	-6.4	-3.5	-6.5	-7.1	-6.4	-6.7	-7.3
D(PAN_CDS)	-10.0	-6.9	-3.8	-7.1	-7.5	-7.0	-7.2	-7.8
D(PER_CDS)	-9.6	-6.6	-3.6	-6.7	-7.2	-6.7	-7.0	-7.7
D(VEN_CDS)	-4.4	-1.2	-0.8	-1.2	-1.2	-1.1	-1.2	-4.5
D(AVG_CDS)	-13.5	-3.3	-2.0	-3.3	-3.5	-3.2	-3.4	-7.0
D(AV_IG_CDS)	-11.0	-7.5	-4.2	-7.6	-8.1	-7.5	-7.7	-8.8

Source: Prepared by the author based on Bloomberg data. Sample: 2008 to 2013. 310 weekly observations.
Note: 100 CDS basis points are represented as 0.01 in the regression.

Table 4. Sensitivity to the average CRF

$HPR_{FRC,k} - HPR_{TB10Y} = \phi_{0k} + \phi_{1k}(HPR_{EME} - HPR_{TB10Y}) + e_k$

A. Sample 2012-2013								
	ARG	**BLR**	**CHL**	**COL**	**MEX**	**PAN**	**PER**	**VEN**
ϕ_{0k}	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.00
t-test	*0.20*	*-1.58*	*1.45*	*-0.10*	*0.85*	*0.02*	*0.23*	*-0.18*
ϕ_{1k}	5.40	1.13	0.61	1.07	1.06	1.06	1.08	2.70
t-test	*4.8*	*28.8*	*23.1*	*48.4*	*44.0*	*46.2*	*47.1*	*9.5*
Adjusted R-squared	0.18	0.89	0.84	0.96	0.84	0.95	0.96	0.47
Durbin-Watson stat	1.82	1.51	1.51	2.28	2.52	2.44	2.19	1.94
B. Sample 2008-2013								
	ARG	BLR	CHL	COL	MEX	PAN	PER	VEN
ϕ_{0k}	0.00	-0.00	-0.00	0.00	-0.00	0.00	0.00	0.00
t-test	*0.65*	*-0.65*	*-0.44*	*0.92*	*-0.27*	*0.66*	*0.16*	*0.44*
ϕ_{1k}	1.60	1.06	0.60	1.07	1.13	1.05	1.09	1.27
t-test	*7.6*	*108.7*	*40.7*	*118.4*	*116.7*	*126.5*	*110.9*	*12.0*
Adjusted R-squared	0.16	0.97	0.84	0.98	0.84	0.98	0.98	0.32
Durbin-Watson stat	1.87	2.11	2.11	2.35	2.36	2.16	2.41	1.61

Source: Author's calculations based on Bloomberg data. Sample: 2008 to 2013, 310 weekly observations.

4.3 The two factors and the replicating portfolio

The estimated model for any asset class (j) based on an emerging country is:

$$R_j^{USD} - HPR_{TB10Y} = \alpha_j + \beta_j(R_{S\&P500} - HPR_{TB10Y}) + \lambda_j(HPR_{EME} - HPR_{TB10Y}) + e_j \tag{8}$$

$R_j^{USD} - HPR_{TB10Y}$ is the excess return in U.S. dollars of assets j over the return on investing in 10-year U.S. Treasury bonds, $R_{S\&P500} - HPR_{TB10Y}$ is the excess return of these assets over the S&P 500 Index, and $HPR_{EME} - HPR_{TB10Y}$ is the credit risk factor (CRF) for the excess return on investing in a synthetic bond portfolio in emerging countries. Note that if α_j is not significantly different from zero, the equation can be reordered, and taking the expected value, it becomes:

$$E(R_j^{USD}) = (1 - \beta_j - \lambda_j)E(HPR_{TB10Y}) + \beta_j\ E(R_{S\&P500}) \\ + \lambda_j\ E(HPR_{EME}) \tag{9}$$

Equation (9) is interpreted as a "Replicating Portfolio." In the absence of arbitrage, the expected return on asset j must be equal to that of its replicating portfolio, which invests $1 - \beta_j - \lambda_j$ in Treasury bonds, β_j in the S&P 500 Index and λ_j in a synthetic bond portfolio with a country risk equal to the average of the countries included in the sample. This enables us to obtain a discount rate in U.S. dollars for assets in emerging economies.

4.4 Estimated sensitivity to the risk factors (β and λ)

Table 5 presents estimates of risk parameters (β and λ) for stock indexes in Latin American countries (equation (8)), with a single average risk factor (Part A) and with the specific risk factor for each country (Part B).

In all specifications and samples, the parameters turn out to be very significant. In addition, the constants are not significant, except for Brazil and Chile in the most recent sample (2012 to 2013). This validates in principle our interpretation that the coefficients are the weights of a replicating portfolio (equation (9)).

The Betas are relatively low, as this parameter's value for the S&P 500 Index is 1, by definition. For example, for Chile, Colombia, and Mexico the value is close to 0.5. This occurs because the credit and market risk factors are significantly correlated. A simple regression of the average CRF over the S&P 500 Index reveals a Beta (β_{CRF}) of 0.34 over the entire period and 0.16 for the 2012–2013 period. This implies that if Betas are estimated using univariate regressions with respect to the S&P 500 Index and then a second risk premium associated with the country credit risk is added, part of the additional premium would be included twice. This drawback has been ignored by Damodaran (2003) and Koller *et al.* (2010).

Comparing the estimates with the average CRF and each country's CRF, the estimated Betas appear to be similar. The Lambdas change as the reference risk factors also change, as is evident for Argentina.

Estimates for the cost of equity capital in U.S. dollars for each country's stock market are presented in the second half of Parts A and B of Table 5.

Table 5. Estimated β and λ for aggregated stock markets and cost of equity capital

$$R_j^{USD} - HPR_{TB10Y} = a_j + b_j(R_{S\&P500} - HPR_{TB10Y}) + l_j(HPR_{EME} - HPR_{TB10Y}) + e_j$$

A) Average Credit Risk Factor												
Sample	**2012 to 2013**						**2008 to 2013**					
N. obs.	**103**						**310**					
	ARG	BRL	CHL	COL	MEX	PER	ARG	BRL	CHL	COL	MEX	PER
Const.	**0.02%**	**-0.58%**	**-0.36%**	**-0.18%**	**-0.40%**	**-0.14%**	**0.08%**	**-0.08%**	**0.03%**	**0.05%**	**-0.06%**	**0.06%**
t-test	*0.05*	*-2.31*	*-2.22*	*-0.79*	*-1.36*	*-0.81*	*0.40*	*-0.43*	*0.20*	*0.33*	*-0.23*	*0.61*
ER_SP500 (β)	**1.05**	**0.93**	**0.54**	**0.52**	**0.49**	**0.83**	**0.82**	**0.99**	**0.62**	**0.60**	**0.60**	**0.85**
t-test	*7.94*	*10.17*	*8.31*	*5.23*	*3.86*	*11.02*	*11.79*	*13.68*	*10.82*	*10.77*	*6.81*	*18.85*
AVG_FRC (λ)	**0.65**	**1.33**	**1.29**	**1.01**	**0.84**	**1.30**	**0.74**	**1.10**	**0.60**	**0.62**	**1.00**	**1.16**
t-test	*1.67*	*5.85*	*7.80*	*4.04*	*0.34*	*5.23*	*5.68*	*6.73*	*4.15*	*4.46*	*7.05*	*11.94*
R^2 adjusted	0.31	0.56	0.60	0.42	0.22	0.63	0.59	0.74	0.61	0.58	0.49	0.86
DW	1.73	1.86	1.83	1.61	1.71	1.88	1.95	2.17	1.97	2.10	1.73	1.93
Estimated discount rate												
Risk free rate (1)	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
Risk free rate adj. to arithmetic (2)	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%
Equity risk premium -- Arithmetic mean (3)	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Risk premium credit risk factor (4)	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
Risk premium credit risk factor -- Arithmetic (5)	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Expected return in USD (6)	9.0%	10.2%	8.6%	7.8%	7.2%	9.8%	8.3%	9.9%	7.1%	7.1%	8.1%	9.5%
Recent sample minus total sample	0.7%	0.4%	1.5%	0.7%	-0.8%	0.3%	-	-	-	-	-	-

Table 5. (continued)

B) Individual Credit Risk Factor	ARG	BRL	CHL	COL	MEX	PER	ARG	BRL	CHL	COL	MEX	PER
Const.	**0.00%**	**-0.54%**	**-0.40%**	**-0.18%**	**-0.41%**	**-0.15%**	**0.06%**	**-0.07%**	**0.05%**	**0.04%**	**-0.05%**	**0.06%**
t-test	*0.01*	*-2.17*	*-2.56*	*-0.77*	*-1.36*	*-0.85*	*0.34*	*-0.37*	*0.29*	*0.26*	*-0.20*	*0.59*
ER_SP500 (β)	**1.09**	**0.96**	**0.51**	**0.52**	**0.48**	**0.85**	**0.96**	**0.99**	**0.62**	**0.59**	**0.62**	**0.87**
t-test	*9.46*	*11.38*	*6.79*	*5.28*	*3.62*	*11.90*	*13.58*	*14.12*	*11.36*	*10.71*	*7.16*	*19.44*
AVG_FRC (λ)	**0.07**	**1.25**	**2.01**	**0.92**	**0.74**	**1.13**	**0.13**	**1.05**	**0.93**	**0.60**	**0.81**	**1.02**
t-test	*2.74*	*6.01*	*8.61*	*3.77*	*2.18*	*5.28*	*3.81*	*6.81*	*5.72*	*4.40*	*6.22*	*11.23*
R^2 adjusted	0.34	0.59	0.60	0.42	0.22	0.62	0.58	0.74	0.62	0.59	0.49	0.86
DW	1.73	1.85	1.93	1.58	1.68	1.85	2.02	2.18	1.94	2.10	1.71	1.95
Risk free rate (1)	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
Risk free rate adj. to arithmetic (2)	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%
Equity risk premium -- Arithmetic mean (3)	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Risk premium credit risk factor (7)	14.0%	2.3%	1.1%	1.6%	1.3%	1.5%	14.0%	2.3%	1.1%	1.6%	1.3%	1.5%
Risk premium credit risk factor -- Arithmetic (8)	29.6%	3.4%	1.5%	2.7%	2.6%	2.6%	29.6%	3.4%	1.5%	2.7%	2.6%	2.6%
Expected return in USD (6)	9.7%	11.2%	8.1%	7.7%	7.0%	9.5%	10.9%	10.7%	7.0%	7.1%	7.7%	9.2%
Recent sample minus total sample	-1.2%	0.6%	1.1%	0.6%	-0.7%	0.2%	-	-	-	-	-	-
B)-A) (9)	0.7%	1.0%	-0.5%	-0.1%	-0.2%	-0.3%	2.6%	0.8%	-0.1%	0.0%	-0.3%	-0.2%

Notes: (1) Yields on 10-year U.S. Treasury bonds, Dec. 13, 2013. Source: Bloomberg; (2) Adjusted by 1/2 of the annualized weekly HPR variance of the 10-year bond; (3) Average of estimations by Dimson, Marsh & Staunton (2013), Table 1. Corresponds to arithmetic premia with respect to bonds; (7) Each country's CDS as of Dec. 13, 2013. Source: Bloomberg; (8) Ajusted by 1/2 the annualized variance of each country's FRC, period 2008−2013; (9) Difference between estimations with average and individual credit risk factors. t-tests adjusted for autocorrelation an heteroskedasticity.

The results obtained from various samples and models are similar, with proportionally small differences. An exception may be the case of Chile, where using the most recent sample results in a discount rate 1.4% greater than that obtained using the full sample. In addition, apart from the relatively low discount rate for Argentina,[19] the cost of capital ranking among countries using the most recent sample is perhaps puzzling. This may be due to the corporate leverage of firms in each country's stock market, as explained below.

4.5 Leveraged, un-leveraged, re-leveraged estimates and WACC by country

Estimates of the parameters in Table 5 are affected by industrial composition and by corporate borrowing or leverage in each country.

The cost of equity capital is usually estimated (Damodaran, 2003; Koller *et al.,* 2010) by un-leveraging the risk factors (in this case β and λ) then re-leveraging them while assuming a long-term leverage level for the corresponding project or company.

Table 6 presents the aggregate leverage levels for public companies in each country. Debt, net of cash balances, as a proportion of the stock market capitalization is used as a leverage indicator. With these numbers and certain additional assumptions, we obtain the parameters for the average un-leveraged public company in each country.

It is usual to assume that the Beta for the debt is zero during this process of un-leveraging and re-leveraging, but this is only an intermediate step. Subsequently, the parameters are re-leveraged to obtain the cost of equity capital. This assumption could be particularly inappropriate for below-investment-grade companies or countries. Nevertheless, for the purposes of the following calculations, we assume that the Beta for the debt is zero. If d is the degree of leverage (D/E), the Beta for the assets (β_U) is:[20]

$$\beta_U = \beta_L/(1 + d) \tag{10}$$

19. When the country credit risk is high, such as for Argentina, there is segmentation; see Bansal and Dahlquist (2002).

20. In fact, the result of equation (10) should be $\beta_U = \beta_L/(1 + d) + \beta_D(d)/(1 + d)$, where β_D is the Beta for the debt. Re-leveraging equation (10) with a debt-equity ratio objective of d^* results in $\beta_L{}^* = \beta_L(1 + d^*)/(1 + d)$. Re-leveraging the result without the approximation of assuming that $\beta_D = 0$ results in $\beta_L{}^{**} = \beta_L(1+d^*)/(1+d) + \beta_D(d)(1 + d^*)/(1 + d)$. Thus, the error for assuming that the Beta for the debt is zero is approximately $\beta_D(d^* - d)d$, which presumably will be small.

We must also obtain λ_U, which is sensitive to the credit risk factor of the un-leveraged company. λ_U is the weighted average of the sensitivities of debt (λ_D) and equity (λ_L). In this case, it is inappropriate to assume that $\lambda_D = 0$, because we consider assets or companies that have inherited their own country's risk. For the purpose of un-leveraging these parameters, we assume that λ_D is equal to the sensitivity of the country's credit risk factor to the average credit risk. This parameter was estimated and presented in Table 4. For example, this sensitivity is 1.13 for Brazil and 0.61 for Chile. Thus,

$$\lambda_U = \lambda_D \, d/(1 + d) + \lambda_L/(1 + d) \tag{11}$$

The weighted average cost of capital (WACC) in each case can be obtained using the parameters β_U and λ_U. This is presented in the sixth column of part B of Table 6. The discussion presented earlier supports the assumption that there are no tax advantages to using debt for the countries in the sample.

Finally, to illustrate common practice, the results are re-leveraged in order to determine the cost of equity capital, assuming a leverage level equal to the weighted average of the sample (d) of 0.44. The sensitivities can be estimated by clearing β_L and λ_L from equations (10) and (11), respectively.[21]

4.6 "Imported" Betas and the incremental credit risk premium

Due to information availability, often industry Betas are "imported" from companies based in developed countries, which are then adjusted in order to evaluate an asset or project in an emerging country. The un-leveraging and re-leveraging process can be performed with imported Betas.

As explained, estimating Betas with univariate regressions with respect to indices of developed countries and then separately adding a country risk premium may result in the same risk factor being included twice.

21. The resulting cost of capital for Argentina proves to be abnormally below the average of other countries, which is surprising given its risk rating. This result is due to the local stock market having a low estimated sensitivity to the average credit risk of Latin American countries. This may reflect segmentation in this market. Pricing models that assume integration understate the cost of capital in segmented markets. See Bansal and Dahlquist (2002).

It can be shown that estimating Betas with univariate regressions (for example, with respect to the S&P 500 Index) for country or industry k, leads to the following result:

$$\beta_{kTOT} = \beta_k + \beta_{CRF}\lambda_k \tag{12}$$

Where β_{kTOT} is the Beta of a univariate regression, β_k is the regression coefficient with two risk factors, β_{CRF} is the sensitivity of the credit risk factor to the S&P 500 Index, and λ_k is the sensitivity of the local stock market (or industry or local company) to the credit risk factor. Therefore, if we use an imported univariate Beta to calculate the cost of capital, the incremental risk premium associated with the second must be estimated as:

$$CDS - \beta_{CRF}MMERP \tag{13}$$

This premium is clearly less than the average CDS, given that β_{CRF} is positive. We would need to subtract between 80 and 160 basis points from the CDS levels (adjusted by convexity), depending on the sample period considered, which results in an incremental risk premium of between 180 and 90 basis points, respectively.[22] Only this incremental premium (and not the total CDS spread) must be multiplied by the exposure to the second risk factor λ_k and added to the cost of capital for an equivalent company or project in a developed country.

If an estimate of λ_k for the specific industry is not available, the average exposure for the country can be used as an approximation, whose levered and un-levered estimates are presented in Table 6.

4.7 Converting discount rates into other currencies

Finally, we may need to convert discount rates from one currency to another.

Koller *et al.* (2010) argue that adjusting for differences in expected inflation between currencies is sufficient. For example, if the estimated discount rate in local currency is an inflation-adjusted rate (to discount

22. See the notes to Table 5.

Table 6. Leveraged, un-leveraged, and re-leveraged estimates, and WACC by country

	N° Firms	Agg Debt	Agg Cash	Agg Mkt Cap	Assets	Cash/ Assts	Net Agg Debt/ Equity	Median Net Debt/Equity
Argentina	62	$19,534	$6,272	$51,739	$71,273	0.09	0.26	0.26
Brazil	175	$404,263	$62,441	$491,847	$896,110	0.07	0.69	0.41
Chile	128	$176,318	$31,226	$232,647	$408,965	0.08	0.62	0.42
Colombia	41	$74,215	$28,313	$189,704	$263,919	0.11	0.24	0.18
Mexico	100	$188,498	$51,082	$516,406	$704,904	0.07	0.27	0.19
Peru	62	$40,759	$30,934	$82,877	$123,637	0.25	0.12	0.18
Total	568	$903,588	$210,267	$1,565,219	$2,468,807	0.09	0.44	0.27

	Country Debt Lambda	Leveraged Beta	Leveraged Lambda	Un-leveraged Beta	Un-leveraged Lambda	Cap. Cost Asset	Re-leveraged Beta	Re-leveraged Lambda	Equity Cost of Capital Re-leveraged
Argentina	5.40	1.05	0.65	0.84	1.62	10.6%	1.21	-0.06	7.8%
Brazil	1.13	0.93	1.33	0.55	1.25	8.5%	0.79	1.30	9.6%
Chile	0.61	0.54	1.29	0.33	1.03	7.1%	0.48	1.22	8.2%
Colombia	1.07	0.52	1.01	0.42	1.02	7.4%	0.61	1.00	8.1%
Mexico	1.06	0.49	0.84	0.38	0.88	6.9%	0.55	0.81	7.4%
Peru	1.08	0.83	1.30	0.74	1.27	9.4%	1.07	1.36	10.9%
Total	1.10	0.68	1.10	0.47	1.10	7.8%	0.68	1.10	8.6%

Source: The original data for aggregate debt (Agg Debt), aggregate cash (Agg Cash), market capitalization (Agg Mkt Cap), and Assets. Data Page of Aswath Damodaran (http://pages.stern.nyu.edu/~adamodar/), corresponding to data updated to December. 2013. Numbers in millions of USD. (1) Debt minus cash over market cap; (2) Obtained as the slope coefficient of regressing each country's credit risk factor against the average risk factor (see Table 4, sample 2012-2013); (3) See Table 5, sample 2012-2013; (4) Assumes Beta of Debt equal to zero and is obtained as (Leveraged Beta)/(1+D/E), where D/E net debt to equity; (5) Obtained as: (Country Debt Lambda)*(D/E)/(1+D/E) + (Leveraged Lambda)*(1/(1+(D/E)); (6) Uses the premia from Table 5; (7) Beta and Lambda are re-leveraged assuming an average D/E equal to 0.44; (8) Calculated with re-leveraged parameters and uses premia from Table 5.

inflation-adjusted cash flows) with an expected U.S. inflation of 2%, we simply subtract 2% from the cost of capital in U.S. dollars.

Alternatively, we can take as a reference the long rate in local currency and the equivalent rate in U.S. dollars with the same country risk. For example, we can start with the interest rate on the "synthetic" bonds, as described above, then add the difference between the rate in local currency and the synthetic rate in U.S. dollars to the cost of capital in U.S. dollars. The differences in expected inflation and exchange rate risk premia will be reflected in the differences between interest rates, but in this case are market-determined.

These calculations are presented in Table 7. The third column shows the differences between nominal interest rates in local currency and the corresponding synthetic rate in U.S. dollars. These differences are added to the discount rate in U.S. dollars to obtain the corresponding rate in local currency (the nominal rate in this case).

Finally, we need to consider that the interest rate differential in various currencies relating to the same issuer (e.g., a country) may not only reflect devaluation expectations, but also a currency risk premium. This means that the rate in local currency will be "too high" with respect to a risk-neutral case. Thus, the additional currency risk premium should be subtracted from the differential between rates. This point is not fully explained here. We merely suggest a method to take into account this possibility.

This can be seen in Table 7. We assume that each country's currency (in reality, the short-term bonds in each country's currency) are also part of integrated markets that are valued according to the two-risk-factor model used in this paper. As shown in columns 4 and 6 of this table, some currency Betas and all their Lambdas are significant (with the exception of Argentina, whose currency does not float). This corroborates the conjecture that a relationship exists between exchange rate and credit risks. Column 7 shows an estimate of the exchange risk premia implicit in local interest rates. The last column shows the differential between rates adjusted for the implicit risk premium, which is subtracted. The results are mixed. For Brazil, the rate in BRL should be 5.3% higher than the corresponding rate in USD. For Chile and Mexico, the rate should be lower by slightly more than 1%. For Colombia and Peru, the differences are close to zero.

Table 7. Adjustments to discount rates in USD

	Synthetic Yield 10-year bonds USD (%)[1]	10-year local currency bond yields (%)[2]	Yield Differential	β currency[3]	t-test	λ currency[3]	t-test	Currency risk premium (%)[4]	Yield Diferential minus currency risk premium
Argentina	16.9	24.9	8.0	-0.00	-0.05	-0.01	-0.10	-0.0	8.0
Brazil	5.2	12.8	7.6	0.11	2.27	0.75	6.15	2.3	5.3
Chile	3.9	5.2	1.3	0.03	0.70	0.97	7.99	2.6	-1.3
Colombia	4.5	6.8	2.3	0.00	0.08	0.65	5.33	1.7	0.6
Mexico	4.2	6.4	2.2	0.13	2.75	1.14	9.38	3.4	-1.2
Peru	4.6	5.7	1.0	-0.04	-0.96	0.41	3.38	0.9	0.2

Dates around Dec. 13, 2013. (1) Source: Bloomberg, al 13-dic-2013; (2) ARG: Bocon 2022 (Source: www.puentenet.com); BRL Source: Global Financial Database (GFD); CHL BTP a 10 años. Source: LVA Índices; COL. Source:GFD; MEX: GFD; PER: investing.com; (3) Estimated simultaneously against the two risk factors, sample 2012-2013; (4) Corresponds to

5. Summary and conclusions

This paper develops a methodology consistent with the academic literature and financial industry practice to estimate the cost of capital in emerging markets. Our research shows that in many aspects, this is an open issue.

The literature review concludes that there is no consensus regarding the most suitable international asset pricing model for calculating discount rates for emerging countries. In addition, the criteria used by different practitioners are not fully aligned, nor are they consistent with the academic literature. *Ad hoc* models are frequently used.

As others, we adopt the perspective of a global investor, taking the U.S. dollar as the reference currency. We estimate a two-factor model for fixed income, currencies, and equity in emerging countries. The factors are the market risk, measured as the S&P 500's returns in excess of a risk free rate, and credit risk, measured as the excess return of a synthetic bond portfolio with average Latin American country risk. A contribution of this paper is a methodology to determine the second risk factor and the exposure to it. These two risk factors also have a significant explanatory power regarding stock market returns and currency returns for each country in the sample, suggesting an appropriate implicit consideration of exchange rate risk.

The paper also discusses several applied issues, which are important when calculating discount rates in general:

- The global risk premium is about 4% with respect to long-term bonds.
- According to the literature review, the appropriate estimate of the market risk premium is the forecasted arithmetic mean, both for fixed income and for equity investments.
- Using the average CDS as the second risk factor, the average credit risk premium (adjusted to its arithmetic mean) is 2.5% for the countries in the sample.
- The sensitivity of each country's sovereign risk to the average credit risk factor is ranked as follows, from smallest to largest: Chile (0.6); Mexico, Panama, Colombia, and Peru (around 1); Venezuela (2.7); and Argentina (5.4).

- There are differences between debt yields and their expected returns. The latter, and not the yields, should be used to estimate the cost of capital, but the adjustment is important only for non-investment-grade companies or countries.
- Assuming tax advantages of using debt when estimating the weighted average cost of capital is inappropriate in several emerging countries.
- We explain how risk factors should be "un-leveraged" and then "re-leveraged" in the context of the proposed multifactor model.
- Sensitivity to the global risk factor (or Beta) for some applications is derived from similar industries in developed countries. We discuss the relevant issues for this case, which essentially comes down to avoiding a double counting of the same risk source.
- Finally, we explain how to convert discount rates to local currency.

The following results are of interest.

First, applying the two-risk-factor model to Latin American stock indices to obtain the discount rates gives similar results across various samples and specifications. For example, there are no significant differences when we use the specific country credit risk or the average credit risk of investment grade countries as the second risk factor.

Second, the cost of capital tends to align itself with the country risk measured by the CDS when the effect of aggregate leverage for the listed companies included in the indices for each country is considered. The markets with greater sensitivity to market risk (β) also tend to have greater sensitivity to credit risk (λ), based on un-leveraged estimates.

Finally, market and credit risk factors are positively correlated. Therefore, when estimating market β's in a univariate regression, that parameter will be overestimated with respect to the simultaneous estimation of two risk factors. In this case, the additional credit risk premium should be adjusted downwards by between 80 and 160 basis points.

In summary, this paper presents a methodology that suggests a step-by-step process to estimate the cost of capital for emerging countries, in a manner consistent with theory and practice.

REFERENCES

Abuaf, N. (2011), "Valuing Emerging Market Equities – The Empirical Evidence," *Journal of Applied Finance* **21**(2): 1–19.

Abuaf, N. (2015), "Valuing Emerging Market Equities – A Pragmatic Approach Based on the Empirical Evidence," *Journal of Applied Corporate Finance* **27**(1): 71–88.

Adler M. and B. Dumas (1983), "International Portfolio Choice and Corporation Finance: A Synthesis," *The Journal of Finance* **38**: 925–984.

Alexander, I., A. Estache, and A. Oliveri (2000), "A few things transport regulators should know about risk and the cost of capital," *Utilities Policy* **9**(1): 1–13.

Antell, J. and M. Vaihekoski (2007), "International asset pricing models and currency risk: Evidence from Finland 1970–2004," *Journal of Banking and Finance* **31**(9): 2571–2590.

Avramov, D., T. Chordia, G. Jostova, and A. Philipov (2012), "The World Price of Credit Risk," *Review of Asset Pricing Studies* **2**(2): 112–152.

Bansal, R. and M. Dahlquist (2002), "Expropriation Risk and Return in Global Equity Markets," Working Paper, Duke University.

Bekaert, G., C.R. Harvey, C.T. Lundblad, and S. Siegel (2011), "What Segments Equity Markets?" *Review of Financial Studies* **24**(12): 3841–3890.

Blume, M.E. (1974), "Unbiased estimators of long-run expected rates of return," *Journal of the American Statistical Association* **69**(347): 634–638.

Campbell, J.Y. and S.B. Thompson (2008), "Predicting excess stock returns out of sample: Can anything beat the historical average?" *Review of Financial Studies* **21**(4): 1509–1531.

Carrieri, F., V. Errunza, and K. Hogan (2007), "Characterizing world market integration through time," *Journal of Financial and Quantitative Analysis* **42**(4): 915–940.

Chaieb, I. and V. Errunza (2007), "International asset pricing under segmentation and PPP deviations," *Journal of Financial Economics* **86**: 543–578.

Cochrane, J.H. (2008), "The Dog that Did Not Bark: A Defense of Return Predictability," *Review of Financial Studies* **21**(4): 1533–1575.

Cochrane, J.H. and M. Piazzesi (2005), "Bond Risk Premia," *American Economic Review*, **95** (1): 138–160.

Cooper, I. (1996), "Arithmetic versus geometric estimators: Setting discount rates for capital budgeting," *European Financial Management*, **2**(2): 157-167.

Dahlquist, M. and T. Sallstrom (2001), "An Evaluation of International Asset Pricing Models," Working Paper, Duke University.

Damodaran, A. (2003), "Measuring Company Exposure to Country Risk," Mimeo, NYU, p. 1–30**.**

Damodaran, A. (2012), *Investment valuation: Tools and techniques for determining the value of any asset.* Hoboken, NJ: John Wiley and Sons.

Damodaran, A. (2015), "Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2015 Edition," Mimeo, NYU.

Dimson, E., P. Marsh, and M. Staunton (2015), *Credit Suisse Global Investment Returns Yearbook,* Zurich: Credit Suisse Research Institute.

Dimson, E., P. Marsh and M. Staunton (2013), "The Low Return World," in *Credit Suisse Global Investment Returns Yearbook,* Zurich: Credit Suisse Research Institute. p. 5–14.

Erb, C., C. Harvey, and T. Viskanta (1996a), "Political Risk, Financial Risk and Economic Risk," *Financial Analysts Journal* **52**(6): 28–46.

Erb C., C. Harvey and T. Viskanta (1996b), "Expected Returns and Volatility in 135 Countries," *The Journal of Portfolio Management* **22**(3): 46–58.

Fama, E.F. (1996), "Discounting under uncertainty," *Journal of Business* **69**(4): 415–428.

Fama, E.F. and K.R. French (1992), "The Cross-Section of Expected Stock Returns," *Journal of Finance* **47**(2): 427–465.

Fama, E.F. and K.R. French (1993), "Common Risk Factors in the Returns on Stocks and Bonds," *Journal of Financial Economics* **33**(1): 3–56.

Fama, E.F. and K.R. French (2002), "The equity premium," *The Journal of Finance* **57**(2): 637–659.

Fama, E.F. and K.R. French (2012), "Size, value, and momentum in international stock returns," *Journal of Financial Economics* **105**(3): 457–472.

Ferson, W. and C. Harvey (1994), "Sources of Risk and Expected Returns in Global Equity Markets," *Journal of Banking and Finance* **18**(4): 775–803.

Ferson, W.E., S. Sarkissian, and T.T. Simin (2003), "Spurious regressions in financial economics?" *The Journal of Finance* **58**(4): 1393–1414.

Griffin, J.M. (2002), "Are the Fama and French Factors Global or Country Specific?" *The Review of Financial Studies* **15**(3): 783–803.

Hammond, P.B. Jr., M.L. Leibowitz, and L.B. Siegel (2011), eds., *Rethinking the Equity Risk Premium*, Charlottesville, VA : Research Foundation of CFA Institute.

Harvey, C. (1995), "Predictable Risk and Returns in Emerging Markets," *Review of Financial Studies* **8**(3), 773–816.

Hau, H. (2011), **"**Global versus Local Asset Pricing: A New Test of Market Integration**,"** *The Review of Financial Studies* **24**(12): 2891–3940.

Hernández, L. and E. Walker (1993), "Estructura de financiamiento corporativo en Chile (1978–1990)," *Estudios Públicos* **51**(Invierno): 87–156.

Hodrick, R. and X. Zhang (2001), "Evaluating the Specification Errors of Asset Pricing Models," *Journal of Financial Economics* **62**(2): 327–376.

Ibbotson, R.G. and P. Chen (2003), "Long-run stock returns: Participating in the real economy," *Financial Analysts Journal* **59**(1): 88–98.

Jacquier, E., A. Kane, and A.J. Marcus (2003), "Geometric or arithmetic mean: A reconsideration," *Financial Analysts Journal* **59**(6): 46–53.

Karolyi, A. and R. Stulz (2003), "Are Financial Assets Priced Locally or Globally? in G. Constantinides, M. Harris, and R.M. Stulz, eds., *Handbook of the Economics of Finance*, New York: North-Holland, 2003.

Keck, T., E. Levengood, and A. Longfield (1998), "Using Discounted Cash Flow Analysis in an International Setting: A Survey of Issues in Modeling the Cost of Capital," *Journal of Applied Corporate Finance* **11**(3): 82–99.

Koller, T., M. Goedhart, and D. Wessels (2010), *Valuation, Measuring and Managing the Value of Companies*, MacKinsey and Company, Hoboken NJ: John Wiley and Sons.

Lettau, M. and S. Ludvigson (2001), "Resurrecting the (C)CAPM: A Cross-Sectional Test when Risk Premia are Time-Varying," *Journal of Political Economy* **109**(6): 1238–1287.

Lettau, M., S.C. Ludvigson, and J.A. Wachter (2008), "The declining equity premium: What role does macroeconomic risk play?" *Review of Financial Studies* **21**(4), 1653–1687.

Lintner, J. (1965), "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," *Review of Economics and Statistics* **47**(1): 13–37.

Ludvigson, S.C. and S. Ng (2009), Macro factors in bond risk premia. *Review of Financial Studies* **22**(12): 5027–5067.

Miller, M.H. (1977), "Debt and taxes," *The Journal of Finance* **32**(2): 261–275.

Modigliani, F. and M. Miller (1958), "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review* **48**(3): 261–297.

Modigliani, F. and M. Miller (1963), "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review* **53**(3): 433–443.

Moody's Global Corporate Finance (2008), *Special Comment – Corporate Default and Recovery Rates, 1920–2007*, New York: Moody's Investors Service.

Mossin, J. (1966), "Equilibrium in a Capital Asset Market," *Econometrica* 34, 768–783

Pflueger, C.E. and L.M. Viceira (2011), "An empirical decomposition of risk and liquidity in nominal and inflation-indexed government bonds," NBER Working Paper No. 16892.

Pukthuanthong, K. and R. Roll (2009), "Global market integration: A better way to measure it and its application," *Journal of Financial Economics* **94**(2): 214–232.

Rowenhorst, G. (1999), "Local Return Factors and Turnover in Emerging Markets," *Journal of Finance* **54**: 1439–1464.

Sercu, P. (1980), "A Generalization of the International Asset Pricing Model," *Revue de la Association Francaise de Finance* **1**(1): 91–135.

Sharpe, W. (1964), "Capital Asset Prices. A Theory of Market Equilibrium under Conditions of Risk," *Journal of Finance* **19**(3): 425–442.

Simin, T. (2008), "The Poor Predictive Performance of Asset Pricing Models," *Journal of Financial and Quantitative Analysis* **43**(2): 355–380.

Welch, I. and A. Goyal (2008), "A comprehensive look at the empirical performance of equity premium prediction," *Review of Financial Studies* **21**(4): 1455–1508.

Zhang, X. (2006), "Specification Tests of Asset Pricing Models in International Markets," *Journal of International Money and Finance* **25**(2): 275–307.