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Financial Liberalization in Emerging Market Economies: A Catalyst for Stock Market Volatility?

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Financial Liberalization in Emerging Market Economies:

A Catalyst for Stock Market Volatility?

Abstract

This study examines the impact of financial liberalization upon stock market volatility in nine emerging market economies. We construct a model of volatility that includes a unique proxy variable for liberalization. The regressions yield mixed results for the relationship betweem liberalization and volatility: in one case, liberalization causes volatility to decrease and in two cases, liberalization causes volatility to increase.

Dan Kedmey

5/19/05

Introduction:

In the early 1990's, the International Monetary Fund successfully convinced a number of developing nations to ease capital controls and liberalize financial markets. The IMF based this policy on the fundamental assumption that privatized markets allocate investment and resources most efficiently, whether in trade or finance. By opening up financial markets, developing countries can expand and diversify investment, thicken financial markets, and encourage economic growth.

As restrictions on capital flows and foreign investment eased up, international investment rapidly increased in developing countries. Indeed, in Southeast Asia, it reached unprecedented heights. Huang and Yang (1999) point out that international investment accounted for sizeable portions of national GDP: 11% for Malaysia, 10% for Thailand, 5% for Indonesia, and 4% for South Korea.[1] However, in the case of Southeast Asia, investor confidence proved to be fickle. An event like the crash of the Thai baht was enough to send capital flying from the region just as quickly as it had poured in. As a result, Southeast Asia plunged into a severe economic crisis. In the aftermath of the crisis, one major question came to dominate the economic debate surrounding the event: Why did investor confidence change course so rapidly and so harshly?

The IMF viewed the sudden loss in investor confidence as a consequence of the Asian tigers' rotten financial systems. According to the IMF, investors rapidly withdrew their capital because they recognized that "crony capitalism" in the Asian economies was unsustainable. As a result, the IMF made it a top priority to restore investor confidence. They insisted that the afflicted countries root out government interference in the financial market and make financial markets more transparent.

[1] Huang and Yang (1999) p.323

However, not all economists viewed the Asian financial crisis as an essentially rational response to rotten financial systems. Indeed, Paul Krugman pointedly asks why so many economies, with such varied levels of development and cronyism, "all hit the wall at once?" Furthermore, why had the growth of Asian tigers continued for decades without a financial crisis, despite the fact that "crony capitalism" was arguably worse in earlier periods? According to Krugman, the sudden vulnerability of Asian economies did not stem from the rational fears of investors, rather vulnerability stemmed from the fact that "the new debts, unlike the old ones, were in dollars" [2] In other words, the opening of capital markets to foreign investment ushered in unprecedented financial volatility. In the aftermath of the Asian financial crisis, several noted economists, including Paul Krugman, Joseph Stiglitz, and Jagdish Baghwati have criticized the IMF for prodding developing nations to rapidly liberalize their underdeveloped financial markets.

Ultimately, the Asian financial crisis added a sense of urgency to the debate over financial market liberalization. Consequently, a number of economists have constructed insightful studies into the nature of financial markets and the effects of foreign investment in developing countries. My own study endeavors to provide a modest contribution to this trenchant debate, and shed light on the larger question of how equity market liberalization affects stock market volatility in emerging market economies.

Literature Review:

At the forefront of the critique of financial market liberalization is Joseph Stiglitz, who argues that the empirical evidence suggests no link between capital market liberalization and

[2] Krugman p. 100

economic growth (Stiglitz 2002). Indeed, Dani Rodrik reaches precisely this conclusion in his frequently cited study on capital account liberalization (Rodrik 1998). Rodrik takes a sample of over 100 nations and constructs three scatter plots with capital market "openness" on the X-axis and growth, investment, and inflation, respectively, on the Y-axis. The scatter plots reveal no discernible relationship between liberalization and the respective dependent variables. Thus, Rodrik concludes, "capital controls are essentially uncorrelated with long term economic performance."[3]

However, Eichengreen contests that Rodrik is engaging in "fail-safe econometrics" where the absence of correlation is taken as sufficient evidence that none actually exists. Rodrik ignores the fact that omitted variables could mask a significant causal relationship (Eichengreen 2003). Furthermore, Eichengreen argues that the preponderance of economic theory suggests that markets allocate resources more efficiently than government – financial markets are no exception. If international finance is nothing more than intertemporal trade, then financial liberalization should have the same benefits as trade liberalization. Anyone who wishes to contest this view must provide "incontrovertible evidence," for there is no *a priori* reason to reject international financial liberalization.

On the contrary, Stiglitz argues that financial markets differ from international trade because trade centers on goods, whereas finance relies on information and risk. If economic actors have transparent information and developed risk markets, then internationally competitive markets are, indeed, Pareto optimal – a point further elucidated later on in the paper with an examination of the Capital Asset Pricing Model. However, if investors face information asymmetries and incomplete risk markets, then they cannot accurately assess the fundamental

[3] Rodrik (1998) p. 61

value of an asset. These problems are particularly acute for foreign investors attempting to make headway into a recently liberalized developing country. Unfamiliarity with the market, cultural, and physical distance all place international investors at a disadvantage in accurately assessing the price of an asset.

Furthermore, the legal structure of the financial market could be poorly developed. For example, developing countries tend to have weak enforcement of investor rights. In addition to lacking transparency, Martell and Stultz (2003) point out that developing countries may have legal systems easily manipulated by residents or fail to cover expropriation risks. Hellman, Murdock, and Stiglitz (2000) demonstrate the importance of a solid regulatory structure in a financial market by constructing a theoretical model where financial liberalization intensifies competition among banks, thus encouraging gambling behavior. In order to reduce this moral hazard, the model examines the efficacy of several prudential regulations, including capital requirements and deposit-rate controls. The model shows that deposit-rate controls will induce prudent behavior with a Pareto efficient outcome. Overall, the study demonstrates the importance of well-developed prudential regulation for capital markets. Unfortunately, capital markets in developing countries tend to lack these important regulations due to their immaturity. All of these legal deficiencies will contribute to the fickle behavior of international investors in developing countries.

The critique of financial market liberalization rests on a foundation of theoretical work explaining investor behavior. According to Choe, Kho, and Stultz (1998), "foreign investors engage in positive feedback trading and herd."[4] However, they also point out that herding does not necessarily imply volatility – it could be that herds are accurately reflecting permanent price

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[4] Choe, Kho, and Stultz (1998) p. 3

changes in the market. However, foreign investors are destabilizing if their herding behavior results in overshooting of price assessments. In short, the panics and manias of investors could become self-fulfilling prophecies. For example, Antonio Bernardo and Ivo Welch (2004) construct a model for a run on a financial market. In this model, each investor fears having to liquidate shares after a run, but before prices return to a level based on "fundamental values" (the assumption of "fundamental values" comes from neo-classical theory on asset pricing). In order to avoid this, investors prefer selling at the average in-run price, thus causing the run itself. Overall, Bernardo and Welch construct a model that suggests runs and crises are not necessarily caused by liquidity shocks. Indeed, the fear alone of future liquidity shocks, whether justified or not, is enough to trigger capital flight from a country.

This study relates to financial liberalization because liberalization increases liquidity, making financial runs all the more severe. Furthermore, the model concludes that only the fear of liquidity shocks is enough to precipitate a financial crisis. No doubt, information asymmetries and poorly developed risk markets will enhance this fear. Thus, financial liberalization may prove far more destabilizing for developing countries.

However, models of investor behavior do not only lend support to those who oppose financial liberalization. Indeed, a model by Bartolini and Drazen (1997) suggests that capital market liberalization can alleviate investor fears by signaling a government's devotion to responsible fiscal and monetary policy. Specifically, Bartolini and Drazen (1997) examine how a government's current capital control policy can signal future policies. The model attempts to capture the interaction between optimizing, forward looking investors and government, so that governments may use policies affecting capital mobility to signal a favorable future fiscal situation. Essentially, the model suggests that capital control reductions enhance government credibility, whereas restrictions reduce investor confidence. Thus, financial liberalization, if implemented wisely, may serve as a tool to reduce volatility in financial markets by allaying investor fears over the market's macroeconomic fundamentals[5].

Overall, trenchant theoretical arguments appear to support both sides of the debate over capital market liberalization. Not surprisingly, the empirical studies surrounding this debate are no less contentious. Several studies appear to support Stiglitz's argument that international financial liberalization does not necessarily encourage economic growth and almost certainly exacerbates economic volatility. One such study by Grabel (1995) examines the impact of financial liberalization on the volatility of stock markets in developing countries. Grabel uses two volatility indexes based on the neo-classical assumption that assets have an underlying value based on economic fundamentals; volatility is defined by deviation from this underlying value. She also develops a Keynesian volatility index that does not presume any underlying asset value, thus, volatility is defined by the magnitude of asset fluctuations. The study finds that all three volatility indices are positively correlated with financial liberalization. Interestingly, both the Keynesian and neo-classical indices produce consistent results for a majority of countries in the study.

A broader study by Levine and Zervos (1998) examines the effect of capital control liberalization on the functioning of stock markets. Unlike Grabel's singular focus on volatility, Levine and Zervos evaluate the effects of liberalization on stock market size, liquidity, and international integration, as well as volatility. The authors establish a date of "liberalization," and then examine changes in the aforementioned variables before and after this date. For example, a simple t-test is applied to the volatility measurement (estimated as the standard

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[5] An exposition of the Capital Asset Pricing Model (CAPM) on p. 11 reveals the importance of these fundamentals in stock price determination.

deviation on weekly stock market returns), to test for a significant change in volatility before and after the date of liberalization. The results show that after liberalization, stock markets become larger, more liquid, more integrated, and as Stiglitz might expect, more volatile.

Another study by Sebastian Edwards (1999) examines Chile's experience with capital controls and how they affect economic performance. This study differentiates between controls on capital inflows and outflows. The author finds that controls on capital outflows are largely ineffective, while controls on inflows have little to no effect on interest rates and exchange rates, but do reduce stock market instability.

Overall, the literature above lends empirical support to Stiglitz's argument that financial liberalization in developing countries will lead to financial volatility. However, many studies also lend empirical support to Eichengreen's argument. Indeed, a survey of the financial liberalization literature by Williamson and Mahar (1998) finds that many studies provide clear evidence that financial liberalization promotes economic growth. This directly contradicts the aforementioned scatter plots by Dani Rodrik (1998) that suggest no empirical connection between liberalization and growth.

One study in support of liberalization by Bekaert and Harvey (2000) performs a cross-sectional time-series analysis in order to examine the impact of capital market liberalization on the cost of capital, volatility, beta, and correlation with world market returns. Similar to Levine and Zervos (1998), Bekaert and Harvey establish a date in which a country becomes "liberalized," and then examine changes in the relevant variables before and after liberalization. In the case of volatility, Bekaert and Harvey perform a simple t-test to test for changes in volatility before and after the designated date of liberalization. The authors find that liberalization increases volatility by an insignificant amount. They also find that liberalization reduces the cost of capital, suggesting more efficient capital markets. However, there is reason to believe that the effect they measure is upwardly biased. The countries that liberalize may do so *because* of growth in capital accounts.

Kim and Singal (2000) obtain similar results in their own study on stock market openings in emerging economies. Using the Schwert (1989) method of estimation for volatility (see p. 24 for specification of this method) Kim and Singal find that volatility in the 2 years after liberalization does not significantly differ from pre-liberalization levels, and even decreases in the fourth and fifth years.

Edison, Klein, Ricci, and Slok (2002) find similar results when they compare and contrast the major empirical literature on capital account liberalization and economic growth. They argue that the ambiguity of results from previous studies arises from the difficulty of identifying and quantifying capital market liberalization. In response to these difficulties, the authors attempt to synthesize the data from various studies into a common data set. The results show that capital account liberalization promotes economic growth, but the significance of this effect varies from region to region.

Furthermore, Abiad, Oomes, and Ueda (2004) predict that financial liberalization will enhance "allocative efficiency" as measured by the dispersion of Tobin's Q across firms. They test this hypothesis using a financial liberalization index and firm data from India, Jordan, Korea, Malaysia, and Thailand. They find strong evidence that financial liberalization improves allocative efficiency.

Overall, one noticeable trend emerges from the empirical work on financial liberalization: the studies that support Eichengreen's theory tend to focus on growth, whereas the studies that support Stiglitz's theory focus on volatility. However, growth and volatility are not mutually exclusive. By liberalizing capital markets, nations may sacrifice stability for increased growth. If so, liberalization does not necessarily fall under the rubric of “good” or “bad” policy. Rather, it provides a tradeoff between growth and volatility. Of course, the wisdom of this tradeoff depends on the magnitude of changes in growth and volatility, and a bulk of the debate over financial liberalization revolves around which change is greater. Eichengreen aptly refers to this area of debate as the “messy middle ground,” and it is far from conclusive.

Furthermore, a number of studies provide no decisive evidence for or against financial liberalization. One such study by Huang and Tang (2000) examines whether capital market liberalization leads to greater stock price volatility in emerging economies. Unlike most other studies that use monthly or quarterly data, Huang and Tang use data on the daily returns of ten emerging markets. They find that four markets experienced diminished volatility following liberalization, while six markets experienced increased volatility. The authors attribute their distinctive results to their use of daily data, the inclusion of the Asian financial crisis, and the use of a world index.

Another study with mixed results (Rossi 1999) examines the effects of capital account liberalization *and* prudential regulation on financial crises and economic development. Rossi establishes new measures of these variables and does a cross-sectional analysis of 15 developing countries over the period 1990-1997. The author finds that lenient prudential measures and more controls on capital outflows exacerbate financial fragility. However, controls on capital inflows appear to reduce the likelihood of financial crises.

Natalia Tamirisa (2004) also finds mixed results when she breaks down various types of capital controls into four separate indices: controls on inflows and outflows, controls on international transactions, controls on bank operations and foreign exchange market transactions, and controls on stock market operations. Using Malaysia as a case study, the results show that the macroeconomic effects of controls generally vary by their type. Controls on outflows and bank and foreign exchange operations facilitated interest rate reductions while the controls on inflows had the opposite effect. Furthermore, all of the controls have a negligible effect on the real exchange rate.

Overall, these "messy middle ground" studies suggest that capital controls do not have a monolithic effect on developing economies. Different capital controls exhibit different results. In particular, the results appear to diverge for controls on inflows and controls on outflows.

Ultimately, a review of the literature on capital market liberalization reveals that a scholarly consensus has yet to emerge on this issue. The current theoretical and empirical evidence continues to yield mixed results. Consequently, the effect of capital market liberalization in developing countries remains a hot topic of debate.

Theoretical Framework:

To review the debate above, those who support liberalization argue that privatized markets allocate resources most efficiently. In particular, financial liberalization allows a country to expand and diversify investments, thicken financial markets, and encourage economic growth (Eichengreen 2003). However, Stiglitz (2002) argues that if financial actors deal with perfect information and transparent economies, then internationally competitive markets are, indeed, Pareto optimal (Stiglitz 2002). However, if investors face information asymmetries and incomplete risk markets, as they often do in developing countries, liberalization may usher in debilitating financial volatility.

Stiglitz's argument has several implications for financial liberalization. First, even if investors are rational, information asymmetries will create erratic trends in their behavior. Second, information asymmetries are greatest for foreign investors in recently liberalized financial markets. Foreign investors are particularly vulnerable due to language barriers, cultural barriers, unreliable information, and a lack of familiarity with the market. As a result, a developing country that opens up to foreign investment will also experience increased stock market volatility.

In order to construct a model to test Stiglitz's hypothesis, one must understand how stock prices are determined. The Capital Asset Pricing Model serves as a natural starting point. CAPM posits that the price of an asset is determined by the expected present value of future dividends. Therefore, stock price volatility is a function of the variables that effect expected future dividend payments. Specifically, CAPM posits the following relationship:

$$(R_p - r_f) = \beta\ (R_m - r_f)$$

where:

R_p = return on individual stock or portfolio

r_f = return on risk free asset, such as a long term treasury bond

R_m = return on market proxy, calculated from an index such as the S&P 500

β = sensitivity to market risk

The left hand side of the equation measures the expected return on a stock in excess of the expected returns on a risk free asset. The right hand side measures the expected return of the market in excess of the expected return on a risk free asset, also known as the "risk premium." Intuitively, this model suggests that the expected return on a stock or portfolio is determined by its sensitivity to market risk, a relationship captured by beta. If the beta on a stock or portfolio is greater than one, then the stock is highly sensitive to market risk i.e. a change in the market's risk premium will precipitate a greater change in expected returns. Similarly, a beta of less than one indicates that the stock is less sensitive to changes in the risk premium. Overall, the expected return of an asset pivots on its vulnerability to market risk.[6]

Note that CAPM makes a crucial distinction between systematic and unsystematic risk. Unsystematic risk is a function of the characteristics specific to a stock. These company-specific characteristics can take on many different forms, such as managerial performance, the possibility of labor strikes, and even weather.[7] CAPM does not factor in unsystematic risk because it assumes that investors have the ability to hold large, diversified portfolios. As a result, investors will not require price compensation for unsystematic risk because they can easily diversify it away through their portfolios. Systematic risk, on the other hand, captures a stock's sensitivity to market wide fluctuations, which cannot be diversified away. Thus, CAPM focuses solely on systematic risk, as opposed to unsystematic risk.

The CAPM model suggests a linear relationship between sensitivity to market risk as measured by Beta, and expected returns. Graphically, this relationship is captured by the "Security Market Line." This line illustrates the equilibrium reached by investors' consensus on the risk and price of an asset. If an asset such as "X" in the figure below lies below the Security Market Line, investors will consider the asset incorrectly priced. Thus, they will refuse to buy asset X until the price drops, allowing the rate of return to increase until reaching equilibrium at the Security Market Line.[8] Overall, CAPM shows that efficient capital markets will ensure prices hew to the Security Market Line.

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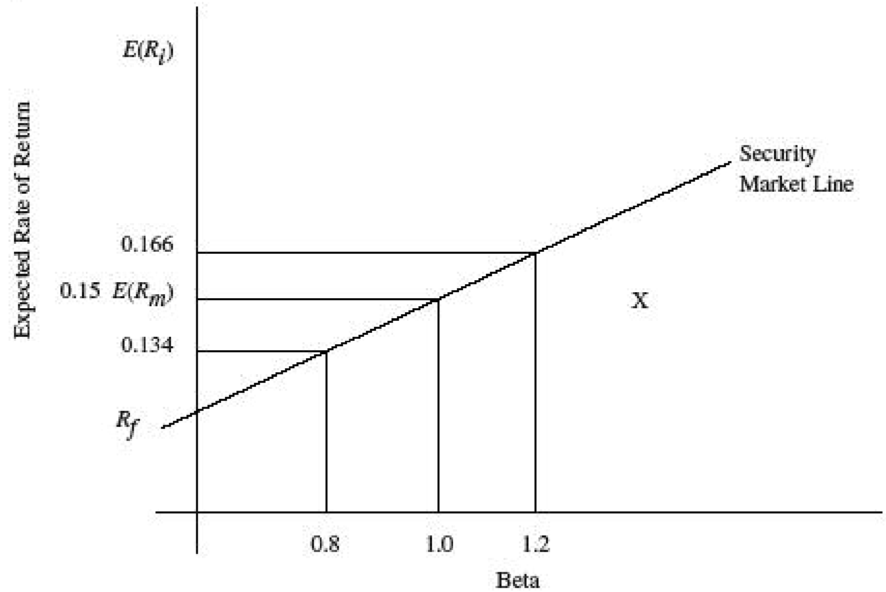
[6] My understanding of CAPM is derived from both Brealey and Myers' Principles of Corporate Finance and Pratt's Cost of Capital: Estimation and Applications (see references)

[7] Pratt p. 71

[8] Pratt p. 73

Exhibit 9.1 Security Market Line



$E(R_i)$ = Expected return for the individual security

$E(R_m)$ = Expected return on the market

R_f = Risk-free rate available as of the valuation date

In a market in perfect equilibrium, all securities would fall on the security market line. The security X is mispriced, with a return less than it would be on the security market line.

Source: Shannon P. Pratt, Robert F. Reilly, and Robert P. Schweihs, *Valuing a Business: The Analysis and Appraisal of Closely Held Companies,* 4th ed. (New York: McGraw-Hill, 2000), 167. Reprinted with permission. All rights reserved.

Ultimately, CAPM suggests that three major variables affect stock price and, by extension, stock market volatility: the risk free rate of return, expected inflation, and the market risk premium. However, CAPM rests on the crucial assumption that investors have transparent and accessible information for these variables, information through which they reach a consensus on price. What happens when an economy is subjected to an influx of investors who face considerable information asymmetries? Theoretically, these investors will have difficulty reaching a consensus on Beta and expected returns. Consequently, prices will fluctuate as investors grapple with insufficient or unreliable information. Graphically, we would expect to see prices fluctuate around the Security Markets Line as "outsider" investors grope for the "true" equilibrium price. Overall, unreliable and/or asymmetrical information impedes the investor's ability to determine the efficient equilibrium price, thus creating asset price volatility.

In essence, this is precisely the scenario Stiglitz warns of with capital market liberalization in developing countries. When developing countries open capital markets to foreign investment, they expose themselves to a large group of investors who face considerable information asymmetries. If poor information renders foreign investors unable to reach a consensus on the equilibrium price of an asset, then foreign investors will usher in significant stock market volatility.

Empirical Specification:

Merges and Binder (2000) incorporate the logic of CAPM into their own model on stock market volatility. They start out with a simple identity for the standard deviation of a firm's stock:

$$\sigma_s = \frac{\sigma(s_1)}{s_0}$$

The equation above shows that the standard deviation of a firm's stock, σ_s, is a function of uncertainty about the time one value of the stock market index, $\sigma(s_1)$, and the initial value of the market index, s_0.

In a one period world, the time one value of a stock equals the terminal cash flow to the equity, i.e., s_1 = expected revenue in period one, factoring in variations on the price level, σ_e. Thus, Merges and Binder arrive at the following identity:

$$\sigma_s = \frac{E(\text{Revenue})\ \sigma_e}{s_0}$$

Furthermore, in a rational securities market, the price of a stock at period zero should equal:

$$s_0 = \frac{E(\text{profit})}{1 + r_f + \gamma}$$

The denominator is directly derived from CAPM, incorporating the major systematic risks that influence the price of an asset. Plugging in s_0 into the denominator of the equation above, Binder and Merges arrive at the following specification:

$$\sigma_s = \frac{\sigma_e(1 + r_f + \gamma)}{E(\text{profit})/E(\text{Revenue})}$$

Overall, the Binder and Merges specification posits that four variables affect stock market volatility: price level uncertainty, the risk free interest rate, the risk premium, and the ratio of expected profits to expected revenue. The variables in the numerator are derived from CAPM, in which price level uncertainty, the risk free interest rate, and the risk premium directly affect the expected returns of a stock and thus, the price of a stock. The variable in the denominator, E(profit)/E(Revenue), is unique to the Binder and Merges specification. Manipulation of the identities above suggests that the ratio of profits to revenue should influence stock price volatility. In addition, Binder and Merges provide an intuitive justification for the inclusion of this variable. Expected profits over expected revenues captures the effects of "two well-known determinants of volatility: financial leverage and operating leverage."[9] For example, an economy with high financial leverage will decrease expected profits, thus contributing to volatility. Similarly, increased operating leverage (such as increased labor costs) will also shrink profits and increase volatility. Overall, there is a strong theoretical basis for the inclusion of this variable.

[9] Binder and Merges (2000) p. 6

With the Binder and Merges specification, we have developed a reasonable model for stock market volatility. Yet, for the purposes of this study, the model requires an additional variable to measure the effects of stock market liberalization. Recall that Stiglitz argues foreign investors will usher in stock market volatility due to information asymmetries. Therefore, the missing variable should measure the changing composition of foreign and domestic investment in a stock market, due to liberalization.

Fortunately, the International Finance Corporation provides precisely this measurement in their "Emerging Markets Database." In particular, the IFC publishes Global (IFCG) and Investable (IFCI) indices for over 20 emerging stock markets (Edison et al. 2002). The IFCI is comprised of IFCG stocks minus the portion of stocks not available to foreigners. Therefore, the ratio of these indexes serves as a measure of a country's financial openness. Adding this ratio to the Binder and Merges model, we arrive at the following regression specification:

$$\ln \sigma_s = \beta_0 + \beta_1 \ln \sigma_e + \beta_2 \ln (1 + r_f) + \beta_3 \ln \gamma + \ln \beta_4 [E(\pi)/E(R)] + \beta_5 (IFCI/IFCG) + \beta_6 (IFCI/IFCG)^2 + u$$

where:

σ_s = stock price volatility, estimated by the standard deviation of monthly returns

σ_e = price level uncertainty, estimated by the residual of the expected price level

r_f = riskless interest rate, estimated from a long term government bond

γ = riskpremium, estimated as the difference between the market return and the risk free interest rate

$E(\pi)/E(R)$ = ratio of expected profits to expected revenues, estimated from monthly data on industrial production * price level (= revenues) and labor costs (approximates costs)

IFCI/IFCG = capital market openness

Thus, there are two parts to this equation. The original part of the equation (β_0 through β_4) specifies the variables through which rational investors determine asset prices. The additional variables, β_5 and β_6, specify the behavior of foreign investors in a recently liberalized developing market. A natural log transformation is avoided for the IFCI/IFCG variable because it will have a value of zero prior to liberalization. However, since there very well could exist a curved relationship between stock price volatility and the openness ratio, we include the square of IFCI/IFCG to account for such a relationship. Overall, if Stiglitz's assumptions about information asymmetries hold true, then we would expect to see a significant positive relationship between ln σ_s and β_5.

Data:

Standard and Poor's Emerging Markets Database provides data on stock returns and inflation. Samples were collected for nine different emerging market economies: Colombia, India, Korea, Malaysia, Mexico, Philippines, Portugal, Thailand, and Turkey. The time periods of available data range from the years 1975-2000 or in some cases 1985-2000, depending on the country. All time periods contain the respective nation's date of liberalization.[10]

The risk-free interest rate was obtained through the Global Insight/DRI databases via Wharton Research Data Services. The rate on a long term treasury bill issued by each country serves as an estimate of the risk free interest rate. The data for E(Profits) and E(Revenue) for each country were obtained through World Development Indicators Online. No direct measurements of profits or revenue could be found for each emerging market economy.

[10] I remain deeply indebted to Kristen Roy and Patricia Loh of the William Davidson Institue at Univeristy of Michigan for providing access to the IFC database.

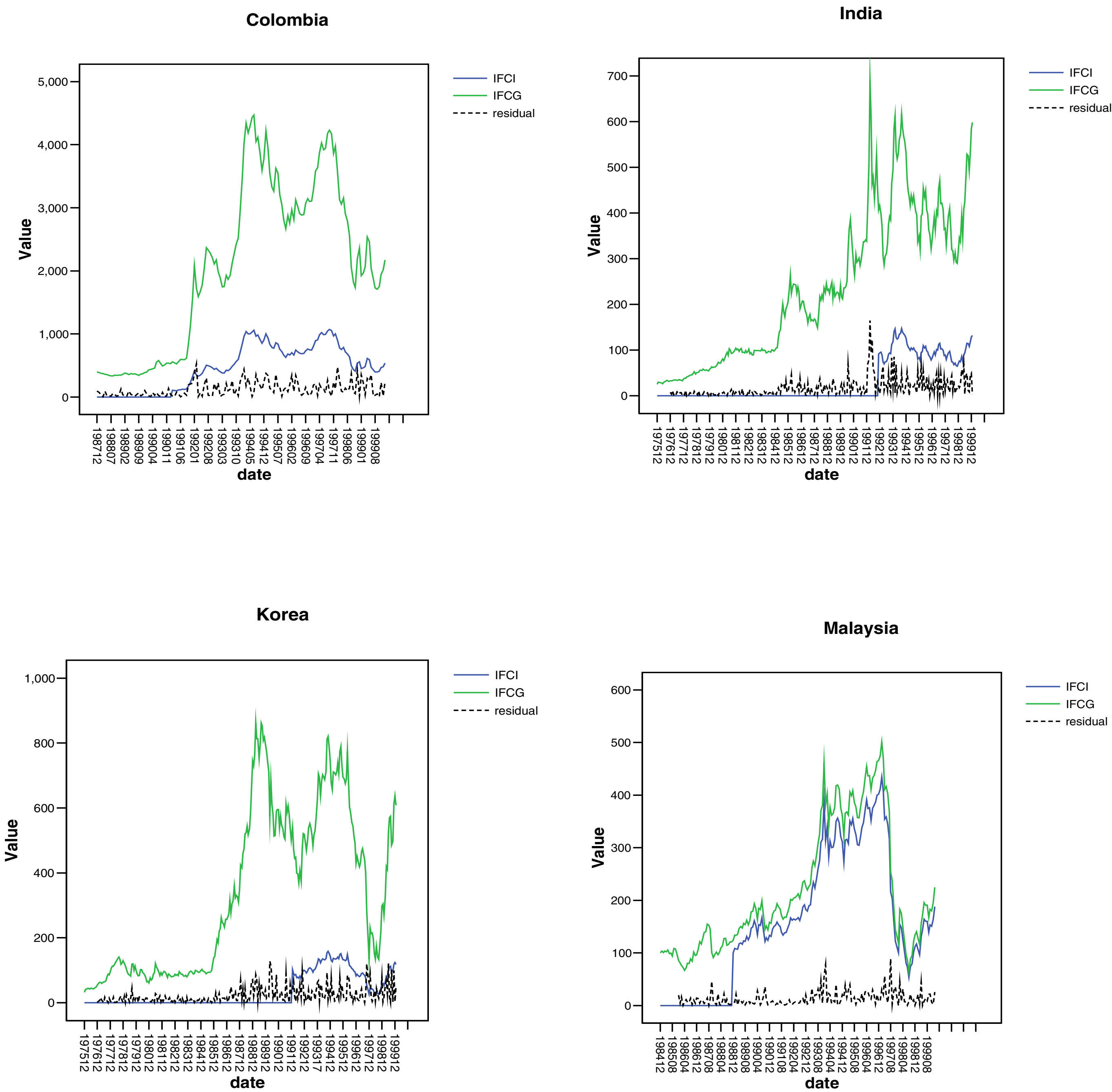
However, data on GDP and total wage expenditure serve as approximations of revenue and profits, a point further elucidated later on in the section on Estimation.[11]

In order to provide a preliminary examination of the data, a collection of graphs were constructed and assembled in Appendix 1. Each graph contains three variables: the IFCG index, denoted by the light shaded line, the IFCI index, denoted by the darker line, and the residuals of the IFCG index, denoted by the dotted line. Notice that the IFCI line remains flat at zero, and then rises around the late 1980's or early 1990's. The flat-lining of the IFCI index indicates that the market is closed to foreigners and hence, maintains a value of zero. Similarly, the rise in the IFCI index indicates that the stock market is opening up to foreigners. If an influx of foreign investors increases the volatility of a given stock market, then we would expect to see greater jumps in the residuals of the IFCG index as the IFCI index rises. Graphically, this relationship would create significantly greater spikes in the residual line as the IFCI line begins to rise. Furthermore, the greater the share foreign investors have in a given market, the more magnified their mistakes would become. Thus, the closer the IFCI line hews to the IFCG line (i.e. the greater the share foreign investors have in a given market), the greater the spikes we expect to see in the residual line.

The following graphs in *Figure 1* reveal mixed results for the abovementioned predictions:

[11] See Appendix 7 for detailed listing of variables and data sources

Figure 1:


Colombia
5,000
4,000
3,000
2,000
1,000
0
Value
IFCI
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residual
198712 198807 198902 198909 199004 199011 199106 199201 199208 199303 199310 199405 199412 199507 199602 199609 199704 199711 199806 199901 199908
date
India
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600
500
400
300
200
100
0
Value
IFCI
IFCG
residual
date
Korea
1,000
800
600
400
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Value
IFCI
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date
Malaysia
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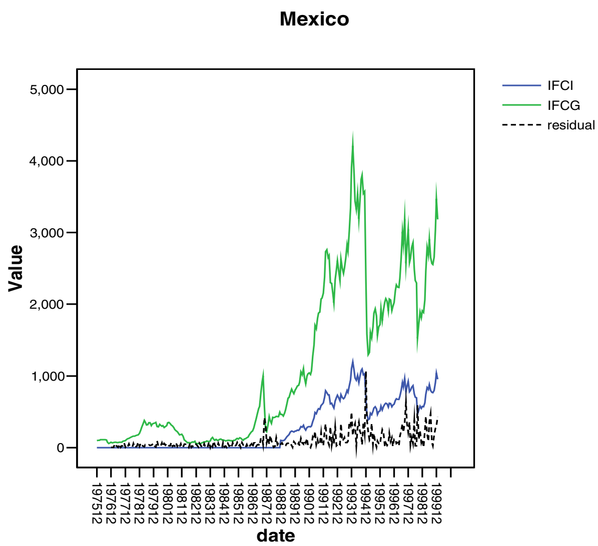
Mexico
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3,000
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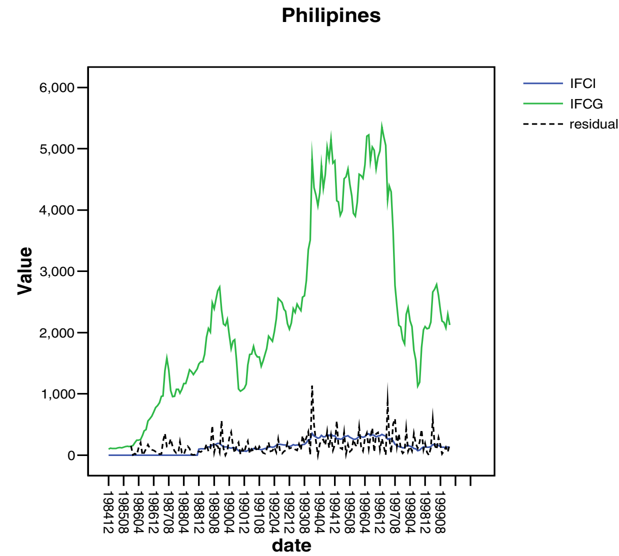
Philipines
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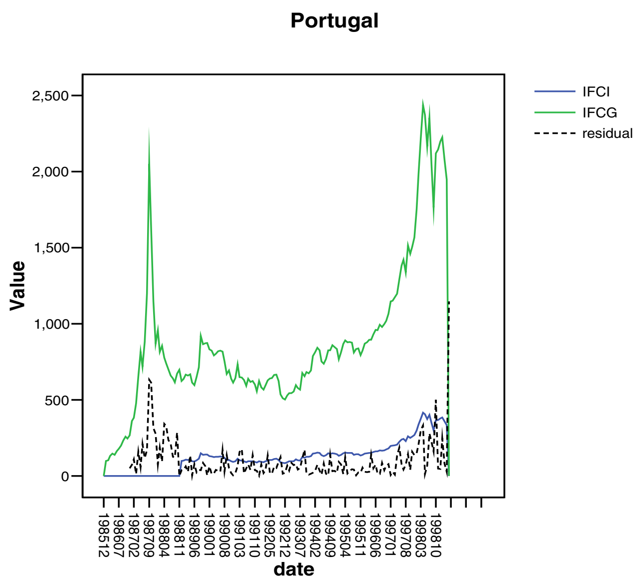
Portugal
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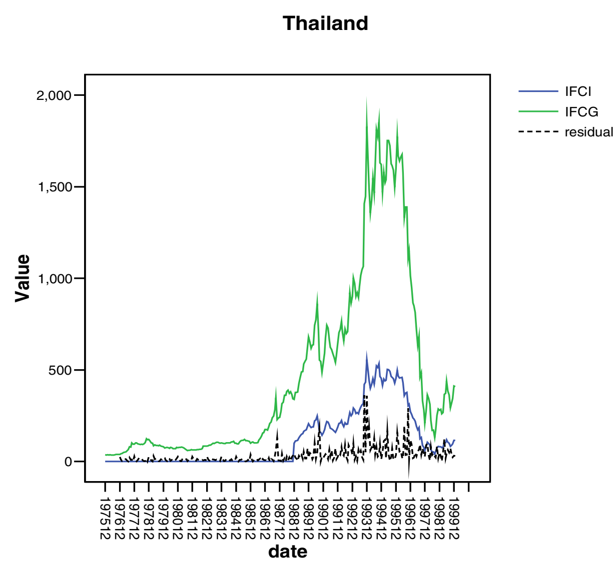
IFCI
IFCG
residual


Thailand
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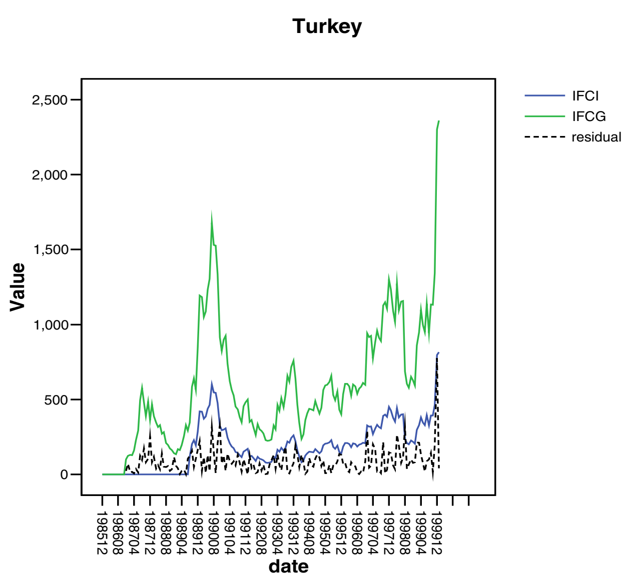
date
197512 197612 197712 197812 197912 198012 198112 198212 198312 198412 198512 198612 198712 198812 198912 199012 199112 199212 199312 199412 199512 199612 199712 199812 199912
IFCI
IFCG
residual


Turkey
Value
2,500
2,000
1,500
1,000
500
0
date
198512 198608 198704 198712 198808 198904 198912 199008 199104 199112 199208 199304 199312 199408 199504 199512 199608 199704 199712 199808 199904 199912
IFCI
IFCG
residual

In several cases – Colombia, Mexico, Thailand, and the Philippines – the residual line does appear to grow more volatile as the IFCI index rises. However, several other countries – India, Korea, Turkey, and Portugal – all exhibit significant volatility in the residuals well before the IFCI index rises. Malaysia, on the other hand, appears to maintain a low level of residual volatility long after the IFCI index rises. Furthermore, no consistent results emerge for the cases where the IFCI line hews closer to the IFCG line. Overall, a preliminary examination of the data suggests mixed results for the relationship between stock market liberalization and volatility.

Estimation:

The raw data directly provides estimates for inflation, the risk free interest rate, IFCI, and IFCG indices. The risk premium is simply estimated as the difference between the market return (calculated from the IFCG indices for each country) and the risk free interest rate. For many of the countries, the estimates of risk premium are sometimes negative, suggesting that investors in emerging market economies frequently view government securities as a riskier investment than stocks. In order to use a natural log on the variable of risk premium (which assumes a multiplicative relationship between the independent and dependent variables), a scalar adjustment is necessary to eliminate all negative values.

As stated earlier, no direct measurements of E(Profits)/E(Revenue) could be obtained. However, proxy measurements were obtained by using GDP as a proxy for revenue, and GDP minus total labor expenditure as a rough measurement for expected profits. Such an approximation clearly has its limitations. In particular, the proxy for E(Profits) does not take into account total capital expenditure. However, Binder and Merges (2000) use the same method to approximate expected profits, arguing that in a labor intensive nation, labor costs serve as a reliable proxy for total costs. Thus, total revenue minus total labor expenditure should closely approximate movements in expected profits. The same assumption is extended to the emerging market economies of this study.

Having established estimation techniques for inflation, the risk-free interest rate, risk premium, and E(Profits)/E(Revenue), all that remains are the primary variables of interest: stock market liberalization and stock market volatility. A review of liberalization dates in Henry (2000), Bekeart and Harvey (2000), and Levine and Zervos (1996) reveals that the date of liberalization for a particular country varies according to the study. This lack of consensus suggests that liberalization is not really an event as much as a process; therefore, choosing the date of liberalization remains somewhat subjective. Furthermore, it should also be noted that the nature of liberalization varies from one nation to the next. While one country may ease restrictions on repatriation of capital, another may allow increased foreign ownership of domestic stock, and still another will ease capital controls. All of these measures fall under the general rubric of "liberalization," yet their effects on stock market volatility could vary greatly. Fortunately, the IFCI/IFCG ratio bypasses this messy issue of which measures more significantly open markets, because the ratio operates as a proxy for equity market openness. Rather than examining the impact of specific liberalization reforms that vary from country to country, IFCI/IFCG measures the impact of openness, a function of said reforms. From this common basis of measurement, it is possible to compare diverse liberalization efforts across countries.

The IFCG index can also be used to estimate the dependent variable, stock market volatility. The IFCG records monthly returns for a particular country's index. Stock market volatility is simply calculated as the standard deviation on these returns. However, stock volatility often times exhibits auto-regressive conditional heteroskedasticity. In simpler terms, volatility measurements often correlate with the measurements from previous periods. In order to correct for the clustering of volatility measurements, we must employ a type of Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) model as outlined in Schwert (1989). Schwert sets up a 12th-order autoregression for the returns, including dummy variables to allow for different monthly mean returns. He then sets up the following equation:

$$\text{A)}\quad Returns_t = \sum_{j=1}^{12} \alpha_j D_{jt} + \sum_{i=1}^{12} \beta_i \, Returns_{t-1} + \varepsilon_t$$

Schwert then takes the absolute values of the errors from equation (A) above, ε_t, and regresses them against the twelve previous error terms:

$$\text{B)}\qquad |\varepsilon_t| = \sum_{j=1}^{12} \gamma_j D_{jt} + \sum_{i=1}^{12} \rho_i \, \varepsilon_{t-1} + u_t$$

Taking the predicted values from the second regression, we obtain the regressand $|\varepsilon_t|$, an estimate of the standard deviation of the stock market return for month t, given information available before month t.

However, Davidian and Carroll (1987) argue that a weighted iteration of the regressions above will yield more efficient estimates. Thus, we weight equation (A) with the predicted error terms $|\varepsilon_t|$ from (B), and once again run the regression. Plugging in these new error terms into (B), we obtain a more efficient estimate of the stock index's standard deviation (i.e. the predicted values from equation (B)). For even more efficient estimates, we iterate this process yet again. Ultimately, this twice iterated GARCH estimation method should correct for the auto-regressive nature of volatility estimates.

Auto-regressive Conditional Heteroskedasticity also poses a problem for estimates of price level uncertainty. Once again the GARCH method outlined by Schwert (1989) and enhanced by Davidian and Carroll (1987) should correct for the clustering of inflation values. In order to do so, simply replace the variable "Returns" in the equations above with "Inflation."[12] Through this iterated GARCH method we obtain the GARCH-corrected estimates for price level uncertainty. Thus, we have obtained all of the necessary estimates for the model.

Descriptive Statistics:

The Descriptive Statistics in Appendix 2 provide further details on the obtained estimates. The dependent variable, "residuals" (i.e. the GARCH corrected error terms from the IFCG index), exhibits a slight positive skew – although in several cases (Colombia, Malaysia, and the Philippines) the skew statistic is not statistically significant.[13] The kurtosis values of "residual" are mostly platykurtic. However, India and Thailand have kurtosis statistics approximately equal to three, and therefore have a normal distribution.

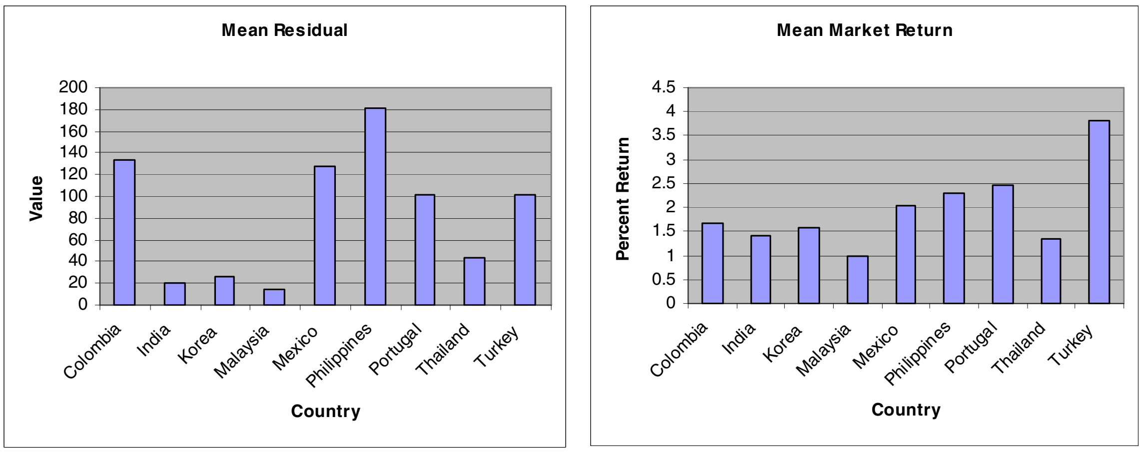
The descriptive statistics for the independent variable of primary interest, IFCI/IFCG, reveal both positive and negative skewness, depending on the country. However, all nations have kurtosis values less than three. Thus, the variable IFCI/IFCG is consistently platykurtic. Further details on the skewness and kurtosis of the control variables can be found in Appendix 2.

Another point of interest in the descriptive statistics is the relationship between stock market volatility and market returns. As stated earlier, the CAPM model suggests that the more risky the stock, the greater the expected returns of the stock for bearing the added risk. Consequently, we would expect to see stock market residuals, or market risk, to roughly

[12] See Appendix 1 for a detailed layout of GARCH correction for the inflation variable.
[13] SPSS suggests a rough significance test where a skew value more than twice its standard error is deemed significant.

correlate with market returns. The following bar graphs (Figure 2) appear to confirm this prediction, showing a rough correlation between the means of the index residuals and the market returns:

Figure 2



Regression Results:

Having estimated the variables and carried out the necessary transformations, an initial regression was run for each nation. Heteroskedasticity will not pose a problem with a time series regression. However, autocorrelation will most likely occur within a time series of financial statistics. Indeed, the Durbin-Watson statistics obtained from the initial regressions and compiled in Appendix 3 reveal that evidence of autocorrelation exists for six of the nine countries. In order to correct for autocorrelation, we take the current values of the dependent variable and subtract the previous values multiplied by "ρ." Likewise, we take the current values of the independent variables and subtract the previous values multiplied by "ρ."[14] It should be

[14] Equation for correction of autocorrelation (Gujarati p. 481):

Corrected Variable = $\text{Variable}_t - (\text{Variable}_{t-1} * \rho)$

noted that the estimation of "ρ" as 1-d/2 only works in large samples. All samples in this study contain 145 values or greater, and thus, are of sufficient scope for the abovementioned estimation of "ρ."

Using the data corrected for autocorrelation, we once again run regressions for each nation. The results are compiled in Appendices 4 and 5. Appendix 4 contains the Model Summary and ANOVA tables in detail for each country. However, these results are more intuitively summarized in Table 1 below

Table 1

COUNTRY	R	R^2	F	SIG	D-STAT
Colombia	.439	.193	5.346	.000	2.069
India	.454	.206	9.073	.000	2.066
Korea	.390	.152	6.607	.000	1.908
Malaysia	.713	.508	19.438	.000	1.931
Mexico	.632	.399	26.879	.000	1.978
Philippines	.414	.171	4.652	.000	2.018
Portugal	.233	.054	1.085	.376	2.011
Thailand	.600	.360	22.960	.000	2.110
Turkey	.512	.262	7.455	.000	2.058

The values for R-square range from .152 to .508, except for the outlier of Portugal with an unusually low R-square of .054. Overall, all regressions (except for Portugal) exhibit a reasonable goodness-of-fit. Furthermore, all of the F-stats are highly significant (above the .999

p-value), indicating that the combined effect of the independent variables is significant. In addition, the Durbin-Watson statistics in Table 1 all have values extremely close to 2, indicating that the aforementioned corrections for autocorrelation were indeed, successful.

Appendix 5 provides a detailed compilation of the coefficients for each regression. However, the most relevant results are once again more intuitively summarized in Table 2 below:

Table 2

	IFCI/IFCG		IFCI/IFCG squared		
Country	B	p-value	IFCI/IFCG^2	p-value	Effect of Foreign Investors on Volatility
Colombia	-22.977 (9.174)	.013	110.108 (36.924)	.003	Negative/Curved
India	-.606 (10.216)	.953	13.108 (43.186)	.762	N/A
Korea	6.667 (17.006)	.695	-29.575 (88.174)	.738	N/A
Malaysia	-2.932 (2.738)	.287	3.818 (3.393)	.263	N/A
Mexico	-5.520 (2.152)	.011	22.243 (7.658)	.004	Negative/Curved
Philippines	9.762 (8.573)	.257	-126.158 (123.900)	.310	N/A
Portugal	-130.767 (158.362)	.411	387.112 (467.325)	.409	N/A
Thailand	16.923 (3.668)	.000	-52.691 (12.598)	.000	Positive/Curved
Turkey	8.886 (5.431)	.104	-23.021 (15.433)	.138	N/A

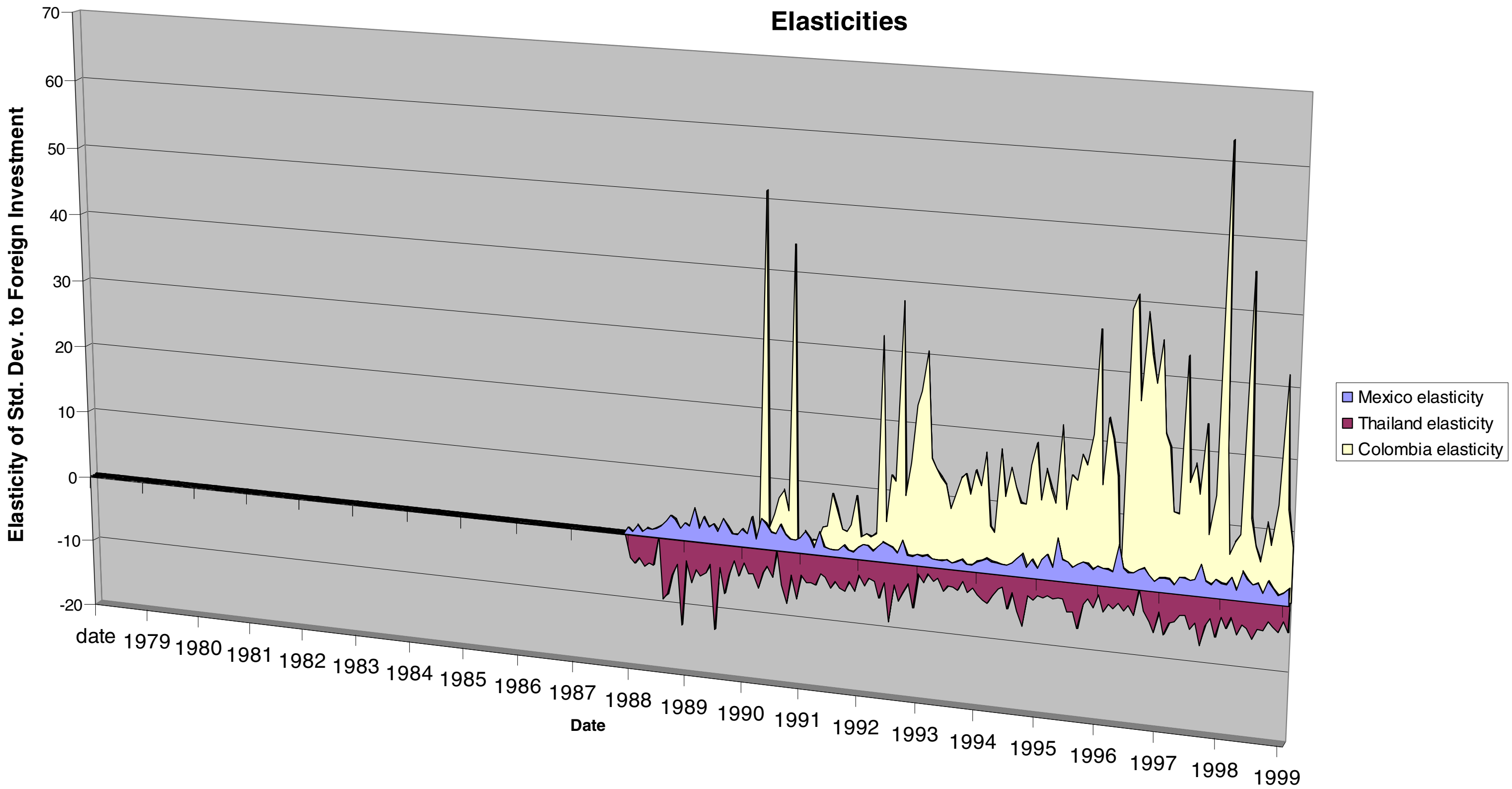
The variable of primary interest, IFCI/IFCG, has a significant coefficient in three nations: Colombia, Mexico, and Thailand. The p-values for IFCI/IFCG of these nations range from .013 to .000, a very high level of significance. The IFCI/IFCG variable in Turkey is less significant, with a p-value of .104. As for the rest of the nations, the IFCI/IFCG variables have p-values that indicate no significance. Colombia, Mexico, and Thailand also have highly significant coefficients for IFCI/IFCG$^{\wedge 2}$, suggesting that a curved relationship exists between stock market openness and stock market volatility.

However, despite high levels of significance, these nations report very different regression results. Notice that Colombia and Mexico have a negative coefficient for IFCI/IFCG and a positive coefficient for IFCI/IFCG$^{\wedge 2}$. Thailand, on the other hand, presents the opposite scenario – a positive coefficient for IFCI/IFCG and a negative coefficient for IFCI/IFCG$^{\wedge 2}$. These opposing results carry important implications for the relationship between stock market openness and volatility. If Stiglitz's hypothesis were correct, then we would expect to see a positive relationship between stock market openness and volatility, at least in the beginning of liberalization. At first glance, it appears such a positive relationship exists in Thailand, whereas the regression results for Colombia and Mexico suggest the opposite relationship: as markets opened up, volatility actually decreased. However, before drawing such a conclusion, we must first examine the magnitude of the coefficients on IFCI/IFCG and IFCI/IFCG$^{\wedge 2}$, for, in theory, it could be possible that the curvature coefficient on IFCI/IFCG$^{\wedge 2}$ greatly overpowers the coefficient on IFCI/IFCG.

Recall that the data necessitated a log-linear relationship between the dependent variable, volatility, and the independent variables of interest, IFCI/IFCG and IFCI/IFCG$^{\wedge 2}$. In order to gain a more intuitive grasp of the coefficients, we convert these values into elasticities so that we may see the percent change in the stock volatility due to a one percent change in the IFCI/IFCG index.[15] The elasticity values are graphed in Figure 3 below:

[15] See Appendix 6 for calculation of the elasticity values.

Figure 3



As expected, the elasticity of stock price volatility to foreign investment remains at zero from the period 1979 – 1988, simply because Mexico, Thailand, and Colombia have yet to open their stock markets to foreign investment. However, notice that following liberalization, the elasticity values are positive for Mexico and Colombia, yet negative for Thailand. The average elasticity value for Mexico is 2.25 %, Colombia, 15.24%, and Thailand, -4.15%. Thus, a 1% increase in foreign investment, on average, increased stock market volatility in Mexico by 2.25% and Colombia by 15.24%, yet decreased volatility in Thailand by 4.15%. How do we remedy these results with the previous observation that the coefficient on IFCI/IFCG was positive for Thailand, yet negative for Mexico and Colombia? The elasticity values reveal that the curvature coefficient on IFCI/IFCG$^{\wedge 2}$ overwhelms the direct relationship between IFCI/IFCG and volatility.

For example, Thailand may initially exhibit a positive relationship between volatility and stock market openness (hence the positive value on the IFCI/IFCG coefficient), however, this relationship could curve downwards so greatly that we soon see a negative relationship (hence the negative elasticity of volatility to stock market openness).

Overall, when looking across countries, we observe mixed results for the effects of liberalization upon stock market volatility. The mixed results suggest that there are certain, country specific factors that influence the relationship between stock market openness and volatility. Thus, these regressions present confounding results for theories that assume liberalization has uniform effects across countries. In some countries, such as Colombia and Mexico, liberalization appears to enhance volatility, whereas in other countries such as Thailand, liberalization appears to reduce volatility.

Nor do the control variables report consistent results across countries. Their significance and values vary widely from one nation to the next. Such mixed results suggest that the macroeconomic factors that theoretically determine stock prices and volatility (inflation, interest rate, risk premium, and profits/revenue) will not necessarily have the same explanatory power across different markets. Overall, these mixed regression results reveal the limitations of sweeping theoretical predictions about the effects of liberalization across countries and markets. Market specific factors remain an important determinant in the success or failure of a stock market liberalization policy.

Conclusion:

Economists have waged a heated debate over financial liberalization in developing countries, particularly in the wake of the Asian financial crisis. Depending on your assumptions about financial markets, liberalization can either be a source of incredible growth or debilitating volatility. In either case, financial liberalization will end up affecting the livelihoods of millions. For this reason, financial liberalization remains an area of necessary and urgent research.

However, such a large, macroeconomic study will inevitably possess several shortcomings. For example, it is a profoundly reductive process to specify a variable as complex as stock market volatility and to compare it across a wide array of developing countries. One must assume general rules of investor behavior and asset pricing. However, volatility and asset pricing are extremely complex phenomena. One need only consider the diversity of capital pricing literature to see the difficulty of specifying such variables. In short, volatility specifications are highly prone to omitted variable bias. A scholar can only use his/her best judgment in determining the appropriate model. Furthermore, even if a specification of volatility appears imminently reasonable, the limitations of data may render certain variables immeasurable. Indeed, Binder and Merges provide a solid theoretical basis for including the ratio of expected profits over expected revenues, yet a lack of data necessitated the use of very rough approximations to estimate the variable.

Another limitation ofthe study is its tendency to aggregate the variable for financial liberalization. Recall that financial liberalization involves the easing of any number of restrictions, whether on capital inflows, outflows, or the percentage of foreign ownership allowed in the market. Each of these restrictions may have different effects on volatility. Thus, by aggregating these restrictions, my own study does not produce results that carry prescriptive implications for specific policies. Naturally, such a broad study leaves open more specific questions that could serve as topics for future research. For example, how does the easing of specific capital restrictions affect volatility? Or how does the sequencing of these measures affect volatility? Such studies would provide more policy specific conclusions. My study only endeavors to test Stiglitz's hypothesis that developing countries have market deficiencies that may render liberalization a dangerous prospect. With this study, I only wish to shed some light on the impact of equity market liberalization, as a general phenomenon, upon stock market volatility. The results of this study would suggest that the impact of equity market liberalization does not exist as a general phenomenon. Rather, it is specific to the countries in which it is implemented.

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Appendix 1: Schwert (1989) Method of Estimating Price Level Uncertainty

Schwert sets up a 12^{th}-order autoregression for inflation, including dummy variables to allow for different monthly levels of inflation. He then sets up the following equation:

$$\textbf{A)}\quad \mathbf{Inflation_t = \sum_{j=1}^{12} \alpha_j D_{jt} + \sum_{i=1}^{12} \beta_i\, Inflation_{t-1} + \varepsilon_t}$$

Schwert then takes the absolute values of the errors from equation (a) above, ε_t, and regresses them against the twelve previous error terms:

$$\textbf{B)}\quad \mathbf{|\varepsilon_t| = \sum_{j=1}^{12} \gamma_j D_{jt} + \sum_{i=1}^{12} \rho_i\, \varepsilon_{t-1} + u_t}$$

Taking the predicted values from the second regression, we obtain the regressand $|\varepsilon_t|$, an estimate of the standard deviation of the stock market return for month t, given information available before month t.

Davidian and Carroll (1987) argue that a weighted iteration of the regressions above will yield more efficient estimates. Thus, we weight equation (A) with the predicted error terms $|\varepsilon_t|$ from (B), and once again run the regression. Plugging in these new error terms into (B), we obtain a more efficient estimate of inflation's standard deviation (i.e. the predicted values from equation (B)). For even more efficient estimates, we iterate this process yet again. Ultimately, this twice iterated GARCH estimation method should correct for the auto-regressive nature of inflation estimates.

Appendix 2: Descriptive Statistics

Country	Variable	N	Minimum	Maximum	Mean	Std.	Skewness	Skewness Std. Error	Kurtosis	Kurtosis Std. Error
Colombia	residual	146	-5.1	279.5	133.7	58.5	0.095	0.201	-0.429	0.399
India	residual	255	0.7	74.0	20.69	10.9	1.243	0.153	3.000	0.304
Korea	residual	255	6.1	49.2	25.95	8.58	0.331	0.153	-0.149	0.304
Malaysia	residual	146	2.9	35.9	15.13	6.24	0.321	0.201	0.037	0.399
Mexico	residual	255	46.4	316.4	128	59.2	0.956	0.153	0.409	0.304
Philippines	residual	145	68.5	325.4	180.9	54.3	0.317	0.201	-0.280	0.400
Portugal	residual	125	17.6	243.3	100.9	44.1	0.954	0.217	0.763	0.430
Thailand	residual	255	4.3	137.9	42.88	21.3	1.314	0.153	3.026	0.304
Turkey	residual	134	20.1	193.0	101.9	36.6	0.449	0.209	0.015	0.416
Colombia	IFCI_IFCG	146	0.0	0.3	0.171	0.1	-1.043	0.201	-0.840	0.399
India	IFCI_IFCG	290	0.0	0.3	0.071	0.11	0.884	0.143	-1.219	0.285
Korea	IFCI_IFCG	290	0.0	0.2	0.065	0.09	0.706	0.143	-1.510	0.285
Malaysia	IFCI_IFCG	182	0.0	0.9	0.616	0.37	-1.073	0.180	-0.846	0.358
Mexico	IFCI_IFCG	290	0.0	0.3	0.133	0.14	0.171	0.143	-1.964	0.285
Philippines	IFCI_IFCG	182	0.0	0.1	0.048	0.03	-1.039	0.180	-0.869	0.358
Portugal	IFCI_IFCG	159	0.0	0.2	0.131	0.07	-1.320	0.192	-0.190	0.383
Thailand	IFCI_IFCG	290	0.0	0.3	0.134	0.14	0.161	0.143	-1.978	0.285
Turkey	IFCI_IFCG	158	0.0	0.4	0.276	0.14	-1.489	0.193	0.229	0.384
Colombia	IFCG	146	334.0	4467.5	2068	1331	0.073	0.201	-1.295	0.399
India	IFCG	290	25.0	688.9	234.7	164	0.507	0.143	-0.809	0.285
Korea	IFCG	290	32.6	862.3	333	254	0.445	0.143	-1.280	0.285
Malaysia	IFCG	182	63.9	500.6	215.7	120	0.808	0.180	-0.741	0.358
Mexico	IFCG	290	46.7	4208.4	1079	1120	0.824	0.143	-0.677	0.285
Philippines	IFCG	182	100.0	5354.8	2301	1480	0.491	0.180	-0.773	0.358
Portugal	IFCG	161	0.0	2436.0	876.9	505	1.366	0.191	1.798	0.380
Thailand	IFCG	290	34.8	1852.1	458.2	506	1.356	0.143	0.687	0.285
Turkey	IFCG	170	0.0	2360.8	589.2	415	1.217	0.186	2.522	0.370
Colombia	IFCI	146	0.0	1069.8	463.3	358	0.016	0.201	-1.319	0.399
India	IFCI	290	0.0	146.5	29.63	46.7	1.068	0.143	-0.580	0.285
Korea	IFCI	290	0.0	158.3	32.84	50.5	1.113	0.143	-0.409	0.285
Malaysia	IFCI	182	0.0	434.3	158.2	129	0.365	0.180	-0.987	0.358
Mexico	IFCI	290	0.0	1195.3	281.7	350	0.769	0.143	-0.898	0.285
Philippines	IFCI	182	0.0	356.1	140.1	111	0.284	0.180	-1.037	0.358
Portugal	IFCI	161	0.0	416.2	125.9	102	0.939	0.191	0.880	0.380
Thailand	IFCI	290	0.0	555.6	113.9	156	1.245	0.143	0.363	0.285
Turkey	IFCI	170	0.0	816.3	186.6	161	0.929	0.186	1.321	0.370
Colombia	mktreturn	146	-19.9	37.3	1.659	9.49	1.269	0.201	3.421	0.399
India	mktreturn	289	-24.4	35.3	1.42	8.08	0.525	0.143	1.374	0.286
Korea	mktreturn	289	-33.6	70.9	1.59	11.1	1.321	0.143	6.148	0.286
Malaysia	mktreturn	181	-31.2	53.7	0.99	10.5	0.636	0.181	4.661	0.359
Mexico	mktreturn	289	-59.3	39.6	2.045	12.3	-0.848	0.143	3.510	0.286
Philippines	mktreturn	181	-29.3	46.9	2.3	11.2	0.717	0.181	2.700	0.359
Portugal	mktreturn	158	-29.3	70.8	2.469	11.4	1.823	0.193	8.899	0.384
Thailand	mktreturn	289	-33.8	46.9	1.347	10.1	0.309	0.143	3.498	0.286
Turkey	mktreturn	157	-40.7	71.3	3.823	20	0.971	0.194	1.391	0.385
Colombia	int rate	146	4.2	9.6	6.418	1.39	0.371	0.201	-0.829	0.399
India	int rate	224	1.2	35.3	10.64	5.19	2.234	0.163	6.957	0.324
Korea	int rate	290	3.0	21.0	8.081	4.48	1.166	0.143	0.171	0.285
Malaysia	int rate	182	2.0	10.0	5.327	1.64	-0.053	0.180	-0.737	0.358
Mexico	int rate	262	9.6	155.7	37.97	26.4	1.619	0.150	3.074	0.300
Philippines	int rate	182	4.0	13.7	7.395	2.45	0.214	0.180	-1.051	0.358
Portugal	int rate	161	3.3	19.0	12.01	3.85	-0.756	0.191	-0.452	0.380
Thailand	int rate	290	4.0	16.5	10.85	2.54	-0.009	0.143	0.126	0.285
Turkey	int rate	170	40.0	79.0	53.34	8.39	0.924	0.186	0.324	0.370

Appendix 2: Descriptive Statistics

Country	Variable	N	Minimum	Maximum	Mean	Std.	Skewness	Skewness Std. Error	Kurtosis	Kurtosis Std. Error
Colombia	inflation	146	-20.4	37.2	1.271	9.47	1.283	0.201	3.453	0.399
India	inflation	289	-24.4	35.2	1.185	8.08	0.551	0.143	1.426	0.286
Korea	inflation	289	-33.6	68.5	1.252	11	1.286	0.143	5.939	0.286
Malaysia	inflation	181	-31.3	53.6	0.812	10.6	0.633	0.181	4.649	0.359
Mexico	inflation	289	-59.4	39.5	1.687	12.4	-0.850	0.143	3.446	0.286
Philippines	inflation	181	-29.4	46.9	2.128	11.2	0.732	0.181	2.742	0.359
Portugal	inflation	158	-29.3	70.8	2.262	11.4	1.838	0.193	8.856	0.384
Thailand	inflation	289	-33.8	46.9	0.892	10.1	0.377	0.143	3.564	0.286
Turkey	inflation	157	-40.7	71.3	3.364	19.9	0.979	0.194	1.414	0.385
Colombia	risk premium	146	-31.9	25.1	4.759	9.67	-1.401	0.201	3.409	0.399
India	risk premium	224	-59.7	21.0	-9.52	10.9	-0.556	0.163	2.402	0.324
Korea	risk premium	289	-38.6	65.9	-6.47	12.1	1.048	0.143	4.832	0.286
Malaysia	risk premium	181	-37.5	47.9	-4.34	10.9	0.546	0.181	4.015	0.359
Mexico	risk premium	262	-170.0	9.7	-35.9	27.5	-1.332	0.150	2.794	0.300
Philippines	risk premium	181	-37.5	38.0	-5.07	11.5	0.587	0.181	2.226	0.359
Portugal	risk premium	158	-43.8	55.8	-9.51	11.6	1.258	0.193	6.336	0.384
Thailand	risk premium	289	-45.0	34.4	-9.5	10.8	0.354	0.143	2.544	0.286
Turkey	risk premium	157	-109.9	24.3	-49.7	22	0.717	0.194	1.218	0.385
Colombia	P/R	145	0.1	0.1	0.081	0	0.495	0.201	-0.007	0.400
India	P/R	289	0.1	0.1	0.082	0	-0.060	0.143	-0.325	0.286
Korea	P/R	265	0.1	0.1	0.081	0	-0.444	0.150	-1.217	0.298
Malaysia	P/R	156	0.1	0.1	0.077	0	-0.538	0.194	-0.625	0.386
Mexico	P/R	289	0.1	0.1	0.08	0	-0.185	0.143	-1.042	0.286
Philippines	P/R	181	0.1	0.1	0.079	0	2.370	0.181	5.572	0.359
Portugal	P/R	157	0.1	0.1	0.075	0	0.918	0.194	-0.850	0.385
Thailand	P/R	290	0.1	0.1	0.079	0	0.562	0.143	-0.758	0.285
Turkey	P/R	170	0.1	0.1	0.078	0	0.338	0.186	-1.090	0.370

Appendix 3: Durbin-Watson Statistics from Initial Regression

NATION	D-STAT	$P \approx 1 - D/2$	$D_U \leq 2 \leq 4 - D_U$	$D_L \leq 2 \leq D_L$	RESULT
Colombia	2.293	-.1465	1.817 – 2.183	1.651 – 2.349	Zone of indecision
India	1.485	.2575	1.831 – 2.169	1.707 – 2.293	Evidence of Positive Autocorrelation
Korea	1.407	.2965	1.831 – 2.169	1.707 – 2.293	Evidence of Positive Autocorrelation
Malaysia	1.612	.1940	1.817 – 2.183	1.651 – 2.349	Evidence of Positive Autocorrelation
Mexico	1.978	.0010	1.831 – 2.169	1.707 – 2.293	No Autocorrelation
Phillipines	1.799	.1005	1.817 – 2.183	1.651 – 2.349	Zone of Indecision
Portugal	2.236	-.1180	1.803 – 2.197	1.550 – 2.450	Zone of Indecision
Thailand	2.110	-.0550	1.831 – 2.169	1.707 – 2.293	No Autocorrelation
Turkey	2.058	-.0290	1.803 – 2.197	1.550 – 2.450	No Autocorrelation

Appendix 4: Model Summary and ANOVA Tables

Colombia

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.439(a)	.193	.157	1.18706	2.069

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	45.201	6	7.533	5.346	.000(a)
Residual	188.819	134	1.409		
Total	234.020	140			

India

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.454(a)	.206	.183	.48019	2.066

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	12.553	6	2.092	9.073	.000(a)
Residual	48.422	210	.231		
Total	60.975	216			

Korea

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.390(a)	.152	.129	.30679	1.908

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.731	6	.622	6.607	.000(a)
Residual	20.800	221	.094		
Total	24.531	227			

Malaysia

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.713(a)	.508	.482	.34533	1.931

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.909	6	2.318	19.438	.000(a)
Residual	13.476	113	.119		
Total	27.384	119			

Mexico

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.632(a)	.399	.384	.35652	1.978

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	20.499	6	3.417	26.879	.000(a)
Residual	30.888	243	.127		
Total	51.387	249			

Philippines

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.414(a)	.171	.135	.29267	2.018

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	2.391	6	.398	4.652	.000(a)
Residual	11.563	135	.086		
Total	13.954	141			

Portugal

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.233(a)	.054	.004	.43603	2.011

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.238	6	.206	1.085	.376(a)
Residual	21.484	113	.190		
Total	22.722	119			

Thailand

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.600(a)	.360	.344	.42732	2.110

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	25.155	6	4.192	22.960	.000(a)
Residual	44.737	245	.183		
Total	69.892	251			

Turkey

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.512(a)	.262	.227	.35282	2.058

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	5.568	6	.928	7.455	.000(a)
Residual	15.685	126	.124		
Total	21.253	132			

Appendix 5: Coefficients

Colombia

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-22.154	145.446		-.152	.879
Price level uncertainty	-.041	.083	-.040	-.500	.618
Interest rate	.193	.774	.037	.250	.803
Risk premium	-.684	.284	-.199	-2.409	.017
E(Profits)/E(Revenue)	-10.072	50.318	-.022	-.200	.842
IFCI/IFCG	-22.977	9.174	-2.104	-2.505	.013
$IFCI/IFCG^2$	110.108	36.924	2.405	2.982	.003

India

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-35.814	56.680		-.632	.528
Price level uncertainty	.101	.024	.261	4.217	.000
Interest rate	.249	.121	.163	2.057	.041
Risk premium	-.076	.088	-.064	-.862	.390
E(Profits)/E(Revenue)	-20.199	30.469	-.056	-.663	.508
IFCI/IFCG	-.606	10.216	-.097	-.059	.953
$IFCI/IFCG^2$	13.108	43.186	.501	.304	.762

Korea

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	101.989	22.835		4.466	.000
Price level uncertainty	.033	.017	.119	1.900	.059
Interest rate	.146	.086	.131	1.695	.091
Risk premium	-.003	.055	-.004	-.058	.954
E(Profits)/E(Revenue)	56.703	12.959	.312	4.375	.000
IFCI/IFCG	6.667	17.006	1.291	.392	.695
$IFCI/IFCG^2$	-29.575	88.174	-1.104	-.335	.738

Malaysia

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	36.533	14.682		2.488	.014
Price level uncertainty	.403	.054	.512	7.462	.000
Interest rate	-.339	.184	-.155	-1.839	.069
Risk premium	.005	.101	.004	.050	.960
E(Profits)/E(Revenue)	16.833	7.150	.304	2.354	.020
IFCI/IFCG	-2.932	2.738	-1.203	-1.071	.287
$IFCI/IFCG^2$	3.818	3.393	1.325	1.125	.263

Mexico

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	34.813	10.460		3.328	.001
Price level uncertainty	.376	.069	.295	5.455	.000
Interest rate	-.122	.063	-.162	-1.943	.053
Risk premium	-.039	.115	-.028	-.344	.731
E(Profits)/E(Revenue)	12.049	4.131	.247	2.916	.004
IFCI/IFCG	-5.520	2.152	-1.753	-2.565	.011
$IFCI/IFCG^2$	22.243	7.568	2.059	2.939	.004

Philippines

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	9.574	3.898		2.456	.015
Price level uncertainty	.156	.044	.283	3.583	.000
Interest rate	.167	.097	.160	1.723	.087
Risk premium	-.081	.063	-.108	-1.294	.198
E(Profits)/E(Revenue)	2.333	1.714	.110	1.361	.176
IFCI/IFCG	9.762	8.573	.483	1.139	.257
$IFCI/IFCG^2$	-126.158	123.900	-.438	-1.018	.310

Portugal

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	30.226	21.717		1.392	.167
Price level uncertainty	-.186	.079	-.222	-2.362	.020
Interest rate	-.174	.142	-.169	-1.229	.222
Risk premium	-.067	.172	-.045	-.387	.700
E(Profits)/E(Revenue)	4.056	5.892	.093	.688	.493
IFCI/IFCG	-130.767	158.362	-2.950	-.826	.411
IFCI/IFCG^2	387.112	467.325	2.938	.828	.409

Thailand

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	8.521	10.179		.837	.403
Price level uncertainty	.237	.055	.247	4.278	.000
Interest rate	.160	.116	.083	1.384	.168
Risk premium	.019	.066	.016	.292	.770
E(Profits)/E(Revenue)	2.362	3.989	.031	.592	.554
IFCI/IFCG	16.923	3.668	4.647	4.614	.000
IFCI/IFCG^2	-52.691	12.598	-4.207	-4.183	.000

Turkey

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-2.641	6.878		-.384	.702
Price level uncertainty	.408	.074	.424	5.523	.000
Interest rate	.151	.216	.061	.698	.486
Risk premium	-.137	.098	-.120	-1.395	.166
E(Profits)/E(Revenue)	-2.280	2.721	-.072	-.838	.404
IFCI/IFCG	8.886	5.431	1.725	1.636	.104
IFCI/IFCG^2	-23.021	15.433	-1.562	-1.492	.138

Appendix 6: Calculating Elasticity Values

Recall the original specification of the model:

$$\textbf{1)}\qquad \ln \sigma_s = \beta_0 + \beta_1 \ln \sigma_e + \beta_2 \ln (1 + r_f) + \beta_3 \ln \gamma + \ln \beta_4 [E(\pi)/E(R)] + \beta_5 (IFCI/IFCG) + \beta_6 (IFCI/IFCG)^2 + u$$ [16]

Working out the natural log from the left side of the equation, we get:

$$\textbf{2)}\qquad \sigma_s = (e^{\beta 0} + \sigma_e^{\beta 1} + (1 + r_f)^{\beta 2} + \gamma^{\beta 3} + [E(\pi)/E(R)]^{\beta 4}) \rightarrow$$

This part of equation is hereon referred to as constant "A"

$$+ e^{\beta 5(IFCI/IFCG)} + e^{\beta 6(IFCI/IFCG)\text{^}2} + u$$

Taking the partial derivative of volatility (**σ_s**) with respect to stock market openness (**IFCI/IFCG**), we get:

$$\textbf{3)}\quad \frac{\partial \sigma_s}{\partial (IFCI/IFCG)} = A * (\beta_5 + 2 * \beta_5 * (IFCI/IFCG)) * e^{(\beta 5(IFCI/IFCG) + \beta 6(IFCI/IFCG)\text{^}2)}$$

Finally, multiplying both sides by (IFCI/IFCG)/σs, we obtain the elasticity of volatility to stock market openness:

$$\textbf{4)}\qquad \text{Elasticity} = \frac{(IFCI/IFCG)}{\sigma s} * \frac{\partial \sigma_s}{\partial (IFCI/IFCG)}$$

$$= \frac{(IFCI/IFCG)}{\sigma s} * A * (\beta_5 + 2 * \beta_5 * (IFCI/IFCG)) * e^{(\beta 5(IFCI/IFCG) + \beta 6(IFCI/IFCG)\text{^}2)}$$

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[16] σ_s = stock price volatility; σ_e = price level uncertainty; r_f = riskless interest rate
γ = risk premium; $E(\pi)/E(R)$ = ratio of expected profits to expected revenues
IFCI/IFCG = capital market openness

Appendix 7: *Variables*

Variable	Definition	source
IFCG	Monthly stock market index	Emerging Markets Database at William Davidson Insitute
IFCI	IFCG minus stocks not available to foreigners	Emerging Markets Database at William Davidson Insitute
IFCI_IFCG	IFCI/IFCG	calculated
IFCI_IFCG_sq	IFCI/IFCG squared	calculated
Mktreturn	Monthly returns (from IFCG index)	calculated
Int_rate	Monthly interest rate on long term treasury bill	http://Dwrds.wharton.upenn.edu.lib.bus.umich.edu/home/index/shtml
Priceindex	Monthly price index	Emerging Markets Database at William Davidson Insitute
Inflation	Monthly inflation	Emerging Markets Database at William Davidson Insitute
PR	Expected Profit/Expected Revenue	http://devdata.worldbank.org/dataonline
D1 to D11	Dummy variables for 11 months	N/A
gtrus_1 to gtrus_12	Lagged IFCG index (for Schwert estimation)	calculated
residual	Residuals from regressing IFCG against 12 lagged IFCG	calculated
predicted	Predicted values from regression of residual against 12 lagged residual	calculated
res	Residuals from regressing IFCG against 12 lagged IFCG, weighted with predicted	calculated
Predicted2	Predicted values from iterated regression of res against 12 lagged res	calculated
rp	Risk premium	calculated
adj_rp	Risk premium with scalar adjustment	calculated
inf_res	Predicted values from iterated regression of inflation residuals against 12 lagged residuals	calculated
ln_(given variable)	Natural log of some given variable	calculated
c_ln_(given variable)	Variable corrected for autocorrelation	calculated