LOCAL, GLOBAL, AND INTERNATIONAL CAPM: FOR WHICH COUNTRIES DOES MODEL CHOICE MATTER?

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Abstract: For individual stocks of 46 countries, this study investigates empirical differences in discount rate estimates between three risk-return models of interest to practitioners who perform discounted cash flow valuation analysis: (1) the traditional (local) CAPM; (2) the global CAPM (GCAPM), where the only risk factor is the global market index; and (3) an international CAPM (ICAPM) with two risk factors, the global market index and a wealth-weighted foreign currency index. The study finds that model choice makes a substantial difference for many, but not all, countries.

Keywords: discount rate; international CAPM; global CAPM; local CAPM; currency risk

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Practitioner Digest

Modern financial markets are internationally integrated to the point that an international CAPM is conceptually superior to the traditional "local" CAPM, which in principle is appropriate only for a segmented financial market. Moreover, an international CAPM that includes currency risk is conceptually superior to one that ignores it. However, to a practitioner who wants to use a risk-return model to estimate a discount rate for a valuation analysis, the local CAPM is easier to apply than an international CAPM, and an international CAPM that ignores currency risk (termed a global CAPM) is easier to apply than one that includes it.

Because the effort needed to apply each model varies, it is relevant for practitioners to know how much difference the model choice makes in discount rate estimates. This empirical study shows that the model choice tends to make a small difference for some countries and a large difference for others. Therefore, practitioners in some countries can apply an easier model and estimate discount rates that tend to reasonably approximate those of an international CAPM that includes currency risk. Practitioners in countries where model choice makes a substantial difference should beware that applying an easier model may result in substantial errors in discount rate estimates for valuation.

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To estimate a discount rate for a valuation analysis, some textbooks (Sercu, 2009; Solnik and McLeavey, 2009) and articles (Stulz, 1995a,b; Stulz, 1999) say that an *international* risk-return model is more appropriate than the traditional ("local") CAPM, even for most emerging markets (Stulz, 1999). The argument is that world financial markets are now sufficiently integrated, and investors are sufficiently internationally-diversified, to justify an international model, whereas the local CAPM applies only in the passé setting of segmented financial markets and no international diversification.

However, financial information services continue to offer beta estimates (e.g., *Value Line* and brokerage research reports) and market risk premium estimates (e.g., Duff and Phelps, Damodaran) for only the local CAPM and not the input estimates for international risk-return models. Therefore, it is important to know how much difference an international model makes in discount rate estimates, to understand whether the model is worth the additional effort necessary to estimate the inputs.

This study investigates empirical differences between discount rate estimates of the following three risk-return models: (1) the traditional local CAPM; (2) the global CAPM (GCAPM), where the only risk factor is the global market index; and (3) an international CAPM (ICAPM) with two risk factors, the global market index and a wealth-weighted foreign currency index.[1] Of these models, the ICAPM is the most conceptually appropriate in the modern international financial environment, but also takes the most effort to apply. We recognize that many empirical researchers advocate models with additional pricing factors, including factors to capture the impact of time-varying parameters (e.g., Griffin, 2002; Hou et al. 2011; and Bekaert et al., 2014). However, this study focuses only on three "practitioner-friendly" risk-return models that are based on finance theory, as opposed to models that have been empirically estimated as fitting (potentially inefficient) historical data observations.

It is not a given that different risk-return models yield materially different discount rate estimates. In fact, empirical research cited in the next section has typically found relatively modest differences between the three models' discount rate estimates for U.S. stocks. However, modest discount rate differences for U.S. stocks do not imply the same for other countries. Therefore, this study addresses the issue for a large sample of individual stocks from 46 countries, representing 35 currency areas and 97% of the world's financial wealth. We gauge the economic significance of the models' average discount rate difference estimates for each country's sample of stocks. The study uses the local currency perspective because the magnitude of the models' discount rate differences depends on the currency perspective, and the local currency perspective is the most useful to practitioners who want to find the intrinsic value of an asset whose cash flows are projected in the local currency.

The two specific research questions are as follows: First, for which countries does the local CAPM tend to approximate the ICAPM? Second, for which countries does the GCAPM tend to approximate the ICAPM if the local CAPM does not? If the local CAPM adequately approximates

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[1] The study follows the usual convention of referring to the single-factor special case of the general ICAPM as "the GCAPM". For simplicity, the two-factor version of the ICAPM is labelled "the ICAPM", with the understanding that the model is a special case of the general ICAPM.

the ICAPM for a country's firms, use of the easiest-to-apply local CAPM would be justified for that country. If the local CAPM does not adequately approximate the ICAPM for a country's firms, but the GCAPM does, use of the next-easiest-to apply GCAPM would be justified for that country.

The study's main findings are briefly as follows: First, empirical discount rate estimates for the local CAPM and ICAPM differ substantially for firms in many countries. The study identifies the only 6 (of 24) developed countries and 3 (of 22) emerging market countries for which the firms' average absolute difference between the local CAPM and ICAPM estimates is under 65 basis points. Second, the GCAPM improves on the local CAPM in approximating the ICAPM for firms in many, but not all countries. Of the countries where the local CAPM tends to give a poor approximation for the ICAPM, the study identifies the 13 developed and 3 emerging market countries for which the firms' average absolute difference between the GCAPM and ICAPM estimates is under 65 basis points. There are 21 countries for which neither the local CAPM nor the GCAPM yields discount rate estimates that have an average absolute difference from the ICAPM estimate of under 65 basis points.

I. Related Research and Methodology Improvements

Empirical studies of U.S. stocks have tended to find relatively modest discount rate differences between the ICAPM, GCAPM, and local CAPM. See Mishra and O'Brien (2001); Koedijk et al. (2002); Harris et al. (2003); Koedijk and van Dijk (2004a,b); Dolde et al. (2011, 2012); Krapl and Giaccotto (2015); and Krapl and O'Brien (2016). Compared to U.S. stocks, the research on the issue for stocks of other countries is relatively scant.

Koedijk et al. (2017) examines empirical discount rate differences for non-U.S. stocks, reporting firms' average difference between local CAPM and GCAPM estimates that is (1) aggregated across 15 countries, and (2) from the US dollar perspective. In addition to expanding the set of sample countries, our study improves on the Koedijk et al. (2017) research in three important ways: First, we summarize the models' average difference estimates by country. Second, we use the local currency perspective. Third, we examine local CAPM/ICAPM and GCAPM/ICAPM differences, but not the less-useful local CAPM/GCAPM differences reported by Koedijk et al. (2017).

Bruner et al. (2008) also examine empirical discount rate differences for non-U.S. stocks, reporting large average differences between the local CAPM and the GCAPM for stocks in most of 48 countries, but measured from the US dollar perspective. Although Bruner et al. (2008) report the average difference estimates by country, the study otherwise has the same limitations indicated for Koedijk et al. (2017). Additionally, Bruner et al. (2008) use conventional, historical-average factor risk premium estimates. This study's approach is more consistent with finance theory, involving *ex ante* model factor and stock risk premium estimates that are consistent across countries and currencies for a given level of global market risk aversion.

Koedijk et al. (2002) and Koedijk and van Dijk (2004a,b) estimate local CAPM and ICAPM discount rate differences from the local currency perspective. However, these three studies examine only a small number of countries (and with pre-euro data). Also, the three studies focus on estimating the percentage of firms with statistically significant difference estimates; instead, to inform those who want to estimate discount rates, this study stresses the magnitude and economic significance of difference estimates. Additionally, the three studies use an ICAPM with multiple individual currency factors, whereas this study uses a 35-currency wealth-aggregate index as the sole ICAPM currency risk factor. Moreover, the currency index is an innovative wealth-aggregate index that is consistent with ICAPM theory, unlike the published trade-weighted currency indexes that have typically been used in other ICAPM-related research.

II. Review of the Risk-Return Models

This section provides a more precise definition of the three risk-return models, starting with the ICAPM used for the benchmark model.

II.1. ICAPM

In addition to return on the (unhedged) value-weighted global market index, R_G, the study's benchmark ICAPM risk-return model has a currency risk factor, the return on a wealth-weighted foreign currency index, R_X. This model is the simplest version of the general ICAPM where foreign currency risk is priced. The model's risk-return expression for asset *i*'s required risk premium, $RP_i = E(R_i) - r_f$, is derived in the Appendix and shown in equation (1):

$$RP_i = \beta_i'[RP_G] + \gamma_i'[RP_X] \tag{1}$$

where $RP_G = E(R_G) - r_f$ and $RP_X = E(R_X) - r_f$ are the risk premia for the global market index and the foreign currency index, as given in equations (A.3*a*) and (A.3*b*); and β_i' and γ_i' are asset *i*'s *partial* systematic risk coefficients, which are the coefficients in a multivariate regression of asset *i*'s return versus R_G and R_X. The partial risk coefficients are like their single-factor counterparts, beta (β_i) and total "Adler-Dumas (1984)" FX exposure (γ_i), except adjusted for the interaction between R_G and R_X.[2] Throughout the paper, a β symbol is used for beta versus a market index and a γ symbol for exposure versus a foreign currency index.

The ICAPM in equation (1) holds from the perspective of any reference currency, and thereby provides mutually consistent discount rate estimates for a given asset in different

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[2] Whereas $\beta_i = cov(R_i, R_G)/\sigma_G^2$, $\beta_i' = [cov(R_i, R_G)\sigma_X^2 - cov(R_i, R_X)cov(R_G, R_X)]/[\sigma_G^2\sigma_X^2 - cov(R_G, R_X)^2]$, and whereas $\gamma_i = cov(R_i, R_X)/\sigma_X^2$, $\gamma_i' = [cov(R_i, R_X)\sigma_G^2 - cov(R_i, R_G)cov(R_G, R_X)]/[\sigma_G^2\sigma_X^2 - cov(R_G, R_X)^2]$.

currencies. The composition of the global market index is the same from the perspective of any reference currency. The wealth-weighted index of *all* currencies (including the reference currency) also has the same composition from any currency perspective. However, to avoid the idea of a currency index that contains the reference currency, we adjust so that each country's currency index contains only foreign currencies from the perspective of the reference currency. (See the Appendix for details.)

Each currency in a country's foreign currency index has a return equal to the currency's risk-free rate plus the percentage change in the currency versus the reference currency. Each foreign currency's risk premium is equal to the currency's equilibrium expected rate of change versus the reference currency, plus the risk-free rate differential (the foreign-currency's nominal risk-free rate minus the reference-currency's nominal risk-fee rate.) The foreign currency index's risk premium is the wealth-weighted average of the individual foreign currencies' risk premiums.

An economy's wealth weight pertains to the financial wealth of the economy's investors, which is not the same as the market cap value weight of the economy's stocks. For example, U.S. stocks might represent 40% of global market capitalization, but U.S. investors' financial wealth could be only 30% of world financial wealth. The impact of a currency's risk on asset prices depends on the percentage of world financial wealth that uses the currency to buy goods, not the percentage of world wealth represented by the stocks domiciled in the currency's country.

II.2. GCAPM

The global CAPM (GCAPM) is the term usually used for the simplified form of the ICAPM with no explicit currency risk factor. The GCAPM has the same structure as the traditional CAPM, but with the global market index replacing the local market index, as shown in equation (2):

$$RP_i = \beta_i [RP_G] \quad (2)$$

where RP_G is the global market risk premium; and β_i is asset i's beta versus R_G, $\beta_i = cov(R_i, R_G)/\sigma_G^2$.

Empirical evidence that systematic exposure to exchange rate changes is a priced risk factor supports the conceptual superiority of the benchmark ICAPM over the GCAPM. See, for examples, Ferson and Harvey (1993, 1994), Dumas and Solnik (1995), De Santis and Gerard (1998), He and Ng (1998), Harvey et al. (2002), Kolari et al. (2008), and Lee et al. (2009). Nevertheless, the GCAPM has advocates, who often cite the "accepted wisdom" that in theory the GCAPM holds if PPP holds, and who are trading-off the empirical evidence against PPP in exchange for the GCAPM's relative simplicity.[3]

Despite the shortcomings, it seems reasonable to expect the GCAPM to be a better valuation model than the local CAPM in integrated financial markets. Moreover, the GCAPM's relative simplicity makes the model potentially useful in practice for countries where the discount rate estimates reasonably approximate the ICAPM's, relative to the local CAPM's. Stulz's (1995b) Nestlé example, however, shows substantially different estimates by about 150 basis points between the local (Swiss) CAPM and the GCAPM.

II.3. Local CAPM

The well-known traditional (local) CAPM is shown for country Y in equation (3):

$$RP_i = \beta_{iY}[RP_Y] \tag{3}$$

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[3] Sercu (1980) and Ross and Walsh (1983) argue that even under PPP, the GCAPM can hold in at most one currency; if the GCAPM holds in currency C, the correct risk-return model in any other currency has two risk factors: the global market index and currency C's return versus the other currency. O'Brien (1999) shows a simple numerical example. For the "Solnik-Sercu special case", therefore, using the GCAPM in more than one currency is generally *ad hoc* and does not yield consistent discount rate estimates or cross-border valuations. The GCAPM will hold from every currency perspective only in the (unrealistic) special case of logarithmic utility, as suggested by Grauer et al. (1976).

where β_{iY} is asset i's beta versus country Y's local market index, $cov(R_i, R_Y)/\sigma_Y^2$; RP_Y is country Y's market risk premium, $E(R_Y) - r_f$; and R_Y is the return on country Y's local market index. Given the international integration of country Y's financial market, the country's RP_Y must be consistent with the baseline ICAPM risk-return model, viewing the local market index as asset *i*. Koedijk and van Dijk (2004b) also use this approach.

III. Model Inputs and Outputs

Following the advice of Elton (1999), Sharpe (2004), and Levy (2011), the study uses *ex ante* risk premium estimates for model factors and individual stocks instead of mean realized returns. The *ex ante* risk premium estimates are mutually consistent across all countries and all models, which is not possible using historical averages. Because we use monthly data for January 1999 through December 2016, the *ex ante* risk premium estimates should be viewed as for 2017. This section explains the process for the *ex ante* risk premium estimation.

III.1. Global market and foreign currency indexes

The MSCI All Country World Index (ACWI) is the study's global market index. Foreign exchange (FX) rates are used to convert global market index returns from US dollars to local terms and to construct foreign currency index returns. For many currencies, the month-end FX rates are obtained from the Federal Reserve H.10 daily FX rate series. For the remaining countries, the month-end FX rates are derived from the MSCI country equity indexes, which are available in both local currency and US dollars. For currencies in the Fed's H.10 data, the FX rates are virtually identical to those implied by the MSCI country equity index data.

A country's foreign currency index uses world financial wealth percentages of the economies of the 35 currencies, estimated by interpolating estimates in the Credit Suisse Research

Institute's *Global Wealth Databook* for 2000 and 2015, and which represent 97% of world wealth. The raw world wealth percentages are normalized to world wealth weights that sum to 100%. The sample's developed country and emerging market currencies represent 84% and 16% of the total financial wealth of the 35 currency areas, respectively. A currency area's foreign currency index weights are the world wealth weights of the 34 other currency areas normalized to sum to 100%.

These data are used to estimate the inputs for the *ex ante* global market risk premium (RP_G) and foreign currency risk premium (RP_X) for each currency area, per equations (A.3a) and (A.3b). From the perspective of a given home currency, equation (A.3a) says that the global market risk premium (RP_G) depends on the annualized return volatilities of the global market index (σ_G) and the foreign currency index (σ_X), where the impact of the latter volatility depends on the global market index's total FX exposure versus the foreign currency index (γ_G). Similarly equation (A.3b) says that the risk premium on the foreign currency index (RP_X) also depends on the annualized return volatilities of the global market index (σ_G) and the foreign currency index (σ_X), but the impact of the former volatility depends on the foreign currency index's "currency beta" versus the global market index (β_X). These inputs are shown for each currency in Table 1. (Recall the notation convention of a γ symbol for an "FX exposure" versus a currency index and a β symbol for a "beta" versus a market index.)

Equations (A.3a) and (A.3b) also require the home-currency wealth weight (w_H) and an estimate of global market risk aversion, Θ, for which we use 2.50. This estimate is consistent with empirical research by Brandt and Wang (2003), and as shown shortly, yields an annual *ex ante* U.S. equity risk premium "anchor" of 5.51%, which is within the range of estimates of modern surveys, advisory services (e.g., Damodaran and Duff & Phelps), and empirical studies (e.g., Fama and French, 2002; Mayfield, 2004; Welch and Goyal, 2008). Prior studies also used U.S. equity risk premium estimates as similar anchors (Stulz, 1995a; Stulz, 1995b). Although market risk aversion changes with market conditions, implying discount rate changes, discount rate *differences* are relatively insensitive to reasonable assumptions of market risk aversion.

The *ex ante* risk premium estimates for the global market index and the foreign currency index are shown for each currency perspective in the last two columns of Table 1. For example, the ICAPM inputs for the United States are as follows: w_H = 36.5%, σ_G = 15.7%, σ_X = 6.3%, γ_G =1.25, and β_X = 0.20. These inputs and equation (A.3a) yield the *ex ante* global market risk premium estimate in US dollars of $RP_G = 2.50(0.157)^2 + (1 - 2.50)(1 - 0.365)(1.25)(0.063^2) = 0.0569$, or 5.69%. The inputs and equation (A.3b) yield the *ex ante* foreign currency index risk premium estimate of $RP_X = 2.50(0.20)(0.157)^2 + (1 - 2.50)(1 - 0.365)(0.063^2) = 0.0085$, or 0.85%. The RP_X estimate says that ignoring the nominal risk-free rate differences between the index currencies and the US dollar, the equilibrium expected rate of change in the foreign currency index is 0.85% versus the US dollar, which represents a depreciation of the US dollar versus the foreign currency index.

Table 1's *ex ante* risk premium estimates are mutually consistent with each other across all the currency areas, given the global market risk aversion (Θ) of 2.50. We see that whereas the global market risk premium estimate is 5.69% from the US dollar perspective, the range of the RP_G estimates among developed countries is from a high of 7.11% from the Japanese yen perspective to a low of 3.23% from the Australian dollar perspective, mainly because the global market index's volatility (σ_G) is highest from the Japanese yen perspective (18.8%) and lowest from the Australian dollar perspective (11.8%).

Table 1: Risk Premium Estimates for the Global Market Index and Foreign Currency Index

	Symbol	w_H	σ_G	σ_X	γ_G	β_X	RP_G	RP_X
Developed Country Currencies								
Australia	AUD	1.9	11.8	10.3	0.17	0.13	3.23	-1.10
Eurozone	EUR	20.0	14.6	8.4	0.50	0.16	4.92	0.03
Canada	CAD	2.5	12.2	7.7	0.01	0.00	3.70	-0.85
Denmark	DKK	0.4	14.6	6.7	0.62	0.13	4.92	0.03
Hong Kong	HKD	0.5	15.7	3.9	2.00	0.12	5.67	0.54
Israel	ILS	0.3	13.7	6.3	0.35	0.07	4.51	-0.25
Japan	JPY	12.5	18.8	9.9	1.35	0.37	7.11	2.01
New Zealand	NZD	0.4	13.3	11.0	0.38	0.26	3.72	-0.66
Norway	NOK	0.4	14.0	8.5	0.45	0.16	4.43	-0.26
Singapore	SGD	0.4	13.7	3.5	-0.02	-0.00	4.70	-0.18
Sweden	SEK	0.8	13.1	8.3	0.26	0.10	4.01	-0.58
Switzerland	CHF	1.4	16.3	7.8	1.05	0.24	5.75	0.69
United Kingdom	GBP	6.3	14.8	7.4	0.63	0.16	4.98	0.10
United States	USD	36.5	15.7	6.3	1.25	0.20	5.69	0.85
Emerging Market Currencies								
Argentina	ARS	0.3	29.4	25.9	0.99	0.77	11.68	6.54
Brazil	BRL	0.9	23.5	23.7	0.80	0.81	7.13	2.84
Chile	CLP	0.2	13.9	10.4	0.42	0.24	4.12	-0.48
China	CNY	6.7	15.5	4.2	1.71	0.13	5.58	0.51
Colombia	COP	0.2	43.0	45.3	0.89	0.99	18.83	14.89
Czech Republic	CZK	0.1	15.5	9.4	0.71	0.26	5.02	0.25
Egypt	EGP	0.2	29.2	23.8	1.07	0.71	12.22	6.61
Hungary	HUF	0.1	14.9	11.5	0.55	0.33	4.42	-0.15
India	INR	1.2	13.5	6.3	0.23	0.05	4.42	-0.36
Indonesia	IDR	0.5	16.8	13.0	0.42	0.73	5.23	0.52
Malaysia	MYR	0.2	15.3	8.0	0.77	0.21	5.14	0.27
Mexico	MXN	0.8	12.7	9.2	0.22	0.11	3.75	-0.79
Peru	PEN	0.2	38.1	40.3	0.87	0.98	15.06	11.04
Philippines	PHP	0.2	14.7	6.1	0.71	0.12	5.02	0.10
Poland	PLN	0.3	13.2	11.4	0.28	0.39	3.61	-0.71
Russia	RUB	0.4	15.4	9.3	0.70	0.26	5.00	0.23
South Africa	ZAR	0.3	14.4	14.8	0.64	0.52	4.66	0.22
South Korea	KRW	1.2	12.7	9.6	0.26	0.15	3.66	-0.76
Taiwan	TWD	1.5	13.8	4.0	0.19	0.02	4.72	-0.16
Thailand	THB	0.1	14.4	6.3	0.58	0.11	4.84	-0.02
Turkey	TRY	0.4	16.3	16.8	0.59	0.62	4.20	-0.08

For each currency perspective, Table 1 reports the financial wealth weights (w_H), the annualized *ex ante* ICAPM risk premium estimates for the global market index and foreign currency index (RP_G and RP_X), the annualized volatility (standard deviation) of the global market index returns (σ_G); the annualized volatility of the foreign currency index returns (σ_X); the global market index's total FX exposure versus the foreign currency index (γ_G); and the foreign currency index's beta versus the global market index (β_X). The weights and the risk premium and volatility estimates are shown as percentages. The data period spans January 1999 to December 2016.

For the developed countries, the foreign currency index risk premium estimates (RP_X) range from a high of 2.01% (Japan) to a low of −1.10% (Australia). Ignoring the nominal risk-free rate differences between the index currencies and the home currency, a positive (negative) RP_X indicates an equilibrium expected depreciation (appreciation) of the home currency versus the foreign currency index. Per equation (A.3b), each country's foreign currency index risk premium is driven largely by the index's beta versus the global market index (β_X) and the global market index's volatility from the home-currency perspective (σ_G). Japan's high RP_X estimate is driven by the high global market index volatility in Japanese yen (σ_G = 18.8%) and high foreign currency index beta versus the global market index (β_X = 0.37). Australia's low σ_G (11.8%) and low β_X (0.13) help explain its low and negative RP_X estimate. We also note here for use later that there is a positive correlation between the RP_X estimates and the global market index's total FX exposure estimates (γ_G), because of the positive correlation between β_X and γ_G.[4]

III.2. Local equity indexes

Each country's *ex ante* equity risk premium in local currency (RP_Y) is estimated using the ICAPM in equation (1), letting "asset *i*" be country Y's equity index. The MSCI country equity indexes serve as the equity indexes for all countries except for the United States, for which we use the research-standard CRSP value-weighted index. The MSCI indexes consist of large and medium size firms.

The country equity risk premium estimates are shown in Table 2's first data column. The next two columns show the ICAPM risk coefficients for each equity index, β_Y' and γ_Y', from the

[4] The global market index's total FX exposure versus the home-currency's foreign currency index (γ_G) and the foreign currency index's "currency beta" versus the global market index (β_X) are both based on the covariance between R_G and R_X; and $\gamma_G\sigma_X^2 = \beta_X\sigma_G^2$.

local currency perspective. For example, in Swiss francs, the Swiss equity index's estimated partial beta versus the global market index (β'_Y) is 0.76 and partial FX exposure to the Swiss foreign currency index (γ'_Y) is –0.36. Also in Swiss francs, the global market risk premium estimate (RP_G) is 5.75%, and the foreign currency risk premium estimate (RP_X) is 0.69% (per Table 1). Thus, using the ICAPM benchmark risk-return model in equation (1), the required risk premium for Switzerland's equity index is RP_Y = 0.76[5.75%] – 0.36[0.69%] = 4.12%.

In US dollars, the U.S. equity index's estimated partial beta versus the global market index (β'_Y) is 1.02 and partial FX exposure to the U.S. foreign currency index (γ'_Y) is –0.35. Also in US dollars, the global market risk premium estimate (RP_G) is 5.69%, and the foreign currency risk premium estimate (RP_X) is 0.85% (per Table 1). Thus, using the ICAPM benchmark risk-return model in equation (1), the required risk premium for the U.S. equity index is RP_Y = 1.02[5.69%] – 0.35[0.85%] = 5.51%. Although global market risk aversion is unobservable, the use of Θ = 2.50 is mainly a calibration that results in the reasonable U.S. equity risk premium "anchor" of 5.51%.

For each country's equity index, Table 2 also shows three additional risk measures: the beta versus the global market index (β_Y); the total FX exposure to the country's foreign currency index (γ_Y); and the annualized volatility (σ_Y). As Table 2 shows, there is a tendency for a country's partial beta estimate (β'_Y) to exceed the beta estimate (β_Y), and for the partial FX exposure estimate (γ'_Y) to be lower than the total FX exposure estimate (γ_Y). The differences are larger (smaller) for countries with a relatively high (low) covariance between the global market index return (R_G) and the foreign currency index (R_X), resulting in negative partial FX exposure estimates (γ'_Y) for all countries except Hong Kong and China, despite total FX exposure estimates (γ_Y) that are both positive and negative.

Table 2: *Ex Ante* Local Equity Market Risk Premium Estimates (in Local Currency)

	RP_Y	β'_Y	γ'_Y	β_Y	γ_Y	σ_Y
Developed Countries						
Australia	3.07	0.71	-0.71	0.62	-0.59	13.3
Austria	5.47	1.12	-1.20	0.93	-0.64	22.6
Belgium	4.95	1.01	-0.66	0.90	-0.16	19.2
Canada	3.76	0.83	-0.81	0.83	-0.81	14.7
Denmark	4.76	0.97	-0.40	0.92	0.21	18.4
Finland	7.46	1.52	-0.57	1.42	0.19	30.5
France	5.49	1.12	-0.67	1.01	-0.11	17.5
Germany	6.57	1.34	-0.72	1.22	-0.05	21.4
Hong Kong	5.90	1.01	0.33	1.05	2.35	21.9
Ireland	5.20	1.06	-0.35	1.00	0.18	21.7
Israel	3.77	0.80	-0.66	0.75	-0.38	21.1
Italy	5.19	1.06	-0.88	0.92	-0.35	19.8
Japan	5.34	0.79	-0.14	0.74	0.92	18.3
Luxembourg	3.73	0.76	-0.35	0.70	0.03	18.3
Netherlands	5.59	1.14	-0.53	1.05	0.04	18.3
New Zealand	2.38	0.54	-0.56	0.39	-0.35	14.9
Norway	5.49	1.16	-1.35	0.94	-0.82	21.2
Portugal	3.96	0.81	-0.80	0.68	-0.39	18.5
Singapore	5.09	1.01	-1.93	1.01	-1.95	20.5
Spain	5.24	1.07	-0.94	0.92	-0.40	20.5
Sweden	5.86	1.34	-0.84	1.25	-0.50	22.0
Switzerland	4.12	0.76	-0.36	0.67	0.43	13.6
United Kingdom	4.35	0.88	-0.36	0.82	0.20	13.7
United States	5.51	1.02	-0.35	0.95	0.93	15.5
Emerging Markets						
Argentina	8.82	1.14	-0.69	0.61	0.43	41.2
Brazil	4.83	1.11	-1.09	0.23	-0.20	24.5
Chile	2.60	0.56	-0.59	0.42	-0.35	15.7
China	6.59	1.16	0.28	1.19	2.25	29.7
Colombia	-5.75	0.04	-0.44	-0.39	-0.40	26.2
Czech Rep.	3.57	0.75	-0.88	0.52	-0.34	23.5
Egypt	7.56	0.95	-0.62	0.51	0.40	34.6
Greece	6.43	1.32	-1.58	1.06	-0.92	34.2
Hungary	4.81	1.03	-1.54	0.52	-0.97	26.7
India	4.55	0.89	-1.70	0.80	-1.49	25.8
Indonesia	3.03	0.72	-1.45	0.10	-0.93	27.3
Malaysia	2.69	0.55	-0.53	0.44	-0.10	19.0
Mexico	4.24	0.96	-0.80	0.87	-0.59	18.9
Peru	-2.57	0.45	-0.85	-0.38	-0.46	28.4
Philippines	3.28	0.68	-1.52	0.50	-1.04	22.0
Poland	4.39	0.95	-1.37	0.55	-1.01	25.0
Russia	7.28	1.53	-1.54	1.13	-0.47	36.7
South Africa	3.76	0.84	-0.67	0.49	-0.14	17.8
South Korea	4.87	1.09	-1.14	0.92	-0.85	25.3
Taiwan	4.81	0.95	-2.14	0.91	-1.96	23.5
Thailand	4.83	0.99	-2.00	0.77	-1.43	27.8
Turkey	6.01	1.40	-1.53	0.45	-0.71	43.7

For each country and in local currency, Table 2 reports annualized *ex ante* equity risk premium estimates (RP_Y), the equity index's ICAPM risk coefficient estimates (β'_Y and γ'_Y), and other risk measures of the equity index: the beta versus the global market index (β_Y); the total FX exposure to the country's foreign currency index (γ_Y), and the annualized volatility (standard deviation) of the returns (σ_Y).The risk premium and volatility estimates are shown as percentages. The data period spans January 1999 to December 2016.

In principle, the sign on a country's total FX exposure (γ_Y) should be positive (negative) if the firms get an aggregate benefit from foreign currency appreciation (depreciation), as with exporters (importers). Another effect is currency market "flight to (away from) safety" in response to negative (positive) global economic news, pushing the total FX exposure higher for countries with safer (and those pegged to safer) currencies and lower for those with weaker currencies. Table 2 shows the highest γ_Y estimates are for Hong Kong (2.35), China (2.25), United States (0.93), Japan (0.92), and Switzerland (0.43), the lowest are for Taiwan (–1.96), Singapore (–1.95), India (–1.49), Thailand (–1.43), and Poland (–1.01), and otherwise the total FX exposure estimates are generally lower for emerging market countries than developed countries.

Despite the distinction between the total FX exposure of a country's equity index (γ_Y) and the total FX exposure of the global market index (γ_G) from that country's currency perspective, both FX exposure measures are versus the same foreign currency index, and both are from the local currency perspective. Across all countries, the correlation between the γ_Y and γ_G estimates is 0.86, which implies a positive correlation between the RP_X and γ_Y estimates due to the positive correlation the RP_X and γ_G estimates (noted earlier). This insight will be helpful later.

III.3. Individual stocks

The sample of stocks consists of 10,607 firms; 7,052 firms are from developed countries, including 2,036 U.S. firms, and 3,555 firms are from emerging market countries. Datastream is the source for firm-level monthly stock returns and market capitalizations. Monthly returns are calculated from Datastream's total return index (RI) in local currency, which assumes dividend reinvestment as of the ex-dividend date. To be included in the sample, a stock had to be listed on a major stock exchange, have at least 40 consecutive monthly return observations, and not have stale stock prices during more than three consecutive months. The filters are designed to correct for the Datastream data problems noted by Ince and Porter (2006) and Moore and Sercu (2013). These filters tend to substantially reduce the number of sample firms for many countries, and especially tend to eliminate many smaller companies.

Table 3 shows the average of the stocks' *ex ante* risk premium and risk coefficient estimates for each model, by country and in local currency: (1) the average *ex ante* ICAPM risk premium (RP_i^I), followed by the average ICAPM risk coefficient estimates (β_i' and γ_i'); (2) the average *ex ante* GCAPM risk premium estimate (RP_i^G), followed by the average GCAPM global beta estimate (β_i); and (3) the average *ex ante* local CAPM risk premium estimate (RP_i^L), followed by the average local CAPM beta estimate (β_{iY}). Each stock's risk premium estimate is based on the stock's risk coefficient estimates and the *ex ante* model risk premium estimates (in Table 1 for the ICAPM and GCAPM and in Table 2 for the local CAPM).

For example, assume a Swiss stock's risk coefficients are Table 3's average Swiss stock estimates: β_i' = 0.79, γ_i' = –0.50, β_i = 0.67, and β_{iY} = 0.78. Using the global market and foreign currency index risk premium estimates for Switzerland from Table 1 (RP_G = 5.75% and RP_X = 0.69%), the stock's ICAPM risk premium estimate is RP_i^I = 0.79[5.75%] – 0.50[0.69%] = 4.20%, and the stock's GCAPM risk premium estimate is RP_i^G = 0.67[5.75%] = 3.85%. Using the Swiss local equity risk premium estimate from Table 2 (RP_Y = 4.12%), the stock's local CAPM risk premium estimate is RP_i^L = 0.78[4.12%] = 3.21%. These example results are close to the average Swiss stock risk premium estimates in Table 3: RP_i^I = 4.20%; RP_i^G = 3.86%; and RP_i^L = 3.20%. All of the risk coefficient and risk premium estimates in this example are in Swiss francs.

Table 3: Average *Ex Ante* Risk Premium Estimates for Stocks (in Local Currency)

		ICAPM			GCAPM		LOCAL CAPM	
	# Firms	RP_i^I	β_i'	γ_i'	RP_i^G	β_i	RP_i^L	β_{iY}
Developed Countries								
Australia	245	3.15	0.66	-0.92	1.75	0.54	2.73	0.89
Austria	29	3.44	0.70	-0.66	2.93	0.60	3.03	0.55
Belgium	68	3.33	0.68	-0.56	2.90	0.59	2.64	0.53
Canada	406	3.34	0.68	-0.97	2.50	0.68	3.27	0.87
Denmark	73	3.97	0.81	-0.56	3.63	0.74	3.37	0.71
Finland	60	4.34	0.89	-0.58	3.88	0.79	2.49	0.34
France	267	4.32	0.88	-0.61	3.85	0.78	4.06	0.74
Germany	209	4.43	0.90	-0.55	4.00	0.81	4.03	0.61
Hong Kong	307	5.95	0.97	0.85	6.10	1.08	5.47	0.93
Ireland	18	5.23	1.07	-0.74	4.66	0.95	3.69	0.71
Israel	131	3.65	0.77	-0.80	3.19	0.71	2.43	0.64
Italy	91	5.01	1.02	-0.80	4.39	0.89	4.59	0.88
Japan	2,103	3.61	0.51	0.00	3.61	0.51	4.14	0.78
Luxembourg	7	3.19	0.65	-0.52	2.79	0.57	1.89	0.51
Netherlands	71	4.71	0.96	-0.61	4.23	0.86	4.26	0.76
New Zealand	35	2.16	0.49	-0.53	1.30	0.35	1.36	0.57
Norway	59	4.70	1.00	-0.96	3.75	0.85	4.07	0.74
Portugal	23	3.39	0.69	-0.73	2.82	0.57	3.13	0.79
Singapore	118	4.93	0.98	-1.78	4.62	0.98	4.84	0.95
Spain	58	4.16	0.85	-0.72	3.60	0.73	3.70	0.71
Sweden	116	4.84	1.10	-0.74	4.12	1.03	4.25	0.72
Switzerland	137	4.20	0.79	-0.50	3.86	0.67	3.20	0.78
United Kingdom	385	4.31	0.88	-0.75	3.79	0.76	3.75	0.87
United States	2,036	5.45	1.01	-0.35	5.35	0.94	5.52	1.01
Total/Average	**7,052**	**4.16**	**0.83**	**-0.63**	**3.65**	**0.75**	**3.58**	**0.73**
Emerging Markets								
Argentina	30	6.48	0.81	-0.45	5.34	0.46	4.88	0.55
Brazil	16	2.64	0.80	-1.07	-0.56	-0.08	3.55	0.74
Chile	45	2.19	0.47	-0.56	1.38	0.34	2.12	0.81
China	372	2.94	0.51	0.17	2.98	0.53	2.98	0.45
Colombia	12	-4.98	0.02	-0.36	-6.31	-0.34	-4.73	0.82
Czech Rep.	16	1.41	0.31	-0.66	0.62	0.12	1.68	0.47
Egypt	49	4.79	0.61	-0.40	3.83	0.31	4.08	0.54
Greece	64	5.35	1.09	-1.21	4.40	0.90	4.83	0.75
Hungary	29	2.85	0.62	-0.80	1.69	0.38	2.20	0.46
India	796	4.70	0.94	-1.51	3.82	0.86	4.27	0.94
Indonesia	65	2.86	0.70	-1.57	0.09	0.02	2.63	0.87
Malaysia	310	3.51	0.71	-0.57	3.05	0.59	2.60	0.97
Mexico	38	3.31	0.72	-0.79	2.34	0.62	3.04	0.72
Peru	30	0.01	0.34	-0.47	-1.68	-0.11	-1.01	0.39
Philippines	32	3.99	0.83	-1.80	3.08	0.61	3.07	0.94
Poland	131	3.85	0.87	-1.01	2.13	0.59	2.48	0.57
Russia	7	1.02	0.23	-0.56	0.43	0.09	1.41	0.19
South Africa	115	2.62	0.60	-0.68	1.12	0.24	2.38	0.63
South Korea	583	4.29	0.93	-1.16	2.76	0.76	3.64	0.75
Taiwan	438	3.67	0.71	-2.00	3.19	0.68	4.50	0.94
Thailand	171	3.06	0.62	-1.75	2.09	0.43	2.85	0.59
Turkey	206	5.18	1.21	-1.48	1.08	0.26	4.33	0.72
Total/Average	**3,555**	**2.99**	**0.67**	**-0.94**	**1.68**	**0.38**	**2.63**	**0.67**

Table 3 shows by country (in local currency) the average of the stocks' risk premium estimates for each risk-return model, where RP_i^I, RP_i^G, and RP_i^L denote stock i's estimated risk premium from the ICAPM, the GCAPM, and the local CAPM, respectively. The risk premium estimates are stated in annual percentage terms. Table 3 also shows the average of each country's stocks' risk coefficient estimates for each model.

Because the global beta (β_i) estimates are from local currency perspective, the countries' global beta estimates do not necessarily have an expected value of 1. The stocks' average global beta estimate is 0.75 for developed countries and 0.38 for emerging market countries. The average global beta estimates are above 1 for only two countries (Hong Kong and Sweden). Stocks in three emerging market countries have negative average global beta estimates (Brazil, Colombia, and Peru), and several others have low positive global beta estimates, especially Indonesia, Russia, and Czech Republic.

The equal-weighted average local CAPM beta estimate (β_{iY}) is 0.73 for developed country firms and 0.67 for emerging market firms. The value-weighted average beta for all stocks in a market index should be 1, but it is common for the equal-weighted average of U.S. local beta estimates to differ slightly from 1. Still, the average local beta estimates in Table 3 are extremely low for some countries, for example, Finland (0.34), Peru (0.39), and Russia (0.19). A possible explanation is a high concentration with respect to firm size, resulting in the value-weighted local market index being dominated by a few very large firms, like Nokia in Finland.

IV. Empirical Discount Rate Differences

Because a risk premium is equal to the discount rate minus the risk-free rate, a discount rate difference is equal to the risk premium difference. For each pairwise comparison of risk-return models, and by country, Table 4 shows three measures of firms' discount rate differences, in basis points (bp): (1) the mean difference (MD_i), which measures a model's bias tendency versus another model; (2) the mean absolute difference (MAD_i), which measures average magnitude of model differences regardless of direction; and (3) the 75th percentile of the MAD_i ($p75_i$), which indicates how extreme the absolute differences are for 25% of a country's firms. Using paired t-tests and

Wilcoxon Signed Rank tests, *all* of the MAD_i estimates are statistically significant at the 99% confidence level, except for Luxembourg and Russia at the 95% confidence level.

This section discusses the local CAPM vs ICAPM comparison and the GCAPM vs ICAPM comparison. The local CAPM vs GCAPM comparison does not bear on the study's research questions, but the results are provided in Table 4 for interested readers.

There is no expectation about which model should yield higher or lower discount rate estimates for any country. The difference between a stock's local and global beta depends on the systematic connection with the local economy versus the global economy; stocks in some countries tend to have high global beta estimates and stocks in other countries tend to have low ones. Similarly, some stocks in a given country may have high FX exposure, while others do not, depending on the relative level of importing/exporting activity, foreign investment, and so on.

Of course, what constitutes a material discount rate difference depends on the analyst and the application, and we recognize that there is a large amount of noise in discount rate estimates in general, as emphasized by Fama and French (1997).

IV.1. For which countries does the Local CAPM approximate the ICAPM?

The local CAPM tends to give lower discount rate estimates than the ICAPM for stocks by an average MD_i of 58 bp per developed country and 36 bp per emerging market country. The local CAPM yields higher average discount rates than the ICAPM for only two developed countries, Japan (by 53 bp) and the United States (by 7 bp), and six emerging market countries, Brazil (by 91 bp), China (by 4 bp), Colombia (by 25 bp), Czech Republic (by 27 bp), Russia (by 39 bp), and Taiwan (by 83 bp). The local CAPM yields lower average discount rates than the ICAPM by 100 bp or more for five developed countries, Finland, Ireland, Israel, Luxembourg, and Switzerland, and three emerging market countries, Argentina, Peru, and Poland.

Table 4: Summary of Empirical Differences in Discount Rate Estimates

		ICAPM – LOCAL (bp)			ICAPM – GCAPM (bp)			GCAPM – LOCAL (bp)		
	#Firms	MD_i	MAD_i	$p75_i$	MD_i	MAD_i	$p75_i$	MD_i	MAD_i	$p75_i$
Australia	245	42	69	99	140	141	193	-98	112	163
Austria	29	41	51	66	51	52	79	-10	49	63
Belgium	68	69	82	132	43	44	59	26	56	81
Canada	406	7	88	123	84	86	121	-77	114	173
Denmark	73	60	82	114	34	37	49	26	60	87
Finland	60	185	190	261	46	46	69	139	146	204
France	267	26	39	55	47	49	67	-21	39	52
Germany	209	40	53	69	43	50	66	-3	50	70
Hong Kong	307	48	74	104	-15	19	27	63	80	113
Ireland	18	154	164	243	57	61	82	97	116	150
Israel	131	122	143	203	46	49	70	76	104	153
Italy	91	42	74	107	62	62	83	-20	69	89
Japan	2,103	-53	73	102	0	21	29	-53	71	100
Luxembourg	7	130	130	228	40	41	61	90	92	159
Netherlands	71	45	54	66	48	48	64	-3	41	55
New Zealand	35	80	86	102	86	87	111	-6	58	78
Norway	59	63	83	105	95	94	126	-32	99	158
Portugal	23	26	71	103	57	60	80	-31	66	95
Singapore	118	9	47	67	31	31	41	-22	56	77
Spain	58	46	60	86	56	57	80	-10	57	79
Sweden	116	59	73	102	72	74	97	-13	50	68
Switzerland	137	100	106	143	34	35	53	66	74	99
United Kingdom	385	56	65	91	52	55	76	4	43	63
United States	2,036	-7	26	37	10	18	24	-17	35	48
Developed Countries	**7,052**	**58**	**83**	**117**	**51**	**55**	**75**	**7**	**72**	**103**
Argentina	30	160	202	304	114	135	205	46	174	235
Brazil	16	-91	168	247	320	320	410	-411	427	671
Chile	45	7	50	77	81	82	100	-74	77	114
China	372	-4	50	74	-4	11	16	0	50	73
Colombia	12	-25	75	114	133	139	196	-158	163	217
Czech Republic	16	-27	138	186	79	90	115	-106	154	237
Egypt	49	71	137	174	96	99	134	-25	114	120
Greece	64	52	91	127	95	96	135	-43	89	111
Hungary	29	65	92	98	116	122	158	-51	96	116
India	796	43	88	127	88	89	114	-45	93	134
Indonesia	65	23	96	136	277	277	355	-254	260	322
Malaysia	310	91	107	145	46	47	62	45	75	112
Mexico	38	27	53	74	97	97	140	-70	82	125
Peru	30	102	138	196	169	173	242	-67	112	149
Philippines	32	92	115	180	91	93	128	1	90	105
Poland	131	137	149	195	172	180	221	-35	97	143
Russia	7	-39	97	137	59	59	112	-98	117	202
South Africa	115	24	76	95	150	159	198	-126	132	188
South Korea	583	65	88	122	153	153	195	-88	109	158
Taiwan	438	-83	103	148	48	48	64	-131	140	196
Thailand	171	21	68	94	97	96	144	-76	107	168
Turkey	206	85	108	145	410	410	475	-325	326	400
Emerging Countries	**3,555**	**36**	**104**	**145**	**131**	**135**	**178**	**-95**	**140**	**195**

For individual firms' discount rate estimates of the local CAPM, the GCAPM, and the ICAPM, Table 4 provides mean differences (MD_i), mean absolute differences (MAD_i), and 75th percentile MAD ($p75_i$), in basis points (bp), by country.

Looking at the mean absolute difference (MAD_i) column, the average developed country MAD_i estimate is 83 bp, and the average emerging market country MAD_i estimate is 104 bp. The results indicate material differences between the local CAPM and ICAPM discount rate estimates for many countries' stocks. The most extreme differences are found in smaller developed countries and emerging market countries.

For which countries does the local CAPM tend to approximate the ICAPM? To answer this question, one needs to specify what represents an acceptable approximation, which depends on the user and the application. This study arbitrarily specifies a MAD_i estimate of 65 bp or lower as an acceptable approximation. With this specification, the local CAPM provides an acceptable approximation to the ICAPM for the stocks of only six developed countries and three emerging market countries: Austria, France, Germany, Netherlands, Singapore, United States, Chile, China, and Mexico. The MAD_i estimate for U.S. stocks (26 bp) is even lower than the relatively modest differences reported by Mishra and O'Brien (2001), Dolde et al. (2011, 2012), and Krapl and O'Brien (2016).

The MAD_i estimate is over 100 bp for the stocks of five developed countries (Finland, Ireland, Israel, Luxembourg, and Switzerland) and ten emerging market countries (Argentina, Brazil, Czech Republic, Egypt, Malaysia, Peru, Philippines, Poland, Taiwan, and Turkey). Koedijk and van Dijk (2004b) reported differences of comparable magnitudes for firms in eight non-U.S. countries.[5]

[5] The findings are generally robust to using Bloomberg's default national market indexes as alternative local market indexes. Detailed results are available on request.

IV.2. For which countries is the GCAPM acceptable if the Local CAPM is not?

The GCAPM tends to give lower discount rate estimates than the ICAPM by an average MD_i of 51 bp per developed country and 131 bp for emerging market countries. The GCAPM yields higher average discount rates than the ICAPM for only two countries, Hong Kong (by 15 bp) and China (by 4 bp).

Looking at the mean absolute difference (MAD_i) column, the average developed country MAD_i estimate is 55 bp, and the average emerging market country MAD_i estimate is 135 bp. Excluding the nine countries listed above where the local CAPM provides an acceptable approximation, and again using a MAD_i estimate cut-off of 65 bp, the GCAPM is an adequate alternative to the ICAPM for the stocks in thirteen developed countries and three emerging market countries: Belgium, Denmark, Finland, Hong Kong, Israel, Ireland, Italy, Japan, Luxembourg, Portugal, Spain, Switzerland, the United Kingdom, Malaysia, Russia, and Taiwan.

For Switzerland, for example, the ICAPM's discount rate estimates differ from the local CAPM's by a MAD_i estimate of 106 bp, but differ from the GCAPM's by a MAD_i estimate of only 35 basis points. Therefore, using the GCAPM in lieu of the ICAPM may be reasonable for Swiss stocks, given that the GCAPM is easier to apply than the ICAPM.

IV.3. For which countries is neither the GCAPM nor Local CAPM adequate?

Neither the local CAPM nor the GCAPM yields an acceptable approximation to the ICAPM for the stocks in five developed countries and sixteen emerging market countries: Australia, Canada, New Zealand, Norway, Sweden, Argentina, Brazil, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Peru, Philippines, Poland, South Africa, South Korea, Thailand, and Turkey.

V. Further Results: Country and Firm Characteristics

The main findings suggest a follow-up question: Do any country or firm characteristics indicate when the local CAPM or GCAPM would tend to yield acceptable approximations to the ICAPM? This section uses the data at hand to investigate the issue further.

V.1. Country characteristics: GCAPM vs ICAPM

By casual inspection, the MAD_i estimates for the GCAPM and ICAPM comparison tend to be high when a country's equity market index has a relatively low global beta (β_Y) and a negative total FX exposure to the foreign currency index (γ_Y). A simple OLS regression of the country MAD_i estimates on these country index risk coefficient estimates (from Table 2) confirms:

$$MAD_i = 170.0 - 111.8\beta_Y - 19.7\gamma_Y$$

with R-square = 0.36, and t-statistics = 7.58; –4.23; –1.69. For Australia, for example, where β_Y = 0.62 and γ_Y = –0.59 (per Table 2), the estimated linear model predicts a MAD_i estimate of 170.0 – 111.8(0.62) – 19.7(–0.59) = 112 bp, compared to the observed MAD_i estimate of 141 bp (Table 4).

Another look at the ICAPM in equation (1) and the GCAPM in equation (2) is instructive for understanding the results. Recall first the earlier observation that almost all the country equity indexes' ICAPM partial beta estimates are higher than the total global beta counterparts: $\beta'_Y > \beta_Y$. For a country equity index, therefore, the first term in the ICAPM equation (1) is typically higher than the GCAPM country equity index risk premium estimate by equation (2): $\beta'_Y[RP_G] > \beta_Y[RP_G]$. Recall second the previous observation that the country equity indexes' partial FX exposure estimates (γ'_Y) are typically negative. Therefore, the second term in the ICAPM equation (1) will typically make the ICAPM estimate for RP_Y lower (toward the GCAPM estimate) or higher (away from the GCAPM estimate), depending on whether the country's foreign currency risk premium estimate (RP_X) is positive or negative. As pointed out earlier, the RP_X estimates are positively correlated with the γ_G estimates, which are in turn positively correlated with the γ_Y estimates. Therefore, there is overlap between negative RP_X estimates and negative γ_Y estimates, so that the ICAPM country equity risk premium estimate (RP_Y) is frequently higher (away from the GCAPM estimate) when a country's total FX exposure estimate (γ_Y) estimate is negative.

For example, in Australian dollars, the Australian equity index's partial beta estimate versus the global market index (β'_Y) is 0.71, and the partial FX exposure versus the Australian foreign currency index (γ'_Y) is –0.71, per Table 2. Also, in Australian dollars, Table 1 provides the global market risk premium estimate (RP_G) of 3.23%, and the foreign currency risk premium estimate (RP_X) of –1.10%. Therefore, the ICAPM's required risk premium for Australia's equity index is RP_Y = 0.71[3.23%] – 0.71[–1.10%] = 3.07%, whereas the GCAPM estimate of 0.61[3.23%] = 1.97% is much lower. This difference drives the relatively large MAD_i estimates for Australian stocks for the ICAPM/GCAPM comparison.

This brief analysis suggests that applying the GCAPM is likely to be problematic for countries whose stocks have relatively low global betas and negative total FX exposures to other currencies. Analysts may find this information helpful, but further research into these and other characteristics is needed.

Bear in mind that the results here are from the local currency perspective. The inferences may be quite different if a common currency is used to measure the models' discount rate differences. From the US dollar perspective, for example, the average absolute GCAPM/ICAPM estimate difference is small for other countries' stocks. The reason is that the US dollar returns of a non-U.S. stock tend to have positive total FX exposure to the U.S. foreign currency index due to the conversion of local currency returns into US dollar returns. Because the discount rate differences of a given country's stocks depend on the currency perspective, using the local currency perspective is essential when comparing risk-return models for any country.

V.2. Differences in discount rate estimates, firm size, and FX exposure

Prior research (Dolde et al., 2012; Krapl and O'Brien, 2016) found that differences between the local CAPM and the ICAPM discount rate estimates are larger for U.S. firms that are small and have extreme levels of total FX exposure in either the positive or negative direction. To investigate this issue for all stocks, Table 5's left side summarizes the MAD_i estimates for quintiles based on firm size (measured by average market capitalization), and the right side does the same for stocks' total FX exposure estimates (γ_i). Panel A shows the results for all sample stocks; Panel B and Panel C split the results into stocks of developed and emerging market countries.

As in the prior research for U.S. stocks, the firm size results show that the MAD_i estimates for the local CAPM and ICAPM comparison tend to drop as firm size increases for both developed and emerging market stocks. The developed country stocks' MAD_i estimate is 70 bp (50 bp) for the smallest (largest) size quintile. The emerging market stocks' MAD_i estimate is 106 bp (80 bp) for the smallest (largest) size quintile. For all size quintiles, the impact of using the GCAPM as an alternative to the ICAPM is quite different for the developed and emerging market firms. On average, the GCAPM estimates for developed country stocks are reasonably close to the ICAPM estimates and are closer than the local CAPM estimates. Emerging market firms show the opposite effect for all size quintiles; the MAD_i estimate for the GCAPM and ICAPM comparison is *larger* than the MAD_i estimate for the local CAPM and ICAPM comparison.

The FX exposure results show that as the average total FX exposure estimate rises from the most negative to the most positive quintile, the MAD_i estimate for the local CAPM and ICAPM comparison drops monotonically for both developed and emerging market stocks. The developed country stocks' MAD_i estimate is 80 bp (49 bp) for the most negative (positive) FX exposure quintile. The emerging market stocks' MAD_i estimate is 103 bp (85 bp) for the most negative (positive) FX exposure quintile. Table 5's FX exposure results are consistent with the country finding discussed earlier that the GCAPM tends to give a more (less) reasonable approximation to the ICAPM when total FX exposure is positive (negative).

Table 5: Differences in Discount Rate Estimates, Firm Size, and Foreign Exchange Exposure

	Firm Size Quintiles					**FX Exposure Quintiles**				
	Small	**Q2**	**Q3**	**Q4**	**Large**	**Neg. FX Exp.**	**Q2**	**Q3**	**Q4**	**Pos. FX Exp.**
Panel A: All Countries										
Size/FX Exp.	*7.54*	*35.2*	*105*	*329*	*7,596*	*-1.58*	*-0.52*	*0.07*	*0.61*	*1.58*
$\lvert RP_i^L - RP_i^I \rvert$	91	72	70	67	56	95	81	69	60	50
$\lvert RP_i^G - RP_i^I \rvert$	100	67	52	47	45	139	101	33	19	19
$\lvert RP_i^L - RP_i^G \rvert$	107	80	79	73	64	138	90	61	60	52
Panel B: Developed Countries										
Size/FX Exp.	*13.9*	*53.2*	*149*	*527*	*10,790*	*-0.89*	*-0.02*	*0.44*	*0.83*	*1.81*
$\lvert RP_i^L - RP_i^I \rvert$	70	60	63	59	50	80	60	56	57	49
$\lvert RP_i^G - RP_i^I \rvert$	51	31	32	33	33	94	31	18	19	20
$\lvert RP_i^L - RP_i^G \rvert$	82	60	62	54	52	89	54	59	56	52
Panel C: Emerging Market Countries										
Size/FX Exp.	*3.05*	*15.0*	*48.5*	*150*	*1,083*	*-2.17*	*-1.22*	*-0.76*	*-0.32*	*0.66*
$\lvert RP_i^L - RP_i^I \rvert$	106	96	93	84	80	103	91	92	88	85
$\lvert RP_i^G - RP_i^I \rvert$	124	135	128	88	92	124	155	159	98	32
$\lvert RP_i^L - RP_i^G \rvert$	116	115	119	113	122	148	136	132	95	73

Table 5 provides mean absolute discount rate differences, in basis points, across quintiles of firm size and total FX exposure estimates, based on two-way comparisons between the local CAPM, the GCAPM, and the ICAPM, where RP_i^L, RP_i^G, and RP_i^I denote a stock's estimated risk premium from the local CAPM, the GCAPM, and the ICAPM, respectively. Panel A reports results for all countries. Panel B (Panel C) reports results for developed (emerging market) countries.

VI. Summary and Conclusion

For stocks in each of 46 countries, this study presents new findings on whether the traditional (local) CAPM and the simple global CAPM (GCAPM) provide discount rate estimates that reasonably approximate those of an international CAPM (ICAPM) version with two risk factors, the global market index and an index of the world's currencies. The last model is conceptually superior, but also the most demanding to apply.

The study makes the following advances in methodology: (1) the use of local currency perspective; (2) the use of *ex ante* model factor and stock risk premium estimates that are mutually consistent across countries, currencies, and models; and (3) the use of a wealth-aggregate currency index, consistent with ICAPM theory.

The study's main findings are as follows: (1) The differences between local CAPM and ICAPM discount rate estimates are relatively large for the average stock of most countries. (2) The GCAPM may be an acceptable alternative to the ICAPM for the average stock of some countries but not for many others. The specific countries for which the local CAPM and global CAPM provide a reasonable approximation to the ICAPM are identified.

The findings are hopefully helpful to practitioners in choosing a risk-return model to use in a discounted cash flow valuation analysis. For a country where the local CAPM tends to adequately approximate the ICAPM, choosing the country's local CAPM seems reasonable in lieu of expending the additional effort necessary to apply the ICAPM. This situation seems to apply for the United States and a few other countries. For a country where the local CAPM does *not* tend to adequately approximate the ICAPM, the GCAPM provides a reasonable approximation for the stocks of some countries but not of many others.

References

Abuaf, N., Jorion, P., 1990. Purchasing power parity in the long run. *Journal of Finance* 45, 157-174.

Adler, M., Dumas, B., 1983. International portfolio choice and corporation finance: A synthesis. *Journal of Finance* 38, 925-984.

Adler, M., Dumas, B., 1984. Exposure to currency risk: Definition and measurement. *Financial Management*, 41-50.

Bekaert, G., Ehrmann, M., Fratzscher, M., Mehl, A., 2014. The global crisis and equity market contagion. *Journal of Finance* 69, 2597-2649

Bekaert, G., Harvey, C., 1995. Time-varying global market integration. *Journal of Finance* 50, 403-44.

Billio, M., Donadelli, M., Paradiso, A., Riedel, M., 2017. Which market integration measure? *Journal of Banking & Finance* 76, 150-174.

Brandt, M., Wang, K., 2003. Time-varying risk aversion and unexpected inflation. *Journal of Monetary Economics* 50, 1457-1498.

Bruner, R., Li, W., Kritzman, M., Myrgren, S., Page, S., 2008. Market integration in developed and emerging markets: Evidence from the CAPM. *Emerging Markets Review* 9, 89-103.

Brusa, F., Ramadorai, T., Verdelhan, A., 2014. The International CAPM redux. Oxford Said Business School RP 2014-11.

De Santis G., Gerard B., 1998. How big is the premium for currency risk? *Journal of Financial Economics* 49, 375-412.

Dolde, W., Giaccotto, C., Mishra, D., O'Brien, T., 2011. Foreign exchange exposure and cost of equity for US companies: Local versus global CAPM. *Journal of Applied Finance* 21, 78-88.

Dolde, W., Giaccotto, C., Mishra, D., O'Brien, T., 2012. Should managers estimate cost of equity using a two-factor international CAPM? *Managerial Finance* 38, 708-728.

Dumas, B., 1994. Partial vs. general equilibrium models of the international capital market. F. van der Ploeg, Ed., *Handbook of International Economics*, (Basil Blackwell, London), 301-347.

Dumas, B., Solnik, B., 1995. The world price of foreign exchange risk. *Journal of Finance* 50, 445-479.

Elton, E., 1999. Presidential address: Expected return, realized return, and asset pricing tests. *Journal of Finance* 54, 1199-1220.

Engel, C., Hamilton, J., 1990. Long swings in the dollar: Are they in the data and do markets know it? *American Economic Review* 80, 689-713.

Evans, M., Lewis, K., 1995. Do long-term swings in the dollar affect estimates of the risk premia? *Review of Financial Studies* 8, 709-742.

Fama, E., French, K., 1997. Industry costs of equity. *Journal of Financial Economics* 43, 153-193.

Fama, E., French, K., 2002. The equity premium. *Journal of Finance* 57, 637–659.

Ferson, W., Harvey, C., 1993. The risk and predictability of international equity returns. *Review of Financial Studies* 6, 527-566.

Ferson, W., Harvey, C., 1994. Sources of risk and expected returns in global equity markets. *Journal of Banking & Finance* 18, 775-803.

Grauer, F., Litzenberger, R., Stehle, R., 1976. Sharing rules and equilibrium in an international capital market under uncertainty. *Journal of Financial Economics* 3, 223-256.

Griffin, J., 2002. Are the Fama-French factors global or country-specific? *Review of Financial Studies* 15, 783-803.

Harris, R., Marston, F., Mishra, D., O'Brien, T., 2003. Ex ante cost of equity estimates for U.S. firms: The choice between global and domestic CAPM. *Financial Management* 32, 51-66.

Hau, H., 2011. Global versus local asset pricing: A new test of market integration. *Review of Financial Studies* 24, 3891-3940.

He, J., Ng, L., 1998. The foreign exchange exposure of Japanese multinational corporations. *Journal of Finance* 53, 733-753.

Hou, K., Karolyi, A., Kho, B., 2011. What factors drive global stock returns. *Review of Financial Studies* 24, 2527-2574.

Ince, O., Porter, R., 2006. Individual equity return data from Thomson Datastream: Handle with care! *Journal of Financial Research* 29, 463-479.

Karolyi, A., Stulz, R., 2003. Are financial assets priced locally or globally. *Handbook of the Economics of Finance*, Edited by G M Constantinides, M Harris and R Stulz, Elsevier, 975-1020.

Kearney, C., Lucey, B., 2004. International equity market integration: Theory, evidence and implications. *International Review of Financial Analysis* 13, 571-583.

Koedijk, K., Kool, C., Schotman, P., van Dijk, M., 2002. The cost of capital in international financial markets: local or global? *Journal of International Money and Finance* 21, 905-929.

Koedijk K., Mahieu R., ter Horst J., van Toor J., 2017. The world we live in: Local or global? Discussion Paper DP 11831, CEPR, January 29, 2017, 1-33.

Koedijk, K., van Dijk, M., 2004a. Global risk factors and the cost of capital. *Financial Analysts Journal* 60, 32-38.

Koedijk, K., van Dijk, M., 2004b. The cost of capital of cross-listed firms. *European Financial Management* 10, 465-486.

Kolari J., Moorman T., Sorescu S., 2008. Foreign exchange risk and the cross-section of stock returns. *Journal of International Money and Finance* 27, 1074-1097.

Krapl, A., Giaccotto, C., 2015. Foreign exchange risk and the term-structure of industry costs of equity. *Journal of International Money and Finance* 51, 71-88.

Krapl, A., O'Brien, T., 2016. Estimating cost of equity: Do you need to adjust for foreign exchange risk? *Journal of International Financial Management & Accounting* 27, 5-25.

Lee, C., Ng, D., Swaminathan, B., 2009. Testing international asset pricing models using implied costs of capital. *Journal of Financial and Quantitative Analysis* 44, 307-335.

Levy, H., 2011. *The Capital Asset Pricing Model in the 21st Century: Analytical, Empirical, and Behavioral Perspectives*. Cambridge University Press.

Lo, M., Morley, J., 2015. Bayesian analysis of nonlinear exchange rate dynamics and the purchasing power parity persistence puzzle. *Journal of International Money and Finance* 51, 285-302.

Mayfield, S., 2004. Estimating the market risk premium. *Journal of Financial Economics* 73, 465-496.

Mishra, D., O'Brien, T., 2001. A comparison of cost of equity estimates of the global and domestic CAPMs. *Financial Review* 36, 27-48.

Moore, L., Sercu, P., 2013. The smallest firm effect: An international study. *Journal of International Money and Finance* 32, 129-155.

O'Brien T., 1999. The global CAPM and a firm's cost of capital in different currencies. *Journal of Applied Corporate Finance* 12, 73-79.

O'Brien, T., Dolde, W., 2000. A currency index global capital asset pricing model. *European Financial Management* 6, 7-18.

Obstfeld, M., Rogoff, K., 2000. The six major puzzles in international macroeconomics: Is there a common cause? *NBER Macroeconomics Annual* 15, 339-390.

Officer, L., 2012. Purchasing power parity in economic history. *Handbook of Exchange Rates*, 159-187.

Rogoff, K., 1996. The purchasing power parity puzzle. *Journal of Economic Literature* 34, 647-668.

Ross, S., Walsh, M., 1983. A simple approach to the pricing of risky assets with uncertain exchange rates. R. Hawkins et al., Eds., *Research in International Business and Finance* 3, (JAI Press, Greenwich, CT), 39-54.

Sercu, P., 1980. A generalization of the international asset pricing model. *Revue de l'Association Française de Finance* 1, 91-135.

Sercu, P., 2009. *International Finance: Theory Into Practice*. Princeton University Press.

Sharpe, W., 2004. *Master of Finance: William F. Sharpe*. American Finance Association Interview video: http://www.afajof.org/details/video/2870841/William-Sharpe-Interview.html.

Solnik, B., 1997. The world price of foreign exchange risk: Some synthetic comments. *European Financial Management* 3, 9-22.

Solnik, B., 1974. An equilibrium model of the international capital market. *Journal of Economic Theory* 8, 500-524.

Solnik, B., McLeavey, D., 2009. *Global Investments*. Pearson Education, Boston.

Stulz, R., 1981. A model of international asset pricing. *Journal of Financial Economics* 9, 383-406.

Stulz, R., 1995a. The cost of capital in internationally integrated markets: The case of Nestlé. *European Financial Management* 1, 11-22.

Stulz, R., 1995b. Globalization of capital markets and the cost of capital: The case of Nestlé. *Journal of Applied Corporate Finance* 8, 30-38.

Stulz, R., 1995c. International portfolio choice and asset pricing: An integrative survey. R. Jarrow, et al., Eds., *Handbooks in Operations Research and Management Science* 9 (Elsevier, Amsterdam), 201-223.

Stulz, R., 1999. Globalization, corporate finance, and the cost of capital. *Journal of Applied Corporate Finance* 12, 8-25.

Taylor, A., 2002. A century of purchasing-power parity. *Review of Economics and Statistics* 84, 139-150.

Taylor, A., Taylor, M., 2004. The purchasing power parity debate. *The Journal of Economic Perspectives* 18, 135-158.

Welch, I., Goyal, A., 2008. A comprehensive look at the empirical performance of equity premium prediction. *Review of Financial Studies* 21, 1455-1508.

Appendix: ICAPM Derivation

The general ICAPM was pioneered by Solnik (1974), Sercu (1980), Stulz (1981), and Adler and Dumas (1983). The general ICAPM assumes that purchasing power parity (PPP) is violated, which implies that investors in different economies realize different real returns from a given asset and thus that systematic exposure to exchange rate changes is a priced risk. Solnik (1997) uses a single-factor ICAPM representation by viewing asset returns hedged against exchange rate risk and a (partially) hedged global market index. The model here uses the more standard risk-return relationship in terms of unhedged returns (e.g., Solnik and McLeavey, 2009).[6]

As explained in Adler and Dumas (1983), the most general version of the ICAPM includes a risk premium for: (1) the global market index of risky assets; (2) the inflation risk of the reference currency's economy; and (3) the uncertain foreign inflation rates of each of the other economies, *expressed in the reference currency*, which includes components for the foreign country's uncertain inflation and the uncertain nominal FX rate between the foreign currency and the reference currency. A convenient and popular simplifying assumption is that each economy's inflation rate is non-stochastic when measured in its own currency. Adler and Dumas (1983) call this model the "Solnik (1974) - Sercu (1980) special case", where there is no inflation risk premium for the reference currency, and the currency risk premia apply to *nominal* FX risks.

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[6] Additional insights on the general ICAPM may be found in the reviews by Ross and Walsh (1983), Dumas (1994), Stulz (1995c), and Solnik (1997). Supporting the ICAPM as a risk-return model are the significant extent of international financial market integration and an overwhelming amount of empirical evidence against PPP. See Karolyi and Stulz (2003), Hau (2011), and Brusa et al. (2014) for empirical evidence supporting international asset pricing. Examples of discussion and empirical results on international financial market integration are Bekaert and Harvey (1995), Kearney and Lucey (2004), and Billio et al. (2017). For evidence against PPP, see Abuaf and Jorion (1990), Engel and Hamilton (1990), Evans and Lewis (1995), Obstfeld and Rogoff (2000), Taylor (2002), Taylor and Taylor (2004), Officer (2012), and Lo and Morley (2015). Rogoff (1996) summarizes empirical results to that time, concluding that the volatility of PPP deviations has comparable magnitude to the volatility of nominal exchange rates.

The fundamental risk-pricing relation of the Solnik-Sercu ICAPM, adapted from equation (10.9) in Dumas (1994), is:

$$RP_i \;=\; q\; cov(R_i, R_G) + \; \textstyle\sum_{C \neq H} w_C \; q(1/q_C - 1)\; cov(R_i, x^{H/C}) \qquad \text{(A.1)}$$

where RP_i is asset i's required risk premium expressed in the home currency (currency H), equal to asset i's required expected rate of return, $E(R_i)$ minus the nominal currency-H risk-free rate; R_i is asset i's return, consisting of the asset's local currency return and the change in the FX value of the asset's local currency versus currency H; R_G is the return in currency H on the unhedged global market index; $x^{H/C}$ is the return in currency H on a deposit in currency C; w_C is the percentage of world wealth of the economy using currency C; q_C is the average degree of risk aversion of investors in the economy using currency C; and q is the global (harmonic mean) degree of relative risk aversion (over all economies, including that of currency H): $1/q \;=\; [\sum_C (w_C\,/q_C)]$.

In the Solnik-Sercu ICAPM, the currency risk factors, based on bilateral FX rates, have generally unobservable weights (Solnik, 1997). However, each weight simplifies to w_C, and the currency risk factors may be aggregated into a currency portfolio, by the simplifying condition that investors' average risk aversion is the same across economies, so that for all currencies (including H), $q_C = q = \Theta$, the representative investor's risk aversion (Ross and Walsh, 1983).[7] For a wealth-weighted portfolio of currencies that excludes currency H, currency C's weight is w'_C = $w_C/(1 - w_H)$. Then, w_C in equation (A.1) is $(1 - w_H)w'_C$. The resulting simplified risk-pricing model is shown in equation (A.2):

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[7] The equal average risk aversion assumption seems benign. Why would the average European and U.S. investor have a sharply different degree of risk aversion? Perhaps Chinese investors are less risk averse, but China's currency has so little volatility that its impact on currency index returns is negligible. The equal average risk aversion assumption permits model simplification and tractability, in the spirit of the CAPM's assumption that all investors have "homogenous expectations" of expected return and covariance estimates for all assets.

$$RP_i = E(R_i) - r_f = \Theta\ cov(R_i, R_G) + (1 - \Theta)(1 - w_H)\ cov(R_i, R_X) \qquad \text{(A.2)}$$

where r_f is the currency-H risk-free rate, and R_X is the return in currency H on a wealth-weighted index of all other currencies, $\sum_{C \neq H} w'_C\ x^{H/C}$.

For this "special case of the Solnik-Sercu special case", aggregate the simplified risk-pricing expression (A.2) twice, first over all risky assets in the global market, then over all currencies other than currency H. The results are the *ex ante* risk premium expressions for: (1) the global market index, $RP_G = E(R_G) - r_f = \Theta\sigma_G^2 + (1 - \Theta)(1 - w_H)cov(R_G, R_X)$; and (2) the foreign currency index, $RP_X = E(R_X) - r_f = \Theta cov(R_X, R_G) + (1 - \Theta)(1 - w_H)\sigma_X^2$. These factor risk premium expressions may be alternatively expressed in equations (A.3a) and (A.3b):

$$RP_G = \Theta\ \sigma_G^2 + (1 - \Theta)(1 - w_H)\ \gamma_G\ \sigma_X^2 \qquad \text{(A.3}a\text{)}$$

$$RP_X = \Theta\ \beta_X\ \sigma_G^2 + (1 - \Theta)(1 - w_H)\ \sigma_X^2 \qquad \text{(A.3}b\text{)}$$

where Θ is the global market price of risk; w_H is the world wealth weight for currency-H's economy; $\gamma_G = cov(R_G, R_X)/\sigma_X^2$ is the global market index's total FX exposure versus the foreign currency index; and $\beta_X = cov(R_X, R_G)/\sigma_G^2$ is the foreign currency index's beta versus the global market index. The study uses equations (A.3a) and (A.3b) to find *ex ante* ICAPM factor risk premium estimates.

By solving equations (A.3a) and (A.3b) simultaneously for Θ and $(1 - \Theta)(1 - w_H)$, and substituting into equation (A.2), the result is the ICAPM expression in equation (1) in the text.[8]

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[8] The O'Brien and Dolde (2000) ICAPM tutorial contains some minor glitches related to the use of a U.S. trade-weighted index for the foreign currency index. First, the tutorial ignores the $(1 - w_H)$ term from both currency perspectives. Second, the currency index is rotated from the US dollar perspective into the British pound perspective using FX rate changes, which implies that from the British pound perspective, the currency index incorrectly contains the British pound instead of the US dollar.