

## **Methodology and assumptions used to build the World CAPM, JP Morgan and Bank of America models**

### **World CAPM**

To build the world CAPM model, we start with the traditional CAPM relationship which states that the expected return on a security should be commensurate to its systematic risk. As described by the formula below, the expected return is equal to the risk-free rate + the country beta times the equity risk premium.

$$K_e = R_{fw} + \beta_{em} [E(r_w) - R_{fw}]$$

The annual expected return on the equity is calculated over a period of 6 years, from December 1992 to November 1998.

$R_{fw}$  for the risk-free rate, we use the 10 year US Treasury yield, updated monthly over the period of analysis

$E(r_w)$  Expected return on the world portfolio.

$E(r_w) - R_{fw}$  Equity risk premium. We make the assumption that this measure remains constant over our period of analysis. We use the April 1998 value of 9.35% for the return on the world portfolio, which was used by Paul Gibbs in a presentation made in an internal JP Morgan presentation July 1998. We use the November 1998 risk free rate of 4.73% and thus a constant risk premium of 4.62%. Although an argument can be made that the risk premium should vary over this period, making it vary generates extremely low risk premia during various periods within our data. In practice, the risk premium is generally not updated regularly and we concluded that it would be better to keep it as a constant. Paul Gibbs noted in an email that while we could make the risk premium vary, it was acceptable to keep it as a constant.

$\beta_{em}$  Beta is a measure of sensitivity to the risk of the world portfolio. It is equal to the covariance of the country's returns with the world returns divided by the variance of the world's returns:

$$\beta_c = \text{covar}(r_c, r_w) / \sigma_w^2$$

We first calculate the monthly standard deviation, defined as the squared sum of the monthly returns on the country's stock market index minus the average of these returns over a rolling period of 60 months of returns. For instance, the December 1992 monthly standard deviation is calculated using the monthly returns between January 1988 and December 1992.

$$\text{Monthly } \sigma_w = [(\sum (x - \text{average}(x)))^2 / (n - 1)]^{0.5}$$

We then translate the monthly standard deviation into an annualized standard deviation by multiplying it by the square root of 12 and square the result to get the annualized variance of world returns.

$$\text{Annual } \sigma_w = \text{Monthly } \sigma_w * (12)^{0.5}$$

$$\text{Annual } \sigma_w^2 = (\text{Annual } \sigma_w)^2$$

The covariance of the country's returns with the world returns is equal to the square root of the product of the country's variance with the world's variance times the correlation of the country's returns with the world's returns.

$$\text{covar}(r_c, r_w) = \text{Correl}(r_c, r_w) * (\sigma_w^2 * \sigma_c^2)^{0.5}$$

We define the predicted excess return as the total expected return minus the risk-free rate.

### **JP Morgan Modified World CAPM**

JP Morgan's Modified World CAPM uses the same framework as the World CAPM and makes an adjustment to the beta:

$$K_e = R_{fw} + \text{adj } \beta_c [E(r_w) - R_{fw}]$$

$$\text{adj } \beta_c (\text{JPM}) = \text{SQRT}((41\% * \sigma_c^2) / \sigma_w^2)$$

As for World CAPM, annualized predicted returns are calculated for the period December 1992 – November 1998, and updated on a monthly basis. The equity risk premium, the risk-free rates and the variances are the same as those that were calculated for the World CAPM predicted returns.

41% is the average level of systematic risk over total risk for developed countries. In our calculations, we use an IF function for every month of our period of analysis. If the ratio of systematic risk over total risk is below to 41%, we use 41% to calculate the beta. If it is higher than 41%, we use the actual ratio to calculate the beta.

We define the predicted excess return as the total expected return minus the risk-free rate.

## Bank of America “Total Risk” Method

Bank of America’s model is also a variation on the World CAPM model. As we showed in the first part of this PAE, it is very close to JP Morgan’s Modified World CAPM model. The adjusted beta is calculated as the ratio of an individual country’s equity volatility to that of the US market. The adjusted beta is reduced by 40%, based on a study that found that 40% of the variation in equity volatility could be explained by variations in credit quality, which suggests that the equity premium may be overstated by 40%. As opposed to JP Morgan methodology which uses the world market as its benchmark, the Bank of America methodology uses the US market as a benchmark. A sovereign spread is also added to the risk-free rate.

$$K_e = R_{fw} + \text{SovSpread} + \text{adj } \beta_c [E(r_w) - R_{fw}]$$

$$\text{adj } \beta_c (\text{BoA}) = 0.60 * \sigma_c / \sigma_{\text{usa}}$$

As for World CAPM, annualized predicted returns are calculated for the period December 1992 – November 1998, and updated on a monthly basis. The risk-free rates and the variances are the same as those that were used for the World CAPM predicted returns.

The risk premium is set as a constant 5.5%, as described in the article written by Stephen Godfrey and Ramon Espinosa in the *Journal of Applied Corporate Finance* article (Fall 1996).

We define the predicted excess return as the total expected return minus the risk-free rate.

## **EXECUTIVE SUMMARY**

### **Purpose of the PAE**

The purpose of this Policy Analysis Exercise is to test the validity of JP Morgan's methodology for calculating the cost of equity in emerging markets and help it develop a more robust model. The central question is the following: How valid are the Capital Asset Pricing Model (CAPM) and JP Morgan's adjusted version of CAPM in determining the cost of equity in emerging markets and how can they be improved?

### **Why does the cost of equity matter?**

The cost of equity in an emerging market establishes the discount rate to be used in capital budgeting decisions for projects in that country. Despite the fundamental importance of the cost of equity, much uncertainty remains in the public and private sector financial communities regarding the proper way to determine it when investing in emerging countries. This uncertainty has fundamental repercussions on the channeling of funds to these emerging countries. At stake is the fact that lack of clarity regarding how to value assets and projects in these countries keeps investors away. Enhancing the ability of CAPM and of JP Morgan's "Modified World CAPM" to estimate the cost of equity in emerging markets would lower the level of uncertainty and spur investments in the long-run.

### **Key issues regarding the cost of equity in emerging markets**

We first set the context for our analysis by discussing the key factors to consider when developing a cost of equity model and by doing a survey of the various methodologies currently utilized in the private and public sectors. A few critical issues are highlighted:

first, are these emerging markets segmented or integrated? Second, what are the characteristics of the investor? Is the investor a local company or a large multi-national company? If a market is entirely segmented, a local CAPM model that solely captures the risks of local factors is most appropriate. If the market is fully integrated, a model that focuses on the effects of world factors is best. Similarly, the characteristics of the investor, including access to capital, will determine whether the local market or the world market should be used as his/her set of potential investment opportunities.

### **JP Morgan's Modified World CAPM model**

We describe and analyze JP Morgan's model and two other models we compare it to: the World CAPM model and Bank of America's Adjusted CAPM model. We find here that despite different justifications for the adjustments made to the basic CAPM model, the JP Morgan and Bank of America models are extremely similar in practice.

## **FINDINGS**

### **Testing the validity of JP Morgan's model**

We test the validity of JP Morgan's model by using statistical analysis conducted on data from 15 different emerging countries plus the United States. The World CAPM and Bank of America models are used for purpose of comparison. Using time-series analysis, we regress actual annual excess returns against annual excess returns predicted by these three models, updated monthly over a period of 72 months, using monthly data from these countries' stock indices. The returns predicted by the three models are based on a rolling period of 60 months of past volatility. While expected returns generated by the World CAPM and JP Morgan models are not meant to equal actual returns period after

period, they should be strongly correlated to actual returns over time. Based on this analysis, we find that:

- ***JP Morgan's model out-performs the other two models analyzed.*** In most of the regressions we run, with and without dummy variables to control for regional and circumstantial effects, we find that the coefficients on JP Morgan's predicted returns are closer to 1 than the other two models and that its results are statistically significant. While results from the JP Morgan and Bank of America models are significantly apart, both perform substantially better than World CAPM. World CAPM actually shows *negative* correlation to actual returns when the effect of financial crisis is not controlled for.
- ***But the model fails to explain a large proportion of emerging markets returns.*** JP Morgan's model, as well as the other two, generate low R-squared, suggesting that they are missing a number of important factors affecting equity returns in emerging markets.
- ***The model is worse at calculating the cost of equity in Asia and during periods of crisis.*** Introducing dummies to control for regional and circumstantial effects, we find that the model is clearly worse at determining the cost of equity during periods of financial crisis. It also under-performs when applied to Asian countries, even when controlling for the effect of financial crisis.

## RECOMMENDATIONS

### **Developing a multi-factor CAPM-based model for emerging markets**

After having determined empirically that the JP Morgan model fails to capture important effects in emerging markets, we attempt to improve it by testing the validity of including a number of variables into a CAPM-based multi-factor model. We seek to go beyond the

traditional multi-factor approach of including market-based financial measures such as PE and Price to Book Value ratios. Building on recent research, we test three categories of variables: macro-economic factors, measures of the legal environment, and measures of corporate governance. A preliminary correlation analysis helps us determine how to sequence the testing of these variables, and which variables to test together and separately. Based on time-series statistical analysis, we recommend that:

- ***GDP Growth and change in foreign exchange should be included in a new multi-factor model.*** Both of these measures prove to be statistically significant in all scenarios we run, suggesting that these are omitted variables when the JP Morgan model is run on its own.
- ***A measure of the legal environment should also be added.*** We find that any one of three measures of the legal environment should be included. These are measures of enforceability of contracts, rule of law, and corruption.
- ***A measure of corporate governance should be incorporated.*** We find a compound measure of shareholders' rights to have a statistically significant effect on actual returns, with and without controlling for a number of other variables. Although largely ignored until the recent Asian financial crisis, issues of corporate governance and investor protection matter. Recent research as well as our statistical analysis strongly suggest that investors require a return on this variable and that it should be accounted for in a multi-factor asset-pricing model.

### **Next steps**

JP Morgan should enhance its current Modified World CAPM model by incorporating the variables described above into a new multi-factor model. This will entail determining the appropriate risk premia to be applied to each of these factors.

## **I 1. WHY DOES THE COST OF EQUITY IN EMERGING MARKETS MATTER?**

The discount rate is central to all capital budgeting decisions. This issue goes to the heart of investing in emerging markets, whether the investor is a multinational company acquiring assets or a public sector entity investing in public works. In 1997 alone, companies from developed economies purchased \$65 billion worth of assets in emerging economies, according to UNCTAD. However, at a time when many of the emerging markets are privatizing their state-owned companies, a great deal of uncertainty exists in valuing these assets.

The recent privatization effort of Rosneft, the largest Russian state-owned company, illustrates the point. Large disagreements regarding the value of the company subsided through-out the process, with the Russian government valuing the company at \$2.3 - \$2.4 billion and its investment bank, Dresdner Kleinwort Benson valuing it at \$2.1 – \$2.25 billion, while the buying alliances estimated it to be closer to \$1.5 billion. Different perceptions of the cost of money in Russia, coupled with different accounting standards, lack of clear link between output and earnings and uncertainty about future production capacity all played a role in this conundrum. Still, the privatization failed, leaving the Russian government with another hole in the Russian budget.<sup>1</sup>

Differences in risks, lack of understanding of how emerging market returns are influenced by advanced markets and vice-versa, as well as lack of statistically reliable historical data are factors that all international managers and investors have to contend

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<sup>1</sup> “Analysts Grapple with Russian Valuations”, Financial Times, January 31, 1997; “Rosneft Privatization Suspended for at Least 18 Months”, AFX News, October 20, 1998.

with. From a public policy point of view, determining the appropriate cost of equity is crucial in lowering the uncertainty that multinational companies (MNCs), local companies and public sector organizations face when investing in these countries. Gaining a better understanding of this issue would help channel more investments in these countries.

## **I 2. OBJECTIVE OF THE PAE**

Our PAE seeks to help JP Morgan refine its approach to calculating the cost of equity in emerging markets. This will help JP Morgan determine the appropriate discount rate to use when making, and advising on, investments in these countries. JP Morgan developed the “Modified World CAPM” method which makes an adjustment to the CAPM by assuming explicitly that investors have a limited ability to diversify away the “unsystematic” risk present in emerging markets.

JP Morgan is a leading global investment bank that advises and finances corporations, public sector organizations and governments. The approach it uses to determine the appropriate discount rate in any country is influential in determining whether its clients invest in that country and ultimately has an impact on the level of investment in that country.

## II 1. THE COST OF EQUITY IN EMERGING MARKETS: KEY ISSUES

It is often argued that equities in emerging markets have different characteristics than equities in developed capital markets. They tend to have higher volatility, higher average returns and low correlation with developed markets. What drives these differences? Are the risks fundamentally different? Does low correlation affect investors' ability to diversify away these country's unique risks? Emerging market risks can be classified in the following way: political/sovereign risk (including institutional and regulatory risks), macroeconomic risk, commercial/business risk, and currency risk.<sup>2</sup> A meaningful starting point to all of these differences is the degree of integration of the emerging market into the world markets.

### *Are emerging markets segmented or integrated?*

A fundamental issue that is still not well understood is whether emerging markets should be considered segmented or integrated. A perfectly segmented market is one in which foreign capital cannot enter and local capital cannot exit. In this context, the risk premiums are related to the volatility of equity returns in the local market. Factors tending to increase the degree of segmentation include legal restrictions, transaction costs, adverse taxation and psychological barriers.<sup>3</sup> The fact that emerging markets are segmented would tend to explain why their volatility is so different.

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<sup>2</sup> For a discussion of categories, see Don Lessard, "Incorporating Country Risk in the Valuation of Offshore Projects", *Journal of Applied Corporate Finance*, Fall 1996, Volume 9, #3.

<sup>3</sup> See Bruno Solnick, *International Investments*, 3<sup>rd</sup> ed., Reading, Massachusetts: Addison-Wesley Publishing Co., 1996.

On the opposite end of the spectrum, a perfectly integrated market signifies that capital is free to enter and to exit. A recent study by Bekaert and Harvey found that an equity market returns' movement with the world market returns is positively related to the degree of market integration. If markets were fully integrated, then their volatility would be highly correlated to world factors.<sup>4</sup> Another study has found that due to the effects of globalization and deregulation, emerging markets exhibit time-varying integration with the world market.<sup>5</sup> With integration, the expected returns and cost of capital decrease as the access to capital is boosted.

Understanding how integrated a market is relative to the world market is essential in determining the influence of world factors versus local factors in the market's returns, which, in turn, helps determine which method is most appropriate to calculate the cost of capital. If a market is fully integrated, then a model that focuses on the effects of world factors, such as the World CAPM model, would be most appropriate. On the other hand, if a market is entirely segmented, then a local CAPM model that solely captures the risks relative to local factors is best. But all emerging markets vary in their degree of integration and most of them are partially segmented and partially integrated.<sup>6</sup> A recent survey tested the perception of practitioners regarding the integration of capital markets. The respondents considered the US and the UK to be "highly integrated" into the world capital markets, Mexico "slightly less integrated" and Sri Lanka "relatively segmented."<sup>7</sup>

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<sup>4</sup> For an extensive discussion of this issue, see Geert Bekaert and Campbell Harvey, "Emerging Equity Market Volatility", *Journal of Financial Economics*, Volume 43, 1997.

<sup>5</sup> Geert Bekaert, Campbell Harvey, Robin Lumsdaine, "Dating the Integration of World Equity Markets", Working Paper #6724, National Bureau of Economic Research, September 1998.

<sup>6</sup> For an argument in that direction see Richard Heaney and Vince Cooper, "An examination of the variation in equity market returns and volatility in the Asia Pacific region", Working Paper, Australia National University, 1997.

<sup>7</sup> The survey was sent out to 2,700 University of Chicago GSB alumni, in Tom Keck, Eric Levengood, and Al Longfield, "Using Discounted Cash Flow Analysis in an International Setting: A Survey of Issues in Modeling the Cost of Capital", *Journal of Applied Corporate Finance*, Volume 11, #3, Fall 1998.

The task is then to either make an assumption about the level of integration of all emerging markets and treat them similarly, to develop a model that incorporates both local effects and world effects, or to gauge the level of integration of each market and use a methodology that is best suited on an individual basis.

Another complicating factor is the fact that the covariance of emerging market returns with world returns tends to increase when there is high volatility in the world market.<sup>8</sup> Recent fire sales by investors holding securities in Asia, Latin America and Central and Eastern Europe have shown that emerging markets that were considered to have low correlation with the world market suddenly showed high correlations amongst each other as well as with the world market.<sup>9</sup> To a large extent, this can be explained by the fact that it was the same investors, the large US and European funds, that were invested in these different markets. This brings us to the importance of determining who is invested in these emerging markets and for whom the cost of capital needs to be calculated.

### ***Whose Perspective?***

The characteristics of the investor is another fundamental issue to consider when determining the cost of equity in emerging markets. In a quasi-segmented market, a local investor and a foreign, international investor face different constraints. The international investor can hold an internationally diversified portfolio, whereas the local investor is often limited to holding a locally diversified portfolio. When considering the same asset in the local market, what may be considered diversifiable risk for the international investor may be systematic risk for the local investor. For the purposes of our analysis,

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<sup>8</sup> Bekaert and Harvey, September 1998.

<sup>9</sup> Roy Smith and Ingo Walter, "Risks and Rewards in Emerging Markets Investments", Working Paper, New York University Salomon Center, 1997.

we focus on the perspective of an outside investor who has the ability to hold an internationally diversified portfolio of assets.

A further distinction should be made between international investors that consider the US market as their set of potential investment opportunities and those that extend their set to include the world markets. If one uses a CAPM based model, an investment's beta will be influenced by the market selected as a benchmark. Using the world market as a benchmark will tend to reduce the computed cost of equity since more country risk becomes diversifiable.

In recent years, another distinction has often been made between the theoretical market portfolio that is assumed in the CAPM framework to be held by the investor and the actual portfolio that is held by the investor in practice. Managers of multi-national companies often seek to measure the risk of a project independently of the diversification benefits that the investment might provide to its portfolio of investments and to the portfolio of its investors. Moreover, if they wish to incorporate the benefits of diversification in calculating their discount rate, they might take as a benchmark their company's actual portfolio of investments rather than the global portfolio. For this reason, some practitioners are moving toward an approach that seeks to capture the "total risk" of the project rather than only the risks that are correlated to the returns of the global portfolio.<sup>10</sup> From a theoretical perspective, however, the fact that the company or business unit is not diversified does not justify a "total risk" approach since it is the shareholders that ultimately value their investment and they can be assumed to be globally diversified.

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<sup>10</sup> For a good example, also described extensively below, see Stephen Godfrey and Ramon Espinosa, "A Practical Approach to Calculating Costs of Equity for Investments in Emerging Markets", *Journal of Applied Corporate Finance*, Volume 9, #3, Fall 1996.

## **II 2. DIFFERING APPROACHES TO THE COST OF EQUITY IN EMERGING MARKETS**

### **World CAPM**

The Capital Asset Pricing Method developed by Sharpe, Lintner and Treynor in the 1960's is the standard risk and return model used for capital budgeting decisions. It separates systematic risk from unsystematic risk and posits that the expected return on an investment should be commensurate to its systematic risk, assuming that the unsystematic risk can be diversified away.

The World or Global CAPM uses the world market as a benchmark. Beta is calculated as a measure of sensitivity to the risk of the world portfolio (as opposed to the local market's portfolio, as is often the case) and is multiplied by the world risk premium, calculated as the difference between the expected return on the world portfolio and the risk-free asset.

The simplifying assumptions made by the CAPM theory are under greater strain in emerging markets than in developed markets. For instance, CAPM assumes that because the investor holds the market portfolio, any unsystematic risk of a single investment will be compensated or "diversified away". In reality, the possibility of a currency devaluation, a change in governmental policy, or any other country-specific risk cannot be completely diversified away when a multinational company makes a multi-million dollar investment in an emerging market.

Furthermore, World CAPM assumes that the international markets are integrated, a hotly debated issue, as was discussed above. Rene Stulz argues that the Global CAPM model should be used even in quasi-segmented markets because the “marginal” investors are global investors, which means that the cost of equity is being calculated from a global perspective rather than a local one.<sup>11</sup> By contrast, Claude Erb, Campbell Harvey and Tadas Viskanta argue that the World CAPM model is misguided because one simply cannot assume that world markets are integrated.<sup>12</sup>

For these reasons, many investors are adjusting the CAPM methodology for emerging markets, usually to incorporate some of the unsystematic risk of projects and to move closer to a discount rate that captures the “total risk” embedded in a project. Multi-factor asset-pricing models are thus often used instead of CAPM’s single factor model. In general, the number of factors and their weight tends to increase as the perception of a market’s segmentation increases.<sup>13</sup>

### **CAPM-Based Multi-Factor Models**

According to the survey done by Keck, Levengood, and Longfield, most managers make some sort of adjustment to their discount rate when investing internationally by adding factors. There is wide disagreement about what sort of adjustments are justified and which ones are not. Often, these ad-hoc adjustments are arbitrary and inconsistent with the assumptions of the CAPM framework. A prevalent method is to add a sovereign spread to the risk-free rate in order to account for political and sovereign risks. But

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<sup>11</sup> Rene Stulz, “A Model of International Asset Pricing”, *Journal of Financial Economics*, December 1981.

<sup>12</sup> Claude Erb, Campbell Harvey, and Tadas Viskanta, “Country Risk and Global Equity Selection”, *Journal of Portfolio Management*, Winter 1995.

<sup>13</sup> Tom Keck, Eric Levengood, and Al Longfield, September 1998.

adding political and sovereign risks variables is not justified from a theoretical point of view unless one believes that these risks are not diversifiable.<sup>14</sup>

The least justified adjustments are constant factors that are simply added to the discount rate. Those assume that all investments are affected in the same way at all times, a tenuous argument to make. By making this arbitrary adjustment, they often unfairly penalize projects in emerging markets by placing the break-even bar too high.

An adjustment made by academics to asset pricing models used in an international context accounts for exchange rate risk. These models comprise risk premia that reflect the covariances of assets with exchange rates in addition to the premium reflecting the covariance with the market portfolio.<sup>15</sup> Most of the time, however, practitioners do not add a premium to the discount rate for exchange rate risk. Rather, they tend to convert the cash flows using forward rates and discount them with a home-currency discount rate.

Other adjustments that are used for domestic projects can also be made for international projects. An example might be Eugene Fama and Kenneth French's three-factor model, which includes sensitivity of the security's return to the market return, as well as a risk premium for smaller companies and another one based on the book-to-market value ratio.<sup>16</sup> Another potential adjustment can be made for the size of the market capitalization based on the findings that smaller emerging markets have had higher returns than emerging markets with large capitalizations.<sup>17</sup> More generally, industry

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<sup>14</sup> Idem

<sup>15</sup> Bernard Dumas and Bruno Solnik, "The World Price of Foreign Exchange Risk", *The Journal of Finance*, Vol. L, 2, June 1995.

<sup>16</sup> Eugene Fama and Kenneth French, "The Cross-Section of Expected Stock Returns", *Journal of Finance*, Volume 47, 1993.

<sup>17</sup> For a discussion of the small country effect, see Michael Keppler and Martin Lechner, Emerging Markets, Chicago: Irwin, 1997.

factors are often considered more significant than country factors in determining the cost of equity.<sup>18</sup>

Don Lessard argues that the adjustment should depend not only on whether the risks are systematic or diversifiable but also on whether they are one-sided or symmetric.<sup>19</sup>

Country risks, which are of a downside nature, should be taken into account in the cash flows by lowering their expected value. By contrast, risks that are of a symmetric nature, such as macroeconomic risk, should not affect the cash flows, but may justify an added risk premium since they might increase the volatility of the investor's portfolio.

Along the lines of this argument, it seems that many managers make ad-hoc, catch-all adjustments to their discount rates rather than spend more time thinking rigorously about which risks warrant a premium in the discount rate and which ones should be reflected in the expected cash flows. Moreover, if the risk cannot be measured in a fairly accurate or systematic way, it makes more sense to adjust the cash flows explicitly than bury an extra risk premium in the discount rate.

From a theoretical point of view, a more robust approach than the ones cited above might be to construct a multi-factor model that incorporates risk premia for both the sensitivity of a project's returns to world market returns and its sensitivity to the local or regional market returns. This would build on an assumption that markets are partially segmented and partially integrated. A promising method is that of Richard Heaney and Vince Cooper, who base their model on the evidence that emerging markets returns are influenced by both local and world factors and on the importance of regional

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<sup>18</sup> Hagigi, 1988.

<sup>19</sup> Don Lessard, Fall 1996.

integration.<sup>20</sup> Their model uses both a world beta, which is multiplied by a world equity premium, and a regional beta, which is multiplied by a regional equity premium.

### **Non-CAPM Based Approaches**

One of the most prevalent non-CAPM approaches is the dividend yield method. Calculating dividend yields for emerging markets is more problematic than doing so for advanced markets, but feasible. Bekaert and Harvey developed a model that uses a 12-month moving average of dividends divided by current price levels.<sup>21</sup>

A more innovative and potentially more interesting non-CAPM approach has been developed by SBC Warburg Dillon Reed, a Swiss investment bank, using traded equity options of companies and option pricing theory to determine a term structure for the cost of equity.<sup>22</sup> SBC Warburg Dillon Reed first constructs a term structure for the debt of a company, using the term structure for the risk-free rate and a credit spread, and then adds the expected excess equity returns, which are determined from the firm's traded equity options. The estimated cost of equity is then equal to the corporate bond rate plus a call option at forward strike. This approach is thus more forward looking than CAPM by deriving the market's view on the future cost of equity.

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<sup>20</sup> Richard Heaney and Vince Cooper, 1997.

<sup>21</sup> Geert Bekaert and Campbell Harvey, "Foreign Speculators and Emerging Equity Markets", NBER Working Paper, December 1997.

<sup>22</sup> Roger Mills, The Dynamics of Shareholder Value, England: Price Waterhouse, 1998.

### II 3. METHODOLOGIES ANALYZED IN THIS STUDY

#### JP Morgan's "Modified World CAPM"

JP Morgan starts from the premise that equity markets in emerging countries exhibit low correlation with movements in equity markets in the developed world due to a generally low level of liquidity and barriers to capital flows. Using CAPM in this context tends to underestimate the cost of equity because it makes the tenuous assumption that the unsystematic risk can be diversified away. Since unsystematic risk in emerging markets represents most of the risk given the low correlation between the markets, the beta, which is a measure of systematic risk, tends to be very low and thus produces low costs of equity. With no adjustment to CAPM, using a traditional method thus generates the paradoxical conclusion that emerging markets have lower costs of equity than developed economies, despite their higher volatility.

#### *Adjusting the beta*

The "Modified World CAPM" approach makes the explicit assumption that investors have a limited ability to diversify away emerging market risk and posits that the beta for these emerging countries must be adjusted upward. To do so, it increases the ratio of systematic risk to total risk in these countries to the average ratio for developed countries, which JP Morgan estimates at 41%:

$$\sigma_c^2 = \beta_c^2 * \sigma_w^2 + \sigma_\varepsilon^2$$

where:

$\sigma_c^2$	Total risk (country variance of annual returns)
$\beta_c^2 * \sigma_w^2$	Systematic risk
$\sigma_\varepsilon^2$	Non-systematic risk = total risk – systematic risk

It then follows that:

$$\beta_c^2 * \sigma_w^2 = \sigma_c^2 - \sigma_\epsilon^2$$

$$\beta_c^2 = (\sigma_c^2 - \sigma_\epsilon^2) / \sigma_w^2$$

$$\beta_c = \text{SQRT} ((\sigma_c^2 - \sigma_\epsilon^2) / \sigma_w^2)$$

At this point, an assumption is made that the ratio of systematic risk to total risk in emerging markets should be equal to 41%, the average ratio for developed countries:

$$\sigma_c^2 - \sigma_\epsilon^2 = 41\% * \sigma_c^2$$

$$\sigma_\epsilon^2 = \sigma_c^2 - 41\% * \sigma_c^2 = (100\% - 41\%) * \sigma_c^2 = 59\% * \sigma_c^2$$

The beta can now be adjusted:

$$\text{adj } \beta_c = \text{SQRT} (((\sigma_c^2 - 59\%) * \sigma_c^2) / \sigma_w^2)$$

$$\text{adj } \beta_c = \text{SQRT} ((41\% * \sigma_c^2) / \sigma_w^2) = 0.64 * \sigma_c / \sigma_w$$

The beta is thus increased, providing a more reasonable US \$ country cost of equity, using the following CAPM relationship:

$$K_e = R_{fw} + \beta_{em} [E(r_w) - R_{fw}]$$

Country cost of equity = World risk free rate + Modified beta \* [Expected return of world equity market – World risk free rate]

### *Comparing JP Morgan's adjusted beta to the standard beta*

To clarify JP Morgan's approach, it is helpful to look at the mathematical relationship between its adjusted beta and CAPM's standard beta:

Standard beta:

$$\beta_c = \text{covar}(\mathbf{r}_c, \mathbf{r}_w) / \sigma_w^2$$

Since  $\text{covar}(\mathbf{r}_c, \mathbf{r}_w) = \text{correl}(\mathbf{r}_c, \mathbf{r}_w) * \text{SQRT}(\sigma_c^2 * \sigma_w^2)$

$$\begin{aligned} \text{Then } \beta_c &= (\text{correl}(\mathbf{r}_c, \mathbf{r}_w) * \text{SQRT}(\sigma_c^2 * \sigma_w^2)) / \sigma_w^2 \\ &= (\text{correl}(\mathbf{r}_c, \mathbf{r}_w) * \sigma_c * \sigma_w) / \sigma_w^2 = \\ &= \text{correl}(\mathbf{r}_c, \mathbf{r}_w) * \sigma_c / \sigma_w \end{aligned}$$

While JP Morgan's adjusted beta is equal to:

$$\text{adj } \beta_c = 0.64 * \sigma_c / \sigma_w$$

Therefore, JP Morgan's adjusted beta can also be understood as replacing the actual correlation ( $\mathbf{r}_c, \mathbf{r}_w$ ) calculated from the monthly returns with a constant correlation set at 0.64.

### *Calculating the risk premium*

To calculate the equity risk premium, the world risk free rate and sovereign debt spread, which is the spread between a US long bond and the emerging market's long-term dollar-denominated bond, are subtracted from the cost of equity calculated above:

$$\begin{aligned}\text{Country equity risk premium} &= K_e - \text{Adjusted risk free rate} \\ &= K_e - [\text{World risk free rate} + \text{Sovereign debt spread}]\end{aligned}$$

To determine the cost of equity for a specific company or organization wishing to make an investment, the US\$ country cost of equity is calculated by adjusting the equation with the firm's beta:

$$K_i = R_{fw} + R_{em} + \beta_i * [\beta_{em} * (R_w - R_{fw}) - R_{em}]$$

Where  $R_{em}$  is the emerging country risk premium (spread over Treasuries) and  $\beta_i$  is the firm's predicted beta against the local market.

To determine the correct discount rate, this cost of equity is then inserted into the traditional Weighted Average Cost of Capital (WACC) formula.

### **“Total Risk” Approach by Stephen Godfrey and Ramon Espinosa, Bank of America**

This approach also uses CAPM as its foundation and was developed by Stephen Godfrey and Ramon Espinosa from Bank of America in an article published in the *Journal of*

*Applied Corporate Finance* in the Fall of 1996. The methodology is similar to JP Morgan's in its general adherence to CAPM and its adjustment of it in order to reflect the higher volatility of equity market returns observed in emerging markets.

It can be characterized as a "Total Risk" approach, whereby the adjusted beta is calculated as the ratio of an individual country's equity volatility to that of the US market. By contrast, "unadjusted" country betas are typically calculated by regressing the equity returns of individual countries against a world equity portfolio and by multiplying the ratios of volatilities with a correlation coefficient.

Another adjustment is then made to compensate for the double counting that takes place as a result of adding the spreads on sovereign debt to the equity premium. Since credit quality and equity volatility are likely to be correlated, the cost of equity needs to be adjusted downward. The adjusted beta is reduced by 40%, based on a study that found that 40% of the variation in equity volatility could be explained by variations in credit quality, which suggests that the equity premium may be overstated by 40%.

$$\text{adj } \beta_c = 0.60 * \sigma_c / \sigma_{\text{usa}}$$

The adjusted beta is then multiplied by the US equity premium and added to the risk free rate and a sovereign debt spread:

$$K_e = [\text{Rf} + \text{Sovereign debt spread}] + \text{Adjusted beta} * \text{US equity premium}$$

One of the assumptions made by Godfrey and Espinosa is that the diversification benefits of investing in emerging markets are more relevant for the shareholders of multinational companies than for the managers, who may be held accountable for specific investments. They also argue that discount rates that capture part or all of the unsystematic risk in these environments are more meaningful to compare investments from one country to another and that they are also helpful in understanding the perspective of a local investor, who is unlikely to take into account the global diversification benefits of the investment.

### ***Comparing Bank of America's adjusted beta to JP Morgan's***

Although JP Morgan and Bank of America justify their adjustment of beta on different grounds, i.e. JP Morgan to increase the ratio of systematic risk and Bank of America to avoid overstating the sovereign risk, their adjusted betas are calculated in a similar fashion:

$$\text{adj } \beta_c (\text{BoA}) = 0.60 * \sigma_c / \sigma_{\text{usa}}$$

$$\text{adj } \beta_c (\text{JPM}) = 0.64 * \sigma_c / \sigma_w$$

Two differences in the calculation of beta can be noted. One lies in the constant factor used to multiply the ratios of volatility, 0.60 versus 0.64, and the other lies in the market used as a benchmark. The Bank of America methodology chooses the US market as a benchmark, assuming that the investor holds the US market portfolio to diversify its risks, whereas the JP Morgan methodology chooses the world market as its benchmark. One possible explanation for the different choice in benchmark is perhaps that Bank of America caters more to US investors, who are more likely to consider the US stock

market as their set of potential investment opportunities, whereas JP Morgan caters to a more international group of investors, for whom the world market portfolio represents the set of potential investment opportunities.

Another difference between the two methodologies lies in Bank of America's use of a sovereign spread as an added factor to calculate its cost of equity. JP Morgan uses the sovereign spread to back out an inferred risk premium only after it has already calculated its cost of equity; it thus does not add a sovereign spread in the first place to determine the cost of equity.

### III COMPARING THE THREE MODELS: STATISTICAL ANALYSIS

The objective of this PAE is to refine JP Morgan’s proprietary model for determining the cost of equity in emerging markets as well as to draw more general conclusions on appropriate hurdle rates in emerging markets for public and private sector entities. We conduct an empirical comparison of JP Morgan’s “Modified World CAPM” methodology (henceforth “JPM”) to two different approaches to the cost of equity in emerging markets, the standard World CAPM method (henceforth “CAPM”) and Bank of America’s “Total Risk” approach (henceforth “BoA”). We add to the statistical analysis the standard deviation to test its ability to predict equity returns in comparison to the three models and to complete the spectrum of predictors, ranging from World CAPM (systematic risk) to JPM and BoA (systematic risk adjusted upward) to standard deviation (total risk). The three models are run for 15 different emerging countries plus the United States to generate annual country costs of equity updated monthly.<sup>23</sup>

#### **The risk-return trade-off**

All three models are based on the fundamental trade-off between risk and return. Charts in Appendix B show in graphical form the relationship between the volatility of these stock markets going back 5 years and the returns predicted by the three models. In Appendix B1, the cluster of risk-return relationships forming a parabola, i.e. the efficient frontier, is typical of the CAPM model. Appendices B1 and B2 show more linear relationships, since both of the methodologies represented, JPM and BoA, effectively set the correlation factor as a constant. The same dynamics are apparent in Appendices B4-6, which graph the relationship between the betas and the predicted returns for each of

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<sup>23</sup> The group of emerging countries includes Argentina, Brazil, Chile, Greece, Hong Kong, Indonesia, Korea, Malaysia, Mexico, Philippines, Poland, Singapore, Taiwan, Thailand, Turkey.

these methodologies. The line formed by the different points represents the world security market line. The risk-return relationship drawn by the BoA methodology is less linear than the one generated by the JPM model due to BoA's use of sovereign rates to calculate each country's cost of equity.

### **A simple comparison of actual and predicted returns over time**

A simple visual comparison of the actual and predicted returns between December 1992 and November 1997, shows clear trends. Appendices C1-5 show the month by month spot difference between the predicted cost of equity and the actual return for all three methods for a sample of emerging countries in our data set, while Appendices C6-10 show the moving average of that difference. We first notice the extremely high volatility of the difference in returns, ranging for many of our 15 emerging countries between +100% and -100% over the 5 years.

The graphs also suggest that these markets are highly correlated since the three models tend to over-estimate and under-estimate actual returns during the same periods. These differences between predicted and actual should be considered in light of the fact that predicted returns are not meant to equal actual returns period after period since in a CAPM framework, they seek to reflect the return required based on the non-diversifiable risk. With this in mind, we find that for most of the countries surveyed, the models have over-estimated returns between November 1993 and December 1994 and during the last year of our period of analysis, which corresponds to the onset of the Asian financial crisis. In the same vein, these models have under-estimated returns in the United States since January 1994 (see moving average graph in Appendix C10), which corresponds to the extended period of expansion experienced by US stock markets.

## Theoretical framework of the statistical analysis

Our objective in testing these models is to determine how well they fit reality. To do so, we test whether risk, as defined by each of these methodologies, is a good proxy for performance through time series regressions run on the output of these models. We begin with the following equation<sup>24</sup>:

$$R_{it} - R_f = \alpha_i + \beta_i * [R_{mt} - R_f] + \varepsilon_{it}$$

Where  $R_{it}$  is the actual return of portfolio or asset  $i$  in period  $t$ ,  $R_{mt}$  is the market return in period  $t$ ,  $\alpha_i$  is a measure of disequilibrium, and  $\varepsilon_{it}$  is a disturbance term whose expectation is 0 and is independent of the return on the market. If  $\alpha_i$  equals zero, the portfolio or asset is in equilibrium. If it is greater than zero, the expected return is larger than the equilibrium relationship would suggest.

## Methodology

The first part of the statistical analysis seeks to test the validity of the three models through time series regressions. We regress actual annual excess returns against annual excess returns predicted by these three models and several dummy variables to control for geographical and circumstantial factors. We use annual actual and predicted returns for 16 countries updated monthly over a period of 60 months, with each predicted return based on a rolling window of 5 years of past monthly returns. By stacking the

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<sup>24</sup> This framework was originally used to test CAPM in Michael Jensen, "Risk, Capital Assets, and the Evaluation of Investment Portfolio", *Journal of Business*, April 1969, 42, 167-247; Irwin Friend and Marshall Blume, "Measurement of Portfolio Performance Under Uncertainty", *The American Economic Review*, 1973.

observations for each country into one table, we have a sample of approximately  $60 \times 16 = 936$  observations.

## **Main Findings**

### ***All three models fail to explain a large proportion of emerging markets returns***

Our first observation is that the R-squared adjusted for degrees of freedom for all three models are low. When the predicted return is used as the only independent variable, World CAPM's adjusted R-squared is 0.01, while JPM's and BoA's are 0.003 and 0.005. This means that the models fail to capture important effects associated with returns in emerging markets.

### ***The JPM model dominates the World CAPM and BoA models in emerging markets***

In our time-series regressions, we would expect a model with a perfect fit to the dependent variable to show a coefficient of 1 for the predicted return, no intercept, and high statistical significance. Of our three models, the JPM model comes closest to that, with a coefficient of 0.61 and a t-statistic of 1.98, and a relatively small constant of  $-0.03$  (Table 2). We interpret this coefficient as saying that for one percent change in returns predicted by the model, we should observe an increase of 0.61% in the actual return. The BoA model comes close in terms of fitness, with a coefficient of 0.51 and a t-statistic of 2.31. Holding constant the effect of financial crises, the JPM model improves, showing a coefficient of 0.97 and a t-statistic of 3.46, while its adjusted R-squared increases from 0.003 to 0.17 (Table 2).

***All three models do significantly worse in periods of crisis***

When we introduce a “crisis” dummy variable in our regressions to hold constant the effect of periods of financial crisis on equity returns, we find that the R-squared increase dramatically, from a range of 0.003 to 0.02 to a range of 0.16-0.17 (Table 2). This crisis dummy variable accounts for the Asian financial crisis, which we defined as incorporating all observations between June 1997 and November 1998, and the Mexican crisis, which we defined as incorporating observations for Mexico between November 1994 and December 1995.

This crisis dummy is highly statistically significant, in fact more statistically significant than any other independent variable run in all of our regressions, with T-statistics consistently above 10 (Tables 2-3, 5-7). This reinforces the finding that these models do significantly worse during these periods by failing to capture substantial effects.

***World CAPM is least able to adapt to rapidly changing circumstances***

World CAPM stands out as the model least able to perform adequately in times of financial crisis in emerging markets. Unadjusted for any other variable, the World CAPM model not only has a very low R-squared (0.01), but also a negative coefficient, -1.74. Once the crisis dummy is included, World CAPM’s coefficient changes from a negative to a positive of 0.05 and 0.43 when restricted to countries with the lowest systematic risk (Table 3). We note, however, that neither are statistically significant. Similarly, our correlation analysis shows that World CAPM predicted returns are negatively correlated to actual returns, with a coefficient of -0.11 (Table 1.a.). Once the observations affected by the Asian and Mexican crises and those with negative betas are

taken out, returns predicted by World CAPM are positively correlated (+0.12) to actual returns (Table 1.d.).

***Different degrees of correlation with actual returns show different foci***

The wide range of correlations to actual returns for the three models (Table 1a-d.) can be explained by the fact that these models have different orientations. The World CAPM seeks to only account for systematic risk. Since systematic risk represents a low proportion of total risk in emerging markets, World CAPM has a low correlation to actual returns. The JPM and BoA models are adjusted upward so as to capture some of the risk not included in CAPM's measure of systematic risk by essentially setting the correlation factor as a constant. For this reason, they show a higher correlation to actual returns (6% and 7% in Table 1a.) than the World CAPM. Standard deviation can be thought of as a measure of total risk and thus captures more of the actual risk than the three models. It shows higher correlation with actual risk, with 16% correlation when all emerging countries in our data set are included and 23% when only those with the lowest systematic risk are included.

We also note that the World CAPM predicted returns show very low correlation with the JPM and BoA predicted returns (Table 1a.), with 32% correlation with JPM and 17% with BoA when all observations from our data set are included. The correlation goes up to 52% when all observations that have a negative World CAPM beta are taken out (Table 1c.). This low correlation is due to the effect of countries with low systematic risk as illustrated by Table 1e. and Appendix D. The graphs depicting the returns predicted by each method underscore these differences. In Greece, Indonesia and Argentina for instance, World CAPM and JPM have negative correlations, ranging from -8% to -63%.

By contrast, in matured markets with high systematic risk over total risk such as the United States, World CAPM and JPM are almost identical and exhibit a correlation of close to 100% (Appendix D5). With World CAPM, negative correlation between a country's returns and the world returns generates a negative beta. This increases the divide between the World CAPM and the other two models since the JPM and BoA models do not allow for negative betas.<sup>25</sup>

By contrast, the JPM and BoA models are highly correlated, with more than 90% correlation, which is not surprising since the derivations of the two models above showed that they were close in their definition. Both the JPM and BoA models are extremely highly correlated to the standard deviation, which suggests that both models are closer to capturing the total risk embedded in emerging markets than they are to the World CAPM model.

### ***The models are worse at determining the cost of equity in Asia***

We introduce regional dummies to control for regional differences and find that the dummy for Asian countries is consistently statistically significant in all regressions (Tables 2 and 3), with t-statistics ranging from  $-3.81$  to  $-5.17$ . Even when the regional dummies are included with the crisis dummy, we find that the Asia dummy is still very statistically significant (Tables 5-7). This suggests that there are regional factors that need to be accounted for in order to improve the model.

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<sup>25</sup> In the JPM model, the adjusted beta is defined as the square root of the variance of the country's returns times a constant of 0.41 divided by the variance of the world's returns. A negative beta is thus mathematically impossible.

## IV DEVELOPING A MULTI-FACTOR MODEL FOR EMERGING MARKETS

The first conclusion we draw from the analysis testing the validity of the three models is that all three models can be improved significantly. We now attempt to build on the findings above and previous ones from the literature to determine the factors that should be included in a cost of equity model for emerging markets. We use as a basic framework Steve Ross' Arbitrage Pricing Theory (APT) model.<sup>26</sup> Unlike CAPM, APT does not posit that risk can be captured by a single beta statistic. Rather, systematic risk is a function of several macroeconomic influences or factors:

$$R_{it} - R_f = \beta_1 [R_{\text{factor1}} - R_f] + \beta_2 [R_{\text{factor2}} - R_f] + \dots + \beta_N [R_{\text{factorN}} - R_f]$$

The original APT model as well as international versions of it have been tested many times, with some results suggesting that it offers a better description of expected stock returns than the CAPM and some contradicting that finding.<sup>27</sup>

### Methodology

Based on previous research, we set up a list of factors that could be included in a multi-factor CAPM model to enhance the model's ability to calculate the appropriate cost of equity in an emerging country.<sup>28</sup> We divide them into three categories: macro-factors,

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<sup>26</sup> Stephen Ross, The Arbitrage Theory of Capital Asset Pricing, *Journal of Economic Theory*, 1976, 13, 341-360.

<sup>27</sup> Bruno Solnik, Allan Kleidon, Paul Pfleiderer, "International Arbitrage Pricing Theory/Discussion", *The Journal of Finance*, Vol. 38, May 1983; D. Cho, Cheol Eun, Lemma Senbet, "International Arbitrage Pricing Theory: An Empirical Investigation", *The Journal of Finance*, June 1986; Sarath Abeysekera, "International Arbitrage Pricing Theory: An Empirical Investigation", *Southern Economic Journal*, January 1990.

<sup>28</sup> La Porta Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert Vishny, "Law and Finance", *Journal of Political Economy*, December 1998, Volume 106, Number 6 and "Legal Determinants of External Finance", *The Journal of Finance*, Volume LII, #3, July 1997; Elton Edwin, Martin Gruber and

measures of the legal environment, including both legal rules and their enforcement, and shareholders rights and market capitalization over GNP. We include the last two in the same category since previous research has shown that they are highly correlated.<sup>29</sup> Our macro-factors comprise growth of GDP, inflation, and change in foreign exchange. Our factors for the legal environment include measures of enforceability of contracts, expropriation, corruption, and rule of law. Please see Appendix A for a description of each variable.

We design a series of regressions to test these factors by adding them sequentially to either the World CAPM and JPM predicted returns, on an alternate basis. We thereby test the statistical significance of each of these factors to determine whether they were an omitted variable and should be included in a multi-factor model. The annual actual and predicted excess returns (updated monthly) are the same returns used in the first part of the analysis. The macro factors, GDP growth, inflation and change in foreign exchange are updated annually. The remaining variables are constants in our data set. As in the first part of our statistical analysis, the observations for each country are stacked. As a result, our data set includes 4 years \* 12 months \* 16 countries, which totals to about 768 observations.

### **Findings From The Correlation Analysis**

Our first task is to analyze the correlation between the pre-selected factors in order to determine which ones to include in our regression analyses and the order in which they

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Jianping Mei, "Cost of Capital Using Arbitrage Pricing Theory: A Case Study of Nine New York Utilities", *Financial Markets, Institutions and Instruments*, 1994, 3.

<sup>29</sup> Idem.

should be tested (Table 4). Any two variables that are highly correlated should generally not be included in the same regression in order to avoid the problem of multi-collinearity.

***Factors for the legal environment are highly correlated***

Our four factors for the legal environment of a country are highly correlated amongst themselves. Enforceability of contracts is 81% correlated with the measure for corruption, 88% correlated with the measure for rule of law, and 82% correlated with the measure for expropriation. Similarly, corruption is 88% correlated with the rule of law and 68% correlated with expropriation. We should therefore only use one of these measures in any given regression.

***Shareholders' rights is highly correlated to the legal environment measures***

The compound measure of rights of shareholders is 48% correlated with enforceability of contracts, 41% correlated with the rule of law and 29% correlated with expropriation. Similarly, market capitalization over GNP is highly correlated with the factors for the legal environment. We also find that shareholders' rights is correlated to actual returns (7%).

***Change in foreign exchange is correlated to actual and predicted returns***

Unsurprisingly, we find significant correlation between these variables, including 24% correlation with actual and 35% correlation with JPM predicted returns. We would have expected a higher correlation between change in foreign exchange and inflation (16%).

## Main Findings

### *The statistical results present strong evidence for including several of these factors*

Across the multi-variable regressions, we find that many of the factors we include have highly statistically significant t-statistics and that they boost the R-squared significantly. This means that they are likely to be capturing an effect that was omitted when we were attempting to explain actual returns solely with the World CAPM or JPM predicted returns, and that they should be included in a multi-factor asset pricing model.

### *Among the macro factors, GDP growth and change in FX stand out as significant*

Adding the macro factors to our models shows that both GDP growth and change in foreign exchange are highly statistically significant (Table 5). By first including GDP growth in the regression, we find that the t-statistics are very high (-5.5 with World CAPM predicted returns and -4.9 with JPM predicted returns) and that the adjusted R-squared has increased to 18%-19%. Note that the negative coefficient on GDP growth is puzzling at first since we would expect a positive one. However, we saw that the negative correlation was in large part due to the model's inability to adapt to rapidly changing circumstances such as a crisis.

Once other factors are added, we find that change in foreign exchange is statistically significant, with t-statistics of 4.5 and 3.9. Inflation is less significant, with coefficients close to 0 and t-statistics barely or not significant. This is probably due to the fact that the effect of inflation is already captured in the change in foreign exchange and suggests that the two variables should not be included together in a multi-factor model.

### ***The measures of legal environment show strong statistical significance***

Except for expropriation, all of our measures of a country's legal environment show very strong t-statistics (Table 6). Since they are highly correlated amongst each other, we ran them separately. Corruption came out strongly with t-statistics of 4.01 when associated with World CAPM predicted results and 3.9 with JPM predicted results. Rule of law and enforceability of contracts also showed strong statistical results, with t-statistics ranging from 2.8 to 3.8. Risk of expropriation is not-statistically significant in our regressions. These findings suggest that the effect of institutions is missing from the World CAPM and JPM models and that they should be incorporated to be enhanced.

### ***Shareholders' rights has a statistically significant impact on actual returns***

Shareholders' rights also shows statistically significant results when added to the predicted World CAPM or JPM returns and the macro factors. Given the correlation with the legal environment measures, we did not run them simultaneously. This suggests that issues of corporate governance and of investor protection have an important effect on the cost of equity in emerging markets, which supports findings from recent research.<sup>30</sup>

Market capitalization over GNP comes out-statistically significant but the coefficients are insignificant (-0.0004 with both World CAPM and JPM). These results are too inconclusive to warrant including this variable in a multi-factor model, although more testing might prove otherwise.

### **A word of caution**

The conclusions and recommendations of this PAE are based on the statistical analysis conducted on the market data provided to us by JP Morgan. Doing statistical analysis on

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<sup>30</sup> La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1997, 1998.

emerging markets data is fraught with danger. Before concluding, we wish to point out two areas that can potentially make the analysis less reliable:

- Our data only extends back to 1987. Since many of these markets are newly developed, the data will only be available as time goes by. This is clearly a handicap to doing time series analysis. By contrast, traditional statistical analysis on beta for the US market extends over a period of 70 years.
- Doing a time series statistical analysis on a rolling period of 60 months of volatility may create a problem of serial correlation and affect the results observed.

Finally, we have made the assumption that calculating the country cost of equity in emerging markets is akin to determining the expected returns on the national stock markets in each of these emerging countries. While this is open to debate, we believe this approach to be currently the best one to approximate of the cost of equity in these markets.

## V CONCLUSION AND RECOMMENDATIONS

The purpose of this PAE was to test the validity of JP Morgan's methodology to calculate the cost of equity in emerging markets and help it develop a more robust model. We conducted this project by first setting the context for the important issues specific to emerging markets that need to be addressed by a model and by conducting a survey of the various methodologies used by practitioners and academics. We then tested empirically the validity of the JP Morgan methodology and compared it to two alternative methods. Building on these results, we tested the significance of several factors to develop a multi-factor model that would enhance the current JP Morgan model by helping it explicitly account for some of the effects that it is currently failing to capture. In light of this research, we draw the following conclusions:

### ***JP Morgan's model performs better in emerging markets than other models we tested***

One of our main findings is that JP Morgan's Modified World CAPM model is a better predictor over time of actual returns in emerging markets than the two alternative methods we tested, the World CAPM model and the Bank of America model. While results from the JP Morgan and Bank of America models are relatively close to one another, both clearly out-perform World CAPM's results. This is comforting since Modified World CAPM was developed by JP Morgan as an improvement on World CAPM.

***But it fails to capture important effects in determining the cost of equity in EM***

- Despite the encouraging statistical results observed, i.e. coefficients close to 1 and high t-statistics, the fact remains that the JP Morgan model exhibits low R-squared, meaning that it fails to explain a significant proportion of actual returns.
- We also determined that the JP Morgan model performed significantly worse during periods of crisis, such as the current Asian financial crisis. The important conclusion here is not that the model does not predict financial crises – it is unlikely ever to do so – but that it does not adapt fast enough to changing circumstances.
- Finally, the model performs worse in determining the cost of equity in Asia, even when controlling for the effects of financial crisis.

***The model can be enhanced by explicitly incorporating a number of factors***

After having determined empirically that the model fails to capture important effects, we tested the validity of including a number of different factors to be added to the measure of risk based on the volatility of past returns provided by the Modified World CAPM model. These factors would enhance any CAPM-based single factor model, even if Barra's multi-factor beta is used, since Barra tends to use equity market-based factors such as PE and price to book value ratios, without considering broader questions of macro-economic factors, legal environment, the quality of institutions, and issues of corporate governance.

***GDP growth and change in foreign exchange are macro-economic factors to include***

Our analysis suggests that both of these were omitted variables when the JP Morgan model was run on its own. These two macro factors stood out as significant when added to returns predicted by the JP Morgan model and would thus enhance the model if

explicitly incorporated. Variations of these two measures could work as well and should be tested.

***A measure of the legal environment should also be included***

One of our most important findings is that the market seems to require a return based on the quality of the institutions of a country. Several studies done recently suggest that the importance of institutions for the equity markets is underestimated. Our research reinforces that notion. Three measures of the legal environment we tested proved to be statistically significant: enforceability of contracts, rule of law and corruption. These are currently unaccounted for in the JP Morgan model and should be included.

***Issues of corporate governance matter and should be included in a multi-factor model***

Issues of corporate governance and investor protection have long been under-estimated in their impact on equity returns. The Asian financial crisis has shown how central these effects could be. Our research supports that conclusion by showing that a compound measure of shareholders' rights has a statistically significant effect on actual returns and should be included in a multi-factor model to be used for emerging markets.

***Next steps***

Next steps for JP Morgan include determining which variation of these factors to use and how to incorporate them into a multi-factor World CAPM model. One approach would be to determine the correct risk premium to be used for each of these variables and to incorporate them into a model building on the current Modified World CAPM model using an APT framework.

JP Morgan also needs to determine whether the current JP Morgan model or the World CAPM model should be used as a base to construct a multi-factor model. The analysis has shown that these models generate significantly different expected returns and that their correlation in countries with low levels of systematic risk is low and even negative at times. By boosting up the beta, the current JP Morgan model attempts to capture some of these effects. The question then becomes whether part of these effects would be double-counted by adding several variables to this model instead of the World CAPM.

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**Table 1.a. Correlation analysis**  
**All emerging countries from data set included**

Variables : Actual annual excess return, predicted World CAPM excess return, predicted JPM excess return, predicted BoA excess return,  
Standard deviation

Number of observations: 948

	<b>Actual</b>	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>	<b>Standard Deviation</b>
<b>Actual</b>	1.00				
<b>World CAPM</b>	-0.11 (b)	1.00			
<b>JPM</b>	0.06	0.32 (a)	1.00		
<b>BoA</b>	0.07 (c)	0.17 (a)	0.96 (a)	1.00	
<b>Standard Deviation</b>	0.16 (a)	0.12 (a)	0.91 (a)	0.93 (a)	1.00

(a) Statistically significant at a 99% level of confidence

(b) Statistically significant at a 95% level of confidence

**Table 1.b. Correlation analysis: Countries with low systematic risk**

Number of observations: 768

	<b>Actual</b>	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>	<b>Standard Deviation</b>
<b>Actual</b>	1.00				
<b>World CAPM</b>	-0.09	1.00			
<b>JPM</b>	0.13	0.36	1.00		
<b>BoA</b>	0.15	0.21	0.95	1.00	
<b>Standard Deviation</b>	0.23	0.14	0.89	0.91	1.00

All are statistically significant at a 99% level of confidence, except World CAPM on Actual

**Table 1.c. Correlation analysis: Without observations with negative World CAPM betas**

Number of observations: 891

	<b>Actual</b>	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>	<b>Standard Deviation</b>
<b>Actual</b>	1.00				
<b>World CAPM</b>	-0.03	1.00			
<b>JPM</b>	0.04	0.52	1.00		
<b>BoA</b>	0.04	0.38	0.96	1.00	
<b>Standard Deviation</b>	0.13	0.37	0.91	0.92	1.00

All are statistically significant at a 99% level of confidence, except World CAPM and JPM on Actual

**Table 1.d. Correlation analysis: Without Months affected by Asian crisis (June 1997 – Nov 1998), by Mexican crisis (Nov 1994 – end 1995) (Mexico only), and observations with negative World CAPM betas**

Number of observations: 604

	<b>Actual</b>	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>	<b>Standard Deviation</b>
<b>Actual</b>	1.00				
<b>World CAPM</b>	0.12	1.00			
<b>JPM</b>	0.05	0.41	1.00		
<b>BoA</b>	0.03	0.29	0.96	1.00	
<b>Standard Deviation</b>	0.05	0.32	0.95	0.94	1.00

All are statistically significant at a 99% level of confidence, except World CAPM, JPM, BoA and Standard deviation on Actual

## Tables 1.e.

### Correlation analysis: Indonesia

Number of observations: 60

	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>
<b>World CAPM</b>	1.00		
<b>JPM</b>	-0.28	1.00	
<b>BoA</b>	-0.57	0.94	1.00

### Correlation analysis: Greece

Number of observations: 60

	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>
<b>World CAPM</b>	1.00		
<b>JPM</b>	-0.08	1.00	
<b>BoA</b>	-0.06	0.99	1.00

### Correlation analysis: Hong Kong

Number of observations: 60

	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>
<b>World CAPM</b>	1.00		
<b>JPM</b>	0.79	1.00	
<b>BoA</b>	0.63	0.96	1.00

### Correlation analysis: USA

Number of observations: 60

	<b>World CAPM</b>	<b>JPM</b>	<b>BoA</b>
<b>World CAPM</b>	1.00		
<b>JPM</b>	0.999	1.00	
<b>BoA</b>	0.74	0.74	1.00

**Table 2. Time-series regression of stacked monthly annual excess returns on predicted excess returns for 16 countries over 60 months based on a rolling window of 60 months of volatility**

Dependent variable : Actual annual excess return

Number of observations : 948

Independent variable	Coefficients (t-Statistics)											
	World CAPM predicted excess return	-1.74 (-3.29)				0.05 (0.09)					-1.73 (-3.31)	
JPM predicted excess return		0.61 (1.98)				0.97 (3.46)				0.01 (0.03)		
BoA predicted excess return			0.51 (2.31)				0.51 (2.52)				0.15 (0.52)	
Standard deviation predicted excess return				0.33 (4.86)				0.18 (2.85)				0.34 (3.89)
Intercept	0.09 (3.88)	-0.03 (-0.91)	-0.04 (-1.32)	-0.10 (-3.44)	0.13 (5.78)	0.05 (1.68)	0.06 (1.96)	0.06 (1.95)	0.22 (4.13)	0.17 (3.23)	0.16 (3.07)	0.13 (2.53)
Asia									-0.20 (-3.81)	-0.22 (-3.94)	-0.23 (-4.08)	-0.29 (-5.17)
Latin America									-0.05 (-0.95)	-0.07 (-1.13)	-0.09 (-1.36)	-0.19 (-3.01)
Emerging Europe									-0.03 (-0.54)	-0.06 (-0.83)	-0.08 (-1.11)	-0.21 (-2.96)
Asian/Mexican crises					-0.35 (-12.89)	-0.35 (-13.72)	-0.35 (-13.41)	-0.33 (-12.68)				
Adjusted R-squared	0.01	0.003	0.005	0.02	0.16	0.17	0.16	0.16	0.05	0.04	0.04	0.055

**Table 3. Time-series regression of stacked monthly annual excess returns on predicted excess returns for 16 countries over 60 months based on a rolling window of 60 months of volatility**

**Countries with low systematic risk**

Dependent variable : Actual annual excess return      Number of observations : 768

Independent variable	Coefficients (t-Statistics)											
	World CAPM predicted excess return	-1.35 (-2.37)				0.43 (0.79)					-1.57 (-2.73)	
JPM predicted excess return		1.35 (3.59)				1.69 (4.93)				0.88 (1.75)		
BoA predicted excess return			1.23 (4.16)				1.10 (4.06)				1.08 (2.72)	
Standard deviation predicted excess return				0.54 (6.43)				0.32 (4.03)				0.54 (5.24)
Intercept	0.071 (2.67)	-0.11 (-2.85)	-0.17 (-3.55)	-0.21 (-5.42)	0.12 (4.76)	-0.03 (-0.86)	-0.04 (-0.86)	-0.01 (-0.32)	0.21 (3.81)	0.09 (1.40)	0.043 (0.61)	-0.03 (-0.50)
Asia									-0.23 (-3.97)	-0.24 (-4.12)	-0.26 (-4.44)	-0.22 (-3.91)
Latin America									-0.06 (-0.93)	-0.09 (-1.56)	-0.14 (-2.14)	-0.12 (-2.1)
Emerging Europe									-0.05 (-0.80)	-0.16 (-2.05)	-0.21 (-0.21)	-0.24 (-3.38)
Asian/Mexican crises					-0.37 (-11.95)	-0.38 (-12.73)	-0.36 (-12.16)	-0.34 (-10.97)				
Adjusted R-squared	0.006	0.015	0.021	0.05	0.161	0.186	0.178	0.178	0.05	0.04	0.05	0.073

## Testing a multi factor model

**Table 4. Multi-factor correlation analysis**

Number of observations: 780

	Actual	CAPM	JPM	GDP growth	Inflation	FX Change	Expropriation	Enforceability of contracts	Corruption	Rule of law	Shareholders rights	Market cap / GNP
<b>Actual</b>	1.00											
<b>CAPM</b>	-0.096	1.00										
<b>JPM</b>	0.11	0.02	1.00									
<b>GDP growth</b>	-0.19 <sub>(a)</sub>	-0.20 <sub>(a)</sub>	-0.19 <sub>(a)</sub>	1.00								
<b>Inflation</b>	0.05	0.27 <sub>(a)</sub>	0.28 <sub>(a)</sub>	-0.11 <sub>(c)</sub>	1.00							
<b>FX Change</b>	0.24 <sub>(a)</sub>	0.18 <sub>(a)</sub>	0.35 <sub>(a)</sub>	-0.27 <sub>(a)</sub>	0.16 <sub>(a)</sub>	1.00						
<b>Expropriation</b>	-0.001	0.002	-0.55 <sub>(a)</sub>	0.16 <sub>(a)</sub>	0.009	-0.01	1.00					
<b>Enforceability of contracts</b>	0.05	0.08	-0.58 <sub>(a)</sub>	-0.01	-0.07	-0.09	0.82 <sub>(a)</sub>	1.00				
<b>Corruption</b>	0.12 <sub>(c)</sub>	0.15 <sub>(a)</sub>	-0.28 <sub>(a)</sub>	-0.02	0.06	0.03	0.68 <sub>(a)</sub>	0.81 <sub>(a)</sub>	1.00			
<b>Rule of law</b>	0.08	0.02	-0.46 <sub>(a)</sub>	0.09	0.02	-0.01	0.87 <sub>(a)</sub>	0.88 <sub>(a)</sub>	0.88 <sub>(a)</sub>	1.00		
<b>Shareholders rights</b>	0.07	-0.12 <sub>(c)</sub>	-0.44 <sub>(a)</sub>	0.06	0.01	-0.04	0.29 <sub>(a)</sub>	0.48 <sub>(a)</sub>	0.31 <sub>(a)</sub>	0.41 <sub>(a)</sub>	1.00	
<b>Market cap / GNP</b>	-0.13 <sub>(b)</sub>	0.12 <sub>(b)</sub>	-0.49 <sub>(a)</sub>	0.44 <sub>(a)</sub>	-0.14 <sub>(a)</sub>	-0.14 <sub>(a)</sub>	0.39 <sub>(a)</sub>	0.36 <sub>(a)</sub>	0.40 <sub>(a)</sub>	0.40 <sub>(a)</sub>	0.22 <sub>(a)</sub>	1.00

(a) Statistically significant at 99% level of confidence

(b) Statistically significant at 95% level of confidence

(c) Statistically significant at 90% level of confidence

## Description of variables

<b>Actual :</b>	Actual excess return (total return minus risk-free rate) over a period of 12 months, MSCI emerging markets database.
<b>CAPM :</b>	Excess return predicted by World CAPM model, based on MSCI emerging markets numbers.
<b>JPM :</b>	Excess return predicted by JP Morgan Modified World CAPM model, based on MSCI emerging markets.
<b>GDP Growth :</b>	Annual GDP Growth, IFS February 1999
<b>Inflation :</b>	Annual change in consumer prices, indexed in 1990, IFS February 1999
<b>FX Change :</b>	Annual change in foreign exchange (currency per SDR), IFS February 1999
<b>Rule of law :</b>	Assessment of the law and order tradition in the country measured by the country risk rating agency International Country Risk (ICR). Averages of the months of April and October of the monthly index between 1982 and 1995.
<b>Risk of expropriation :</b>	ICR's assessment of the corruption in government. Average of the months of April and October of the monthly index between 1982 and 1995.
<b>Enforceability of contracts :</b>	ICR's assessment of the risk of repudiation of contracts. Average of the months of April and October of the monthly index between 1982 and 1995.
<b>Corruption :</b>	ICR's assessment of the corruption in government. Average of the months of April and October of the monthly index between 1982 and 1995.
<b>Shareholders rights :</b>	Compound measure of rights of shareholders, including voting rights, possibility of proxy voting by mail, cumulative votes for directors, existence of oppressed minority shareholders; source : Bankruptcy and reorganization laws, courtesy of Professor Lopez-de-Silanes.
<b>Market cap/GNP :</b>	Total market capitalization over GNP, World Bank and International Monetary Fund.

Actual, CAPM, JPM are updated monthly over 60 months for each country ; GDP growth, inflation, and FX change are updated annually ; the remaining variables are constants in our data set.

The MSCI country index data was provided to us courtesy of Paul Gibbs at JP Morgan.

The data on the legal environment and protection of investors' rights was provided to us courtesy of Professor Lopez-de-Silanes.

**Table 5. Time-series regression of stacked annual excess returns on predicted excess returns and macro factors**

Dependent variable : Actual annual excess return

Number of observations : 780

Independent variable	Coefficients (t-Statistics)									
	<b>World CAPM predicted excess return</b>	-1.92 (-2.68)		0.27 (0.39)		-0.53 (-0.77)		-1.49 (-1.82)		0.49 (0.64)
<b>JPM predicted excess return</b>		1.13 (3.07)		1.21 (3.58)		0.90 (2.65)		0.28 (0.67)		-0.42 (-0.86)
<b>GDP growth</b>					-2.06 (-5.50)	-1.81 (-4.89)	-1.58 (-4.15)	-1.44 (-3.72)	-0.13 (-0.26)	-0.23 (-0.48)
<b>Inflation</b>							0.00 (2.58)	0.00 (1.99)	0.00 (1.46)	0.00 (1.73)
<b>Change in FX</b>							0.04 (4.48)	0.04 (3.94)	0.04 (3.60)	0.04 (3.88)
<b>Asia</b>									-0.26 (-5.86)	-0.24 (-4.78)
<b>Latin America</b>									-0.10 (-2.37)	-0.06 (-1.16)
<b>Emerging Europe</b>									-0.003 (-0.05)	0.03 (0.48)
<b>Crises</b>			-0.35 (-11.6)	-0.35 (-12.1)	-0.34 (-11.3)	-0.35 (-12.18)	-0.32 (-9.95)	-0.34 (-10.70)	-0.35 (-12.44)	-0.34 (-12.0)
<b>Intercept</b>	0.09 (3.17)	-0.07 (-2.08)	0.12 (4.65)	0.03 (0.84)	0.26 (7.23)	0.15 (3.74)	0.24 (6.08)	0.16 (3.76)	0.26 (6.10)	0.28 (7.4)
<b>Adjusted R-squared</b>	0.008	0.01	0.15	0.17	0.18	0.19	0.22	0.21	0.27	0.27

**Table 6. Time-series regression of stacked annual excess returns on predicted excess returns, macro factors, and legal measures**

Dependent variable : Actual annual excess return

Number of observations : 780

Independent variable	Coefficients (t-Statistics)									
	<b>World CAPM predicted excess return</b>	-1.67 (-2.05)		-1.56 (-1.91)		-1.86 (-2.27)		-1.50 (-1.84)		0.57 (0.74)
<b>JPM predicted excess return</b>		1.09 (2.03)		1.02 (2.01)		0.76 (1.66)		0.63 (1.10)		0.57 (0.74)
<b>GDP growth</b>	-1.56 (-4.08)	-1.31 (-3.30)	-1.69 (-4.43)	-1.52 (-3.92)	-1.6 (-4.16)	-1.39 (-3.52)	-1.62 (-4.23)	-1.51 (-3.90)	-0.03 (-0.06)	-0.03 (-0.06)
<b>Inflation</b>	0.00 (2.73)	0.00 (1.7)	0.00 (2.51)	0.00 (1.37)	0.00 (2.45)	0.00 (1.43)	0.00 (2.57)	0.00 (1.67)	0.00 (1.47)	0.00 (1.47)
<b>Change in FX</b>	0.04 (4.69)	0.03 (3.63)	0.04 (4.49)	0.03 (3.32)	0.04 (4.53)	0.03 (3.53)	0.04 (4.47)	0.03 (3.54)	0.04 (3.61)	0.04 (-0.53)
<b>Enforceability of contracts</b>	0.06 (2.82)	0.10 (3.47)								
<b>Rule of law</b>			0.03 (3.28)	0.05 (3.79)					-0.008 (-0.53)	-0.008 (-0.53)
<b>Corruption</b>					0.02 (4.01)	0.03 (3.87)				
<b>Expropriation</b>							0.007 (0.73)	0.17 (1.29)		
<b>Asia</b>									-0.29 (-4.38)	-0.29 (-4.38)
<b>Latin America</b>									-0.12 (-2.00)	-0.12 (-2.00)
<b>Emerging Europe</b>									-0.02 (-0.4)	-0.02 (-0.4)
<b>Crises</b>	-0.32 (-9.95)	-0.34 (-10.9)	-0.32 (-10.03)	-0.34 (-10.98)	-0.31 (-9.93)	-0.34 (-10.94)	-0.32 (-9.95)	-0.34 (-10.78)	-0.35 (-12.5)	-0.35 (-12.5)
<b>Intercept</b>	0.10 (1.52)	0.14 (-1.26)	0.12 (2.12)	-0.07 (-0.79)	0.11 (1.93)	-0.03 (-0.43)	0.19 (2.28)	0.01 (0.08)	0.30 (3.23)	0.30 (3.23)
<b>R-squared</b>	0.22	0.22	0.23	0.23	0.23	0.23	0.22	0.22	0.27	0.27

**Table 7. Time-series regression of stacked annual excess returns on predicted excess returns, macro factors, legal measures, market capitalization and shareholders' rights**

Dependent variable : Actual annual excess return    Number of observations : 780

Independent variable	Coefficients (t-Statistics)			
	<b>World CAPM predicted excess return</b>	-1.00 (-1.22)		-1.40 (-1.68)
<b>JPM predicted excess return</b>		0.68 (1.32)		0.71 (1.53)
<b>GDP growth</b>	-1.20 (-2.59)	-1.11 (-2.43)	-1.61 (-4.25)	-1.46 (-10.57)
<b>Inflation</b>	0.00 (2.04)	0.00 (1.29)	0.00 (2.49)	0.00 (1.60)
<b>Change in FX</b>	0.04 (4.3)	0.03 (3.48)	0.04 (4.54)	0.03 (3.72)
<b>Rule of law</b>	0.05 (4.00)	0.06 (4.15)		
<b>Market cap / GNP</b>	-0.0004 (-2.66)	-0.0004 (-2.60)		
<b>Shareholders' rights</b>			0.01 (1.49)	0.03 (2.51)
<b>Crises</b>	-0.33 (-10.55)	-0.34 (-11.14)	-0.32 (-9.96)	-0.33 (-10.57)
<b>Intercept</b>	0.08 (1.20)	-0.05 (-0.57)	0.20 (3.68)	0.06 (0.94)
<b>R-squared</b>	0.23	0.23	0.22	0.22