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An Empirical Investigation of the Impact of Capital Market Liberalization on the Philippine Equity Market

by

Angelo Africa Unite ©

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled ***An Empirical Investigation of the Impact of Capital Market Liberalization on the Philippine Equity Market*** submitted by Angelo Africa Unite in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Finance.

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August 14, 1997

To my parents Amado and Amada.

my sisters Charo. Telly and Clavel.

and

Auntie Nene

Abstract

This thesis investigates the short- and long-term effects of Philippine capital market liberalization on the domestic equity market and its relationship with international equity markets. We draw on concepts and theories of investment and international finance for the economic intuition underlying these issues.

In Chapter 2, we examine the impact of liberalization on the degree of Philippine equity market integration. The results of multivariate cointegration analysis suggest that the Philippine stock market has become integrated with the markets of its major economic partners during the post-liberalization subperiod. However, we find the degree of integration to be weak, possibly owing to remaining barriers to international investments. These results are consistent with the notion that liberalization encourages international capital flows which in turn promotes capital market integration.

In Chapter 3, we investigate the response of American investors to announcements of relaxation of Philippine international investment restrictions, using First Philippine Fund data. The results of our event study indicate that announced relaxation of foreign equity ownership limits are associated with a widening of the fund's discounts. One implication of this is that the imposition of foreign equity ownership restrictions effectively segmented the Philippine equity market and raised the required return on Philippine equities.

In Chapter 4, we examine the impact of liberalization on the short-run dynamic relationships of the Philippine equity market with international equity markets. Using a multivariate GARCH methodology, we find significant lagged cross-market volatility

spillovers to the Philippine market, with stronger evidence in the post-liberalization subperiod. An analysis of the impulse response of conditional volatility reveals that the dynamic impact of past foreign stock market return innovations on current volatility of Philippine stock market returns is quite persistent. These are consistent with the view that international investment barriers insulate the domestic market from external shocks. By liberalizing such restrictions, information contained in foreign stock market movements become an important influence on the behavior of domestic stock market returns.

Overall, our results suggest that recent capital market liberalization in the Philippines may have been partly responsible for increasing the price linkages of the domestic equity market with those of international markets.

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Chapter 1

Introduction[1]

1.1. An Overview of the Philippine Stock Market

The Philippine stock market is one of the oldest in Asia. It dates back to August 1927 when the Manila Stock Exchange (MSE) was established. A second exchange, the Makati Stock Exchange (MKSE), was organized in 1963 but only became operational in November 1965 after much controversy. On March 1994, the two stock exchanges were officially merged into the unified Philippine Stock Exchange (PSE) with a one-price system and single listings. While the two trading floors were maintained, automated trading systems of both exchanges have been modified and interfaced with a single price quotation. Prior to the unification, the two stock exchanges operated independently of each other. However, their roster of stocks was identical since the law then required that all stocks listed on the MSE be automatically listed on the MKSE, and vice versa. Nevertheless, issuing firms still had to go through the process of applying to both exchanges. The existence of two exchanges seemed inconsistent with the requirements of a relatively thin Philippine equity market. Moreover, the presence of two stock exchanges in such a small market is said to have spawned and nurtured problems such as insider trading, broker's arbitrage, stock dumping and control of 'hot' issues (Lopez, 1994). The merger is envisioned to make the Philippine stock market operationally and informationally efficient.

New listing rules requiring larger capitalization, longer track record of profitable operations and greater disclosure from applicants were also promulgated by the unified PSE. Electronic boards which provide latest stock market quotations have been installed in the provincial areas. The Exchange has started using a new computerized surveillance system as an aid for monitoring the market for possible manipulation or insider trading. Finally, the central securities depository system is expected to be operational by the end of 1996. This allows trading in Philippine equities to be conducted on a scripless basis thereby reducing settlement of transactions in 3 to 4 from the 28 days under the previous system.

There is also an over-the-counter (OTC) market in which unlisted stocks, mostly bank shares, are traded. This market plays a pivotal role in preparing firms for eventual listing in the stock exchange. However, this market is small compared to the organized exchange for listed stocks. Member firms of the PSE may trade on OTC securities at all hours in their offices.

As of March 1994, the PSE has a total of 183 individual and corporate members. Membership can be acquired through direct purchase of a seat from the exchange or from an existing member. Membership of the exchange is limited to 200 with each member entitled only to one seat.

A total of 205 firms were listed on the PSE as of the December 1995. These are grouped into the following categories: commercial-industrial (e.g., banking and insurance, cement, construction, communications, firms involved in manufacturing, distribution and trading, food, etc.), mining, oil (e.g. oil exploration and oil production), and property (e.g., firms involved in land and property development). A majority of the securities traded in the PSE are common stocks. Other securities such as preferred stocks, bonds and warrants are also traded although their share of daily trading turnover is trivial. However, only about 75 issues are being actively traded on the floor (Salgado, 1994). A possible reason for this is that some of the listed firms are closely held or have either little or no business activity since their initial listing as speculative mineral issues in the 1970s. On the other hand, Mangaran (1993) and Lamberte and Llanto (1994) cite some possible reasons for the low supply of publicly listed shares. Many Philippine firms are either closely-held by a few individuals or are family-controlled. They are reluctant to go public for fear of losing control of their business as well as exposing their business operations to public scrutiny. A second reason is that some non-listed firms allegedly do not use accounting standards and therefore are able to avoid payment of a significant amount of tax by understating earnings. Thus, going public would reveal the inaccuracies in their financial statements making them liable to pay substantial penalties.

Mining stocks dominated the Philippine stock exchanges until the early 1970s. In 1978, the discovery of oil in the southern part of the country gave rise to oil stocks. Active trading in this sector was however short-lived as oil prospects turned out to be exaggerated. Since then, the stock market has been battered by a succession of negative events. A financial crisis occurred in 1979 which led to the bankruptcy of a number of brokerage firms. In 1983, the assassination of Benigno Aquino, a prominent political arch rival of then President Marcos, confounded the already unstable economy and caused substantial capital flight out of the country and a sharp deterioration in stock market activity. However, the economy has taken off since the installation of a new government under Corazon Aquino in 1986. Consequently, the Philippine stock market experienced unprecedented growth with the commercial and industrial group leading the growth. These are reflected in the size and growth of market capitalization and trading value in the Philippine stock market.

Table 1.1 shows that while market capitalization of the Philippine stock market almost constantly declined during the first half of the 1980s, the market experienced an unprecedented growth rate of 200% in 1986. Henceforth, the stock market has continuously grown , except for the period 1989 to 1990. The decline during this period can be explained by the attempted *coup d'etat* in December 1989. This resulted to some short term political instability which reduced investor confidence. However, this was reversed starting in 1991 when, together with an improvement in political stability, the country gradually instituted sweeping reforms such as deregulation of protected industries, liberalization of foreign investment restrictions, relaxation of foreign exchange controls and foreign equity participation limits, and restructuring of foreign debt. Fueled by the strong market response to initial public offerings (IPOs), market capitalization grew by 192% between 1992 to 1993. Lopez (1994) reports that during 1993, many of the IPOs were practically sold out through commitments or applications to buy or reservations forms even before these issues could be marketed by underwriters and brokers. Moreover, the Philippine stock market was adjudged the best performer among all Asian markets in 1993 and the third best worldwide when the stock market composite index posted an extraordinary appreciation of 154.4% (International Finance Corporation, 1994). Stock market analysts believe that sufficient liquidity coupled with better-than-expected economic growth in the second and third quarters of 1993 led the market to its sterling performance. Market capitalization grew by 38% in 1994 and by a modest 6.0% in 1995. By December 1995, market capitalization stood at US$58.859 billion. The growth in trading activity and liquidity of the market is also apparent in Table 1.1. Beginning in 1986, the Philippine stock market experienced a general upward trend in the market value of trading volume of stocks listed in the exchange. By the end of 1995, the value of traded securities was approximately 26 times the 1986 level. Some industry analysts say that the increase in popularity of equity financing vis-à-vis debt financing in the recent years is a result of an enormous expansion of corporate projects, capital requirements and high cost of borrowing that accompanied the continuous economic recovery in the Philippines (see, e.g., Lamberte and Llanto, 1994; and, Euromoney, 1996).

Despite this encouraging trend, the Philippine stock market is still considered as relatively small especially when compared to the markets of its ASEAN neighbors. In terms of market capitalization, the Philippine market is only about little more than two-fifths of the stock markets of Thailand and Singapore and roughly one-fourth of the Malaysian market.[2] de los Angeles (1995) reports that as of July 1995, only 1% of the total Philippine population participates in the stock market. Only 30% of the funds in the market come from domestic sources with most of the local investors coming from Metro Manila. Many of the 1000 top corporations in the country continue to be closely-held. Only a little more than 60 of these top corporations are listed in the exchange. However, the PSE is aggressively pursuing a market development program in anticipation of the expansion in corporate activity that accompanies the expected future growth prospects of the country. Moreover, in an effort to increase domestic participation in the local stock market, the Philippine government recently announced a policy of setting aside at least 10% of all new IPOs for small investors (International Finance Corporation, 1996).

1.2. Liberalization and Internationalization of the Philippine Capital Market

Philippine policymakers have long been cognizant of the vital role that foreign capital can play in financing the investment requirements that are necessary to ensure the growth of the country's economy. However, despite several attempts at liberalization, the Philippine economy can be described as relatively closed to foreign competition during much of the 1970s and the first half of the 1980s. In turn, the protectionist policies constrained the country's economic growth during these periods. In particular, the historical developments that shaped Philippine foreign investment policy as it is now seem to be marked by an apparent prejudice toward foreign investments. This stems from the country's colonial experience and the need to reassert political sovereignty as a means of effectively controlling the country's economic resources. Laws pertaining to foreign investments in the Philippines follow the philosophy that although foreign investment can assist in the promotion of the country's economic development, it should not supplant Filipino capital. This philosophy is enshrined in the fundamental law of the land which aims at attaining the objective of developing a "self-reliant and independent national economy effectively controlled by Filipinos."

Consequently, foreign ownership has been limited to a maximum of 40% of total equity in most areas of economic activity in the Philippines. To facilitate the monitoring of foreign ownership limits, listed companies that fall into the restricted areas generally classify their shares into two categories: "A" shares and "B" shares. "A" shares are generally reserved for Filipino nationals, while "B" shares are open to any nationality. This classification evolved for ease of monitoring the limit on foreign ownership of firms. It must be noted, however, that not all companies follow this "A" share/"B" share convention. Exceptions include (a) companies that are not involved in restricted areas of business and do not own land and (b) companies that float a sufficiently small percentage of their shares such that the foreign ownership restriction is not violated even if all these shares were purchased by foreigners (e.g. almost all banks). Thus, for areas of economic activities where there are no restrictions on foreign ownership, there would be no purpose nor legal requirement of classifying the shares. There are no differences in the rights, preferences and limitations of the two classes of shares other than the ownership restrictions. However, the purchase of Philippine equities by foreign entities and nonresidents must be registered with the Central Bank in order to qualify for repatriation of dividends and the proceeds resulting from their subsequent sale. Foreign investors buying under their name purchase mostly the "B" shares.

Prior to the major regulatory changes affecting international investments that commenced in 1991, there was a growing clamor especially from foreign investors for the relaxation of the country's foreign equity limits, limits on land ownership and lease tenure, legal barriers to investment in a broad range of industries and sectors as well as improvement in the current investment incentives system as they perceive the policies then as impediments to foreign investments (see Unite, 1995). The Philippines' limitations on foreign ownership of enterprises was observed to be the most stringent among the countries in the Association of Southeast Asian Nations (ASEAN, which includes Brunei, Indonesia, Malaysia, Philippines and Singapore).

In an effort to address the felt need to liberalize the foreign investment climate in the Philippines, the government gradually embarked on a number of regulatory changes affecting the inflow and outflow of international capital. Among other things, the major reforms implemented opened up the domestic capital market to greater global investor participation.

1.2.1 Liberalization of Foreign Equity Ownership Restrictions.

The boldest step taken by the Philippine government which significantly reformed the foreign investment regime was the passage of the Foreign Investment Act of 1991 (FIA) on November 1991. This measure virtually opened all economic sectors to 100% foreign equity ownership, except in those areas specified in a transitory negative list. Moreover, this new law streamlined the investment approval process and more clearly defined the limits and restrictions on foreign investments. A key feature of the FIA is the negative list of sectors where foreign investment would be limited to a maximum of 40%.[3] Foreigners are free to invest in all other sectors without prior approval from authorities. On October 1991, a three-year transitional period went into effect during which foreign ownership is restricted to a maximum of 40 percent in sectors specified in the transitory negative list.

On June 1994, the Philippine economy was further opened to foreign investments when Philippine President Fidel Ramos issued Executive Order No. 182 which effectively deleted List C of the transitory negative list. Foreigners can now fully own businesses in areas such as insurance, travel agencies, wholesale trading, convention organizing, and manufacturing under foreign licenses.

The FIA does not include banking and other financial institutions as they are governed and regulated by the General Banking Act and other laws under the supervision of the Central Bank of the Philippines. For example, Republic Act 337 as amended requires that at least 70% of the voting stock of any banking institution be owned by Philippine nationals. However, on October 1994, the entry of foreign banks to operate in the Philippines was also liberalized via Republic Act No. 7721. Under the new regulations, entry can be effected through a purchase of 60% of the voting stock of an existing domestic bank or of a new banking subsidiary incorporated in the Philippines or through the establishment of branches with full banking authority, subject to the licensing requirements of the Central Bank.

1.2.2. Liberalization of Foreign Exchange Restrictions

Beginning in 1992, the Philippine government has also relaxed existing foreign exchange restrictions. Since January 1992, foreign exchange may be freely sold and purchased (without need for Central Bank prior approval) outside the banking system. Previously, only Authorized Agent Banks, all of which are commercial banks, authorized foreign exchange agents (thrift and rural banks, three-to five-star hotels, duty-free shops, supermarkets, and certain tourist-oriented establishments accredited by the Department of Tourism and issued authority by the Central Bank) , and Authorized Foreign Exchange Buyers (non-bank entities, initially authorized by the Central Bank to purchase foreign exchange with pesos from the general public) could engage in both sale and purchase operations in foreign exchange. As of August 1992, residents of the Philippines were no longer required to sell foreign exchange receipts to authorized banks. Moreover, foreign exchange receipts, acquisitions or earnings were allowed to be deposited in foreign currency accounts, whether in the Philippines or abroad. All remaining restrictions on the repatriation of capital or remittances of dividends from foreign direct equity investments were also removed. Foreign investments duly registered with the Central Bank, or with a custodian bank designated by the foreign investor, are now entitled to full and immediate capital repatriation, and dividend and interest remittance privileges. This is in contrast with previous guidelines where remittances were staggered from three to nine years subject to prior CB approval. Moreover, in January 1992, Philippine residents were allowed to purchase foreign exchange up to US$1 million annually from the banking system for investments abroad, without prior Central Bank approval. This limit was raised to US$6 million in November 1994. Prior to these reforms, the government imposed strict limits on the amount of foreign exchange that residents could bring out of the country.

1.2.3. Country Funds and International Equity Offerings

It should be noted, however, that various events related to market opening and internationalization of the domestic equity market have occurred prior to the major liberalization reforms that were initiated starting in 1991. A number of government-approved closed-end country funds investing in Philippine equities have been launched by investment management companies to meet the needs of foreign investors wishing to gain access to the then restricted domestic capital market. These include, among others, the Manila Fund which was admitted in London's stock exchange on October 1989, the First Philippine Fund listed in the New York Stock Exchange in November 1989, and the JF Philippine Fund and First Philippine Investment Trust which started trading in London's stock exchange on November 1989. Furthermore, some of the leading Philippine companies are also quoted in international markets. For example, the Philippine Long Distance Company (PLDT) is listed on the New York Stock Exchange while the Manila Electric Company has a Luxembourg listing. PLDT, the International Container Terminal Services and J G Summit Holdings have also sold convertible issues in the international market.

1.2.4. Other Reforms

Other measures directed at highlighting the country's commitment to foster and protect foreign investment were also implemented beginning in 1992. These include the reduction of tariff and non-tariff barriers to trade and market entry, reduction of restrictions on foreign exchange transactions on the trade account, deregulation of strategic industries such as telecommunications, aviation, oil and shipping by opening it to competition, and further privatization of state-owned enterprises.[4] The privatization of state-owned enterprises, such as Petron, National Steel Company, the Philippine National Bank (PNB) and the Manila Electric Company (Meralco), enhanced capitalization and stock market activity by expanding the supply of shares.

Ever since the Philippines announced a moratorium on foreign debt payments in 1983, it has been unpopular among institutional investors. However, with the successful restructuring of its foreign commercial bank debt in 1992, the Philippines was able to re-enter the international capital markets via bond issues for the first time since 1983.

The successful implementation of reforms that liberalized and internationalized the domestic capital market combined with recent global investor interest in developing country equity markets may have been responsible for the significant flows of foreign portfolio capital into the Philippines in recent years.[5] For example, Folkerts-Landau and Ito (1995) report that placements of new equity issues in international markets by the Philippines grew from US$53 million in 1990 to US$839 million in 1994. Overseas-based emerging market funds (open- and closed-end) devoted to Philippine equities have likewise expanded rapidly. The net asset value of these funds provide a rough indicator of direct purchases by foreigners of Philippine domestic securities. In 1988, there were 3 mutual funds with a combined net asset value of US$45 million. By 1994, there were 9 mutual funds with a combined net asset value of US$654 million. A report by the president of the Philippine Stock Exchange (de los Angeles, 1995), indicated that approximately 70% of the funds in the Philippine equity market comes from foreign sources. In addition, the domestic market opening measures may partly explain the substantial increase in the Philippine stock market size. Philippine stock market capitalization grew from US$3.5 billion in 1980 to US$12 billion in 1989 and further to US$58.9 billion in 1995 (International Finance Corporation, 1990 and 1996).

Note, however, that despite the preceding reforms, there are some impediments to international capital flows which remain in the Philippine market. These include, among others, restrictions or limitations on foreign equity ownership in economic sectors specified under the Negative Lists A and B of the Foreign Investment Act, some degree of political instability which discourages foreign investors from participating in the economy, the smallness of the domestic equity market which can have negative implications on market liquidity, and the few internationally cross-listed Philippine securities.

1.3. Research Objectives and Thesis Overview

To the extent that barriers to international investments effectively limit cross-border capital movements, the liberalization of these restrictions are expected to increase the inflow of foreign capital into the domestic market. At the same time, the existing literature points out that the relaxation or removal of binding barriers to international investments can increase the sensitivity of the domestic capital market to global factors or foreign influences and its interactions with international capital markets. This is premised on the capital market liberalization process yielding a higher degree of integration of domestic and international financial capital markets.

One notion of financial capital market integration, which stems from the law of one price, is as follows.[6] Capital markets are fully integrated when financial assets with the same risk but traded in different markets have identical expected returns in some common currency (see, e.g., Stulz, 1981; Campbell and Hamao, 1992; and, Bekaert and Harvey, 1995). Intuitively, if international capital markets are integrated, the resultant ease of internationally diversifying an investor's portfolio reduces the sensitivity of the portfolio's return to local events and makes it more sensitive to developments abroad. In contrast, if markets are segmented, the investor's portfolio may be significantly more sensitive to local information than global information and as such required returns can be different across markets. However, it is possible that the degree of integration of a particular market may not be complete. The degree of integration depends upon factors that determine the ease of arbitrage or cross-border trades in assets across international markets. This is because the barriers, if substantial and effective, can prevent cross-border arbitrage activities that eliminate any excess return relative to the return dictated by some economic equilibrium condition. Consequently, financial assets in these markets can have different expected returns even when their risk characteristics are the same.

Economists have traditionally used domestic and foreign interest rate relationships as a measure of the degree of integration of international financial capital markets. One approach to measuring capital market integration based on this technique is interest rate parity. Under this approach, it is predicted that domestic and foreign interest rates will be closely linked if the domestic economy is completely open to the rest of the world and there are no barriers to international capital flows. Specifically, in a world with no transaction costs, the following covered interest parity relation will hold:

$$r_t = r_t^* + f_t \qquad (1)$$

where r_t is the domestic interest rate, r_t^* is the foreign interest rate for a financial asset of identical risk as the domestic asset, and $f_t = \log(F_t) - \log(S_t)$ where F_t is the one-period forward exchange rate and S_t is the current spot exchange rate.

When this condition holds, investors in both countries will be indifferent between investing in their domestic financial asset or in the foreign asset since the total rates of return for the two investment instruments — r_t in the domestic market and $r_t^* + f_t$ in the foreign market — are identical. However, when this condition does not hold, arbitrage profits are possible. In the absence of barriers to international capital flows, funds will flow to the country with the greater overall return and out of the country with lower return. This will tend to increase interest rate in the former country and reduce interest rate in the latter. At the same time, as the currency of the country with greater overall return is bought spot and sold forward, the spot exchange rate increases while the forward rate decreases. This has the effect of reducing the forward rate. This process continues until excess profits are competed away and the overall returns are equalized.

However, in this framework, capital controls and other barriers to international capital mobility (e.g. political risk or risk of future capital controls, differential tax treatment, local information costs) may prevent equalization of national interest rates (see, e.g., Chinn and Frankel ,1994; and, Marston, 1995). This is because restrictions on capital mobility can limit the cross-border arbitrage activities which link domestic and foreign nominal interest rates and the exchange rate and thus give rise to nonzero deviations from the covered interest parity condition, $e_t = r_t^* - r_t + f_t$. On the other hand, even in the absence of capital controls and other barriers to capital mobility, covered interest parity may not hold exactly for interest rates of domestic and foreign financial assets of the same maturity because of differences in default risk. In empirical studies, this source of deviation is usually controlled for by confining interest rate comparisons to same maturity short-term government securities such as Treasury bills. By doing so, any observed covered interest differentials will primarily reflect the influence of barriers to international capital flows.

Empirical analysis of capital market integration usually examines the extent to which Equation (1), or similar versions of it, holds. A popular and simple methodology employed by most of these studies is the investigation of the magnitude and statistical significance of the average covered interest rate differentials over specified sample periods. In this case, narrower differentials are interpreted as a measure of higher degree of integration. An empirical regularity of studies which examine the degree of capital market integration based on covered interest rate differential is that declining deviations from covered interest parity correspond to sample periods after which the countries being investigated have implemented reforms aimed at capital market liberalization. To the extent that a reduction in the covered interest differentials reflects the relaxation of barriers to international capital mobility, this result implies that capital market liberalization increases the degree of integration of domestic and foreign capital markets.

For example, Feldman (1986) finds that during the periods when the Japanese government maintained a system of capital controls, the null hypothesis of covered interest parity between the Japanese and Eurodollar markets is rejected with a high degree of significance. However, for the periods coinciding with the removal of restrictions to international capital flows, he finds that the deviations from covered interest parity decline substantially and the confidence in rejecting the null hypothesis falls rapidly. In particular, he finds evidence that the null of covered interest parity cannot be strongly rejected for sample periods after the Japanese government enacted the Foreign Exchange and Foreign Trade Law which eliminated most capital controls on current and capital account transactions. Otani and Tiwari (1981) find similar results. They find that increases in the deviation from covered interest parity between the Japanese and Eurodollar markets correspond to periods when the Japanese government introduced capital controls. On the other hand, decreases in the deviation are observed in the periods after capital controls have been reduced substantially. Marston (1995) finds evidence of substantial reduction in covered interest differential between the Eurocurrency market rates and the domestic interest rates of Britain, United States, Germany, Japan, and France in sample periods after these countries have removed their capital controls. Chinn et al. (1994) find that the covered interest rate differentials of Australia and New Zealand versus U.S. interest rates have declined at a statistically significant rate over the period during which they have implemented their programs of financial liberalization and that the covered interest parity now holds fairly well for these countries.

Given the recent major reforms related to the relaxation of barriers to international investments in the Philippines, it would be ideal to examine the extent to which covered interest parity holds in this market as a measure of the degree of Philippine capital market integration with international capital markets. Unfortunately, data on forward exchange rates of the Philippine peso vis-à-vis the currencies of the countries included in the study are unavailable. Nevertheless, based on the results of the previously mentioned studies, it is possibly safe to infer that the deviations from covered interest parity would have decreased over the period when the Philippines has implemented capital market liberalization reforms.

A problem with examining simply the deviations from covered interest parity, however, is that it does not distinguish between the short- and long-term implications of capital market liberalization on specific segments of the capital market. In this thesis, we concentrate on examining the impact of capital market liberalization on the Philippine equity market. It was not until recently that academic researchers have shown interest in studying the emerging stock markets of developing countries. One such emerging market that has caught the attention of international investors is the Philippine stock market. Like many developing economies, the Philippines impose barriers to international capital movements that have the effect of insulating the domestic stock market from developments affecting international equity markets. However, as mentioned in the previous section, there has been a recent trend in easing foreign investor access to the Philippine market as well as increasing domestic investor ability to invest outside the country. These recent developments related to the liberalization of the Philippine capital market provide an opportunity to examine their short- and long-term effects on the domestic equity market and on its relationship with other national equity markets. Specifically, we investigate the following implications of capital market liberalization.

In Chapter 2, we explore the impact of capital liberalization on the long run-relationships of the Philippine equity market and international equity markets. In particular, we investigate the effect of the liberalization of capital mobility restrictions on the degree of integration of the Philippine equity market with the equity markets of its major economic partners, namely, the United States, Japan, Taiwan, Hong Kong and Singapore, using multivariate cointegration analysis. Bekaert (1995) distinguishes among three types of barriers that can affect the degree of equity market integration. The first group is comprised of direct restrictions on foreign ownership as well as foreign exchange and capital controls. The second group includes indirect barriers related to the regulatory and accounting environment such as lack of information on these markets and on the health of the companies, the inefficiency and slowness of settlement systems, poor accounting standards, and the fear of expropriation due to minimal investor protection. The third group consists of barriers arising from market-specific risks that discourage foreign investment including liquidity risk, political risk, macroeconomic instability, and currency risk.

A simple and traditional measure of the degree of integration of national stock markets is the simple cross-country correlation of stock market index returns (i.e., first difference of the natural logarithm of stock market price index). Under this approach, an increase in return correlation between pairs of markets is interpreted as evidence of an increase in the degree of equity market integration. For example, Mullin (1993) finds that equity returns in developing countries which instituted reforms that encouraged equity portfolio inflows into the domestic market have become more closely correlated with the equity returns of developed nations. He interprets this as reflective of greater integration of developing country and developed country equity markets. However, long-run information on the interrelationship of the international stock markets that are reflected in the price levels is lost by differencing. This is because return correlations are influenced by both independent short-run trading noises as well as by long-run fundamental relationships among the markets that are induced by their internationalization and liberalization. Consequently, the short-run noise can possibly make the markets appear more independent or less integrated than they truly are.

An alternative approach to measure equity market integration is to test the hypothesis that financial assets with identical risk characteristics that are traded in different markets have the same expected returns, assuming some asset pricing model. Some of the studies which investigated international equity market integration using this approach include world Capital Asset Pricing Model (see, e.g., Harvey, 1991; and, Buckberg, 1995), world arbitrage pricing theory (see, e.g., Solnik, 1983; and, Cho, Eun and Senbet, 1986), world multibeta models (see, e.g., Ferson and Harvey, 1993, 1994; and, Harvey, 1995) and world latent factor models (see, e.g., Campbell and Hamao, 1992). These models implicitly assume that world markets are perfectly integrated and that the asset pricing model used is sufficient to explain the cross section of expected returns of the international equity markets. One problem with this approach is that the hypothesis of market integration may be rejected simply because the asset pricing model used is inappropriate, when in fact equity markets are integrated. Moreover, because these tests assume complete or perfect capital market integration, they do not allow for varying degrees of integration. Stylized facts presented above indicate that there are remaining barriers to international capital flows in the Philippines which is likely be a source of rejection of the null hypothesis of complete integration.

In order to avoid the problems associated with the above approaches, we instead utilize a notion of integration that does not necessitate an asset pricing model nor assumes complete world market integration for its empirical implementation and testing. This concept of integration involves determining whether there exists a long-run equilibrium relationship among the Philippine equity market and international stock markets that is reflected in long-run common movement among the levels of the each country's stock market indexes (not returns). In turn, this long-run relationship is given by the cointegration properties of the national stock market price indexes. Under this concept, finding a cointegration relationship among the national stock market indexes is taken to be suggestive of market integration. We then interpret the finding of more cointegrating relationships as indicative of a higher degree of equity market integration. We examine the impact of capital market liberalization on the degree of Philippine equity market integration by dividing our overall sample period into pre- and post-liberalization subperiods. On the premise that liberalization of restrictions on international capital flows promote market integration, we expect to find stronger evidence of cointegration in the post-liberalization subperiod.

Given that there are remaining barriers to capital mobility in the Philippine market which affect the risk attributes of Philippine equities, it is not surprising to find Philippine stock market returns to be not equal with those of the international equity markets. However, it seems reasonable to infer that common movement of domestic and international stock market prices implies market integration. Common movement in prices perhaps arises from the response of each country to some economic force, perhaps a common world growth factor, which systematically affects the equilibrium prices of the stocks of the different countries. On the other hand, the strength of the comovement and linkages of stock market prices depends on the degree of openness of the international capital markets. This is because the factors that promote market integration, such as liberalization of capital markets and the globalization of securities, also promote international capital mobility. Ripley (1973) argues that, with freer capital mobility, capital flows will tend to reduce interest rate differentials between countries by increasing the supply of capital in the country with the high interest rate and reducing it in the country with the low interest rate. Given that stock prices are affected by interest rate movements, assuming that the present value model of stock prices holds, the comovement of national interest rates via covered interest rate arbitrage will result in comovement between national stock price indexes.

The short-run implications of the liberalization of international investment restrictions in the Philippines are examined in Chapters 3 and 4. In Chapter 3, we investigate the response of American investors to announcements of relaxation of barriers to international investments in the Philippines using data on the First Philippine Fund, a closed-end country fund investing in Philippine equities and traded at the New York Stock Exchange. The First Philippine Fund is the only country fund permitted by the Philippine government to invest in "A" shares of domestic companies that are otherwise available only to Philippine nationals. This feature makes the fund an easily accessible alternative to direct investment in the then restricted Philippine capital market. We employ an event study methodology to determine whether the international investment restrictions in the Philippines are effective and whether the announced relaxation of these restrictions are deemed important by U.S. investors. Specifically, we test whether announcements of relaxation of the restrictions reduce the premiums or increase the discounts on the First Philippine Fund. This null hypothesis is premised on the following theoretical grounds.

Like domestic closed end funds, closed end foreign country funds trade at premiums or discounts over their Net Asset Values (NAVs). However, in contrast to domestic closed end funds, the foreign country fund's NAV is not determined in the same market as its share price. Its NAV is determined by the prices of the underlying securities traded on the foreign market. Given that country funds and their underlying assets are close substitutes, then, if capital markets are integrated internationally, a closed-end country fund's shares and its underlying assets should have similar risk. However, Eun and Janakiramanan (1986) and Hietala (1989) argue that barriers to international investment can cause the expected returns on assets of equal risk to differ across countries. Based on these models, non-zero country fund premiums imply some market segmentation. Moreover, as discussed in Chapter 3, these models suggest that imposition of binding restrictions to international investments will increase the price-to-NAV ratio of the fund investing in that country. An intuitive explanation of this inference is as follows.

Suppose that a particular country legally prohibits foreign investors from directly purchasing its local equity securities. Assume that the only means by which a foreign investor can gain access to this country's equity market is through a closed-end fund, which is allowed to invest in the local securities. This fund will, most likely, have value to diversification-minded foreign investors and possibly sell at a premium over its NAV. Therefore, when the restrictions are relaxed and direct purchase of the securities underlying the fund becomes easier, the fund is likely to have lesser value for the foreign investor. Consequently, the demand for the fund's shares decreases and thus the fund's shares are likely to sell at a lesser premium than before. In summary, the preceding arguments imply that the price-to-NAV ratios of country funds can be affected by barriers to international investments if these restrictions are effective. A test of this hypothesis does not necessitate an underlying asset pricing model nor does it require measures of the effectiveness of the barriers to international investments. This is because when international capital markets are fully integrated, the shares of a closed end country fund and its underlying assets should have similar risk. Consequently the fund's share price should be priced like domestic funds. At the same time, it is possible that foreign investors shift their capital from the country fund to direct purchases of the host country's equities as a result of liberalization. This increases the demand for the host country's equities which in turn increases the NAV of the country fund. This reinforces the effect of reducing the premium or increasing discount on the country fund.

In Chapter 4, we study the implications of capital market liberalization in the Philippines on the short-run dynamic relationships of the Philippine equity market and the equity markets of its major economic partners. In particular, we investigate the impact of capital market liberalization on the transmission of stock returns and stock return volatility among the equity market of the Philippines and those of its major economic partners using the multivariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model.

There are several reasons why we may expect the returns and returns volatilities of the Philippines and those of Taiwan, Japan, Hong, Kong, Singapore and the United States to be related. Firstly, the Philippine economy is related to these countries through international trade and foreign investment. These foreign economies are the Philippines' major trading partners and sources of foreign investments so that any news about the economic fundamentals in these countries will most likely influence the Philippine market fundamentals. Consequently, if stock market movements in these markets are caused by the arrival of fundamental news, then such news originating from the foreign markets will eventually be reflected in the domestic stock prices as rational investors, stock brokers and portfolio managers in the Philippines respond to observed price changes in these other markets. Under this reasoning, we should observe return and return volatility spillovers among the Philippines and the foreign markets of interest whether or not there is cross-country stock trading.

Secondly, models of international asset pricing, e.g. Stulz (1981) and Errunza and Losq (1985), can allow for correlations of stock returns in different countries. Under these models, barriers to international investments that are imposed by countries may effectively segment these countries' capital markets from those of the open markets. Suppose developments in country A lead to changes in this country's asset prices. These models imply that countries whose capital markets are not segmented from that of country A will also experience asset price changes as asset returns equalize between country A and the other countries. As mentioned earlier, equalization of returns may be achieved via cross-country investing or arbitrage activities since there are no effective barriers to international capital flows in integrated markets. On the other hand, countries whose capital markets are segmented from those of country A will not exhibit asset price changes since effective barriers to capital flows which segment these countries' markets can isolate these countries' capital markets from forces which tend to equalize returns across integrated markets. Based on this reason, we expect transmission of stock price movements from the other international markets to the Philippine market given that the cointegration results in Chapter 2 provide evidence that the Philippine equity market has become integrated with these international markets.

A third possible reason for correlations of stock price movements across international markets is market contagion, a concept introduced by King and Wadhwani (1990). Under the market contagion scenario, stock prices in one country may be influenced by changes in the stock prices of another country beyond what is conceivable by information about economic fundamentals. Under the market contagion hypothesis, stock price movements driven by overreaction, speculation, noise trading or even a 'mistake', e.g. failure of market mechanism, in one market may be transmittable to other markets.

Our focus on volatility and the use of time-varying volatility in this study is motivated by the following reasons. First, there is a large body of evidence in the finance literature indicating that most financial time series exhibit volatility clustering, i.e., there is a tendency for large changes tend to be followed by large changes of unknown sign, and that periods of high volatility alternate with periods of relative calm (see, e.g., Bollerslev Chou and Kroner (1992) for a survey of the literature). These are consistent with time-varying conditional volatility. Therefore, if the volatility of price changes in the national stock market indexes included in this study vary over time in a related manner, the finding of significant relationships among international stock market returns may be an artifact of specification error. Second, Ross (1989) shows that it is the volatility of the asset price, not the absolute price change, that is related to the rate of information flow to a particular market. Similarly, the theoretical model of Kyle (1985) suggests that information is revealed in return movements that are reflected in the volatility of returns. Based on these models, the interdependence among the return volatility of each national stock market can be ascribed to the dissemination of information flow across these markets. One implication of these models is that inferences on how information flows between any two stock markets obtained simply from a finding of cross-market interdependence in price changes may not be conclusive. Therefore, the use of time-varying conditional volatility of returns on the national stock market indexes considered in this study provides an alternative way of measuring the flow of information among these markets. The time-varying nature of the volatility of equity market returns is captured by the use of the generalized autoregressive conditional heteroscedasticy specification.

Our method of studying the transmission mechanism of stock market movements enables us to simultaneously estimate the conditional volatility process of the six national stock market indexes. On theoretical grounds, the multivariate specification is more appealing than the bivariate specification which separately examines the transmission process between the Philippine market and each of the foreign equity markets. This is because the multivariate specification allows for any potential interactions or multilateral volatility spillovers that may be occurring among the five other markets. This is also an improvement over the models that utilize the traditional Vector Autoregressive (VAR) methodology which ignores the time-varying conditional volatility of returns and the international spillovers of these return volatilities that might be occurring at the same time.

As in Chapter 2, we examine the impact of capital market liberalization on return and return volatility spillovers between the Philippine equity market and the international equity markets by dividing our overall sample period into pre- and post-liberalization subperiods. Given that capital market liberalization promotes equity market integration, we expect to find stronger evidence of transmission of stock market movements between the equity market of the Philippines and its major economic partners in the post-liberalization subperiod.

Finally, we present our overall findings and conclusion in Chapter 6.

The contribution of our study is three-fold. Foremost, our study represents the first comprehensive investigation of the impact of domestic capital market liberalization on the Philippine equity market. Second, our study provides additional evidence on overseas investor response to domestic capital market liberalization as well as further evidence on the implications of capital market liberalization on international equity market integration and the international transmission of stock market movements. Lastly, our study employs state-of-the-art econometric methodology which incorporates (a) a multivariate approach, (b) time-varying first and second moments, (c) error-correction mechanism, and (d) impulse response analysis of conditional volatility.

Table 1.1: Philippine Stock Market Capitalization, Total Trading Value and Market Turnover

Year	Market Capitalization (US$ million)	Market Capitalization Growth Rate (%)	Trading Value (US$ million)	Trading Value Growth Rate (%)
1980	3,478		619	
1981	1,738	-50.0	163	-73.7
1982	1,981	14.0	142	-12.9
1983	1,389	-29.9	483	240.1
1984	834	-40.0	125	-74.1
1985	669	-19.8	111	-11.2
1986	2,008	200.1	563	407.2
1987	2,948	46.8	1,524	170.7
1988	4,280	45.2	875	-42.6
1989	11,965	179.6	2,410	175.4
1990	5,927	-50.5	1,216	-49.5
1991	10,197	72.0	1,506	23.8
1992	13,794	35.3	3,104	106.1
1993	40,327	192.4	6,785	118.6
1994	55,519	37.7	13,949	105.6
1995	58,859	6.0	14,727	5.6

Source: International Finance Corporation Emerging Stock Markets Factbook, 1990 and 1996

Notes

1. Sections 1.1 and 1.2 of this chapter draws on the Asia Pacific Securities Handbook 1994-1995, Department of Trade and Industry (1992), Directory of World Stock Exchanges (1988), Ernst & Young (1995), Euromoney (1994, 1995, 1996), General Agreement on Tariffs and Trade (1993), International Monetary Fund (1980-1996), International Finance Corporation (1988-1996), Philippine Stock Exchange (1994), Portable Encyclopedia for Doing Business in the Philippines (1996), Republic Act No. 7042 (1991), Rodrigo (1993), Teh and Uy-Tioco (1995), Unite (1995) and Wall Street Journal (various issues).

2. As of December 1995, total market capitalization of these markets are as follows: Thailand - US$141.507 billion; Singapore — US$148.004 billion; and, Malaysia — US$222.729 billion (International Finance Corporation, 1996).

3. List A: areas reserved for Philippine nationals by constitutional mandate and by specific such as mass media and retail trade; List B: activities and enterprises regulated pursuant to law, i.e. defense-related activities, activities detrimental to public morals and health, etc., and List C: sectors in which existing enterprises already adequately serve the needs of the economy and the consumers such as ownership, operation and management of cockpit and cock-fighting activities, import and wholesale activities not integrated with production or manufacture of goods, services requiring a license or specific authorization and subject to regulation by relevant government agencies other than the Board of Investment and Securities and Exchange Commission, etc. (see Republic Act 7042: Foreign Investments Act of 1991).

4. It should be noted, however, that implementation of reforms aimed at trade liberalization and tariff reduction, including the removal of quantitative restrictions on imports and abolition of all export taxes, have been initiated since 1981. Interest rates were also liberalized beginning in 1981. The interest rate liberalization program was completed in 1983 with the lifting of interest rate ceiling on short-term loans. (See Alburo, Bobel, Intal, Hooley, Medalla and Taylor, 1991; and, Vos and Yap, 1996).

5. Foreign portfolio capital includes international placement of bonds, issues of equities in international markets, direct purchases by foreigners of domestic bonds and equities (International Monetary Fund, 1977).

6. We shall refer to the term financial capital market integration simply as capital market integration throughout this chapter and in the succeeding chapters.

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Chapter 2

Capital Market Liberalization and Philippine Equity Market Integration with International Equity Markets

2.1. Purpose of the Study

Given the recent developments in the liberalization and internationalization of the Philippine capital market, it is important to re-examine the issue of Philippine equity market integration with the international equity markets. In particular, this study will investigate the impact of the domestic capital market liberalization on the degree of integration of the equity market of the Philippines with those of its top sources of foreign investments and major trading partners in the Asia-Pacific region, namely, Taiwan, Japan, Hong Kong, Singapore and the United States.

One notion of capital market integration is as follows. Capital markets are fully integrated when financial assets with the same risk but traded in different markets have identical expected returns in some common currency.[1] However, it is possible that the degree of integration of a particular market may not be complete because of the presence of barriers to international capital flows. The degree of integration depends upon factors which determine the ease of arbitrage or cross-border trades in financial assets across international markets. This is because the barriers, if substantial and effective, can prevent cross-border arbitrage activities that eliminate any excess return relative to the equilibrium return dictated by some common global factor. Consequently, financial assets in these markets can have different expected returns even when their risk characteristics are the same. Also, there is a greater likelihood of transmission of market turbulence from one country to another if international capital markets are integrated. Intuitively, if international capital markets are integrated, the resultant ease of internationally diversifying an investor's portfolio reduces the sensitivity of the portfolio's return to local events. That is, unfavorable news in one country may be neutralized by positive news in another country. However, if markets are segmented, the investor's portfolio may be significantly more sensitive to local information than global information and as such required returns can be different across markets. In this study, we attempt to find evidence on the degree of integration of the Philippine capital market and international capital markets using national equity markets data; i.e, equity market integration.

Bekaert (1995) distinguishes among three types of barriers that can affect the degree of equity market integration. The first group is comprised of direct restrictions on foreign ownership as well as foreign exchange and capital controls. The second group includes indirect barriers related to the regulatory and accounting environment such as lack of information on these markets and on the health of the companies, the inefficiency and slowness of settlement systems, poor accounting standards, and the fear of expropriation due to minimal investor protection. The third group consists of barriers arising from market-specific risks that discourage foreign investment including liquidity risk, political risk, macroeconomic instability, and currency risk. However, Bekaert argues that the presence of country funds and/or cross-listed securities might promote equity market integration despite the existence of severe restrictions on direct foreign equity ownership.

The lowering of international investment barriers due to liberalization of direct and indirect impediments to foreign investor participation in the Philippine equity market, as documented in Chapter 1, lead us to infer that the linkage and resultant integration of the Philippine equity market with international equity markets has increased. However, because of remaining barriers to international investment, there is reason to believe that it is not fully integrated with the world capital markets.

2.1.1. Previous Research

Recent literature examining the issue of capital market integration have focused on developing or emerging country equity markets. Indeed, there are studies which provide evidence that the Philippine equity market as well as a number of developing countries which have liberalized their equity markets have become integrated with the global capital market. The existing literature that has investigated the degree of integration of the Philippine stock market with international stock markets can be classified into two categories. The first group examines equity market integration assuming an underlying asset pricing model. The second category of studies investigates the degree of integration based on correlations.

Asset Model Integration Studies

Buckberg (1995), using monthly U.S. dollar stock market index excess return data obtained from the International Finance Corporation (IFC)-constructed emerging stock market indexes for the period 1985 to 1991, investigates the extent of integration of twenty emerging stock markets into the global financial market via tests of a conditional International Capital Asset Pricing Model (ICAPM) with time-varying expected returns and constant conditional proportionality (beta). The ICAPM posits that if emerging markets are part of a global market, then each market's expected returns should be proportional to that market's covariance with the world portfolio. In her study, she uses the world market portfolio index constructed by Morgan Stanley Capital International (MSCI) as proxy. Among other things, Buckberg finds that the estimated beta with the world portfolio for the Philippines (2.812) is not only statistically different from zero but is also one of the largest. More importantly, the results of the (chi-squared) tests of the conditional ICAPM revealed that the model cannot be rejected in 18 of the 20 emerging markets in her sample. The model cannot be rejected for the Philippines at the 1 percent level. She concludes that these markets were integrated into the global capital market during the period 1985 to 1991. Moreover, since only two of the emerging markets banned or severely restricted foreign investment during part of this period, Buckberg conjectures that rising capital flows from industrial economies was evidently the mechanism of integration. She also argues that the strong rejections of the model for 2 of the 20 countries (with 97 percent to 99 percent confidence) "confirm that the test indeed has the power necessary to discriminate between markets that do and do not reject the model". Furthermore, Buckberg investigated whether markets have become more integrated over time by testing the ICAPM on a ten-market sample for the period covering January 1977 to December 1984. However, the Philippines was not in the sample as data prior to 1985 was not available.

Note, however, that Buckberg's results depend on the validity of the implicit assumption that world markets are perfectly integrated and that the ICAPM is sufficient to explain the cross section of expected returns in both emerging and industrialized equity markets. Harvey (1995a) suspects that not all emerging markets are fully integrated into the world capital markets. He documents the varying degrees of direct and indirect barriers that confront foreign investors in the 20 emerging markets in Buckberg's sample. Based on the stylized facts, he concludes that the degree of integration varies across different countries. As such, he doubts whether any asset pricing model that assumes complete integration of capital markets would be able to completely explain the behavior of security prices in these emerging markets.

To illustrate his point, Harvey (1995b) tested a single-factor international asset pricing model with constant expected returns and risks, using monthly U.S. dollar return (not excess returns) data on the same 20 emerging stock market indices as constructed by IFC covering the period 1985 to 1992. The single factor he uses is the excess returns on a world market portfolio constructed by MSCI. Among his findings is that for the Philippines, the single-factor model cannot be rejected. However, while the estimate of the beta on the MSCI world market portfolio is significantly different from zero, the coefficient is less than one (0.77). Furthermore, the R^2 of the regression is quite low (0.09) suggesting that the model is inadequate in characterizing this market's returns. Taken together, the evidence indicates that the Philippine stock market is not well integrated into the global capital market. However, he finds evidence that the Philippine stock market's risk exposure to the world market portfolio changes over time. His estimates of a five-year rolling correlation measure of the local market return and the MSCI excess returns indicate that correlations increased progressively reaching 40 percent in the case of the Philippines. This suggests that this market may be becoming increasingly integrated. Overall, he finds that the model can be rejected for 13 out of the 20 emerging markets in his sample implying that these markets are segmented from the global economy. Harvey (1995b) concludes from his evidence that the single-factor model such as the world beta model which assumes complete integration is not sufficient to characterize expected returns in emerging markets.

Harvey (1995c) further explores the hypothesis that the emerging markets are not completely integrated into the global capital markets by examining the influence of local information and global information on the predictability of returns in emerging equity markets. The stock market index data and sample period are the same as in Harvey

(1995b), except that he uses monthly excess returns on the emerging markets' indexes. In the case of the Philippines, the results of separate bivariate linear regressions of the market's excess returns on the world information variables and on the set of information specific to the Philippine market reveal that both sets of information significantly influence the market's excess returns. Similarly, when local information is combined with the world information, the combined information significantly influences the Philippine market's excess returns. The results of the test of the null hypothesis of exclusion of the local information variables in the Philippine regression equation indicate that the null can be rejected at the 5 percent level of significance, suggesting that Philippine stock market returns are importantly influenced by local information. Moreover, the regression results indicate that the proportion of variance due to local information (0.512) is greater than the proportion of variance due to world information (0.427) suggesting that slightly more than one half of the predictable variance in this market's returns is induced by local information. In contrast, a similar study by Harvey (1991) finds that most of the variation in the developed country expected returns is being driven by global information variables. The evidence that the predictability in Philippine stock market returns is almost equally influenced by local information and global information suggests that the Philippine stock market is partially integrated with the world capital markets. The result is similar for most of the other emerging stock markets, except that the variation explained by local information are even greater in magnitude. Harvey concludes that these findings further puts into question the results of studies using any asset pricing model that assumes complete market integration.

Correlation Studies

On the other hand, Bekaert (1995) examines the degree of integration of nineteen emerging equity markets using an expected return-based correlation measure that does not assume an asset pricing model nor complete world capital market integration. Bekaert's approach is similar to the world latent factors model used by Campbell and Hamao (1992) in studying the long-term capital market integration of the U.S. and Japan. Monthly dollar index excess return data for 1985 to 1992 are based on the emerging stock market data base constructed by IFC for the period 1985 to 1992 while the stock market data on four industrialized countries were obtained from MSCI. In his study, the world factor is assumed to be captured by stock market and interest rate variables of the United States. Bekaert uses the fitted values of the regressions of monthly U.S. dollar excess index returns on two local instruments and three global instruments as estimates of expected returns. The correlation of the regression estimates of the expected returns in the United States and the emerging markets computed using a vector autoregressive framework is then used as the measure of market integration. Bekaert argues this correlation measure is an indicator of the common component in expected returns, and hence it indirectly measures market integration. He then interprets higher correlations as suggestive of higher degree of market integration

Among other things, Bekaert finds that the highest expected return correlations are observed for the industrialized country stock markets as would be expected given the higher degree of integration and the extent of cross-listing of securities between these markets and the U.S. market. Among the emerging markets, the Philippines exhibits one of the highest significant correlations (0.74), with the magnitude of the correlation being comparable with those of the industrialized markets. Overall, the null hypothesis of no correlation cannot be rejected at the 0.01 level. He concludes from his results that there must exist global news factors affecting these markets simultaneously. Moreover, he finds that the evidence suggests that these markets are integrated into the world market although the degree of integration varies across these markets. Bekaert further provides some evidence of a trend toward increasing integration of equity markets by estimating the correlations from an earlier sample (1976 to 1985). This inference was made based only on 13 countries where IFC and MSCI data were available for the earlier period. However, this does not include the Philippines as data was not available prior to 1985.

Although Bekaert's measure does not suffer from the pitfalls of tests of market integration that assume an equilibrium asset pricing model , he cites that one limitation of his measure of market integration is that it works as a perfect measure of integration only in a one-factor world with constant risk exposures. This is because if there were only one source of risk and markets were perfectly integrated, expected returns would be perfectly correlated. However, it is unlikely that only one risk factor explains all of the cross-section and time variation in equity returns. But then, Bekaert argues that it is equally unlikely that expected return correlations are low in perfectly integrated markets. Hence, high expected return correlations estimated based on his methodology may convey information, indirectly, about the degree of market integration. Another problem with Bekaert's approach is an implicit assumption that he makes in his estimation of the correlations of expected returns. He assumes that the VAR framework generates the expected returns correctly. Consequently, if there is measurement error in the resulting expected return estimates that is uncorrelated across the United States and emerging markets, the estimated correlations will overestimate the true degree of expected return correlation. In order to address these issues, Harvey and Bekaert (1995) examine the extent of emerging market integration using a pricing model which allows for time-varying market integration. They find that a number of emerging markets exhibit time-varying integration with some markets appearing more integrated than one might expect based on prior knowledge of investment restrictions. On the other hand they find that other markets appear segmented even though foreigners have relatively free access to their capital markets. However, the Philippine equity market is not in their sample of emerging markets, possibly owing to the lack of data required for their tests.

It should be noted that although the above studies indicate some evidence that the Philippine equity market has become integrated with the world capital market, the results appear to point out that the degree of integration is weak, i.e. the Philippine equity market is not fully integrated into the world market. Specifically, the results of these studies seem to point out the increase in the sensitivity of the returns on Philippine equities to global factors in the latter 1980s and early 1990s and that capital market liberalization reforms instituted during this period may have been partly responsible for this. However, stylized facts pointing to remaining barriers to international investment in the Philippines preclude us from concluding that the integration is complete.

2.1.2. Scope and Limitations of the Study

In order to avoid the problems and the difficulties of measuring equity market integration that were encountered in the previous studies, we instead utilize a notion of integration that does not necessitate an asset pricing model nor assumes complete world market integration for its empirical implementation and testing. This concept of integration involves investigating whether there exists a long-run equilibrium relationship among international stock markets that is reflected in long-run common movement among the levels of the each country's stock market indexes (not returns). In turn, this long-run relationship is given by the cointegration properties of the national stock market price indexes. Under this concept, finding a cointegration relationship among the national stock market indexes is taken to be suggestive of market integration. A detailed explanation of this measure of market integration is provided in the following section.

While the subset of international markets included in our study is smaller compared to the previous studies, it is more defined in the sense that it considers only the countries with which the Philippines has close political and economic ties and which are geographically proximal. For example, all of these economies are members of the Asia Pacific Economic Cooperation (APEC), the Philippines and Singapore are both members of the Association of Southeast Asian Nations (ASEAN), Hong Kong, Singapore and Japan are the major financial centers in Asia, and, Hong Kong, Singapore and Taiwan are three of the four Newly Industrializing Economies (NIEs) in Asia. The United States, Japan, Hong Kong and Singapore have relatively more open, developed and mature equity markets. Although Taiwan still has a restrictive foreign investment policy regime, it has embarked on some reforms aimed at opening up its domestic equity markets to foreign investors since the latter part of the 1980s and it is one of the Asia-Pacific region's fastest growing stock markets in terms of market capitalization and turnover.[2] Thus, it may be reasonable to expect stronger results, either in favor of or against the hypothesis about the extent of Philippine equity market integration. However, we wish to emphasize at the outset that the conclusions reached in this study are confined to the stock markets in the sample. For example, a finding that the Philippine stock market index is not integrated with the other five international stock markets does not imply that the other stock markets are not integrated into the world market in general.

Unlike the previous works, our paper utilizes market data that cover a longer span of time, January 1980 to December 1995. To our knowledge, this is the first study which examines the extent of Philippine equity market integration utilizing data after 1992. The previous studies' empirical evidence on the degree of integration of the Philippine equity market into the global market has been inferred from monthly returns data covering a relatively short period of time, from 1985 to 1992. As discussed in Chapter 1, further opening up of the market occurred after 1992 and the impact of this is not reflected in their results. Moreover, since data prior to 1985 was not available for the Philippines in these studies, not much can be said about the impact of liberalization on the degree of Philippine equity market integration. This issue will be addressed in this paper by investigating the impact of the removal and/or relaxation of capital controls in the Philippines on the degree of integration of the domestic stock market with the other five international stock markets in the sample.

2.1.3. Theoretical Framework: Cointegration and Equity Market Integration

A conventional measure of the degree of integration among international stock markets is the simple cross-country correlation of stock market index returns. Under this approach, an increase in return correlation is interpreted as evidence of an increase in the degree of market integration as well as an indicator of a reduction in the benefits to international diversification. Aside from this economic rationale, there is also a statistical motivation for the use of returns. A source of nonstationarity of equity prices is that the series contains a unit root (or stochastic trend). A statistical implication of a unit root in the series is that most of the distribution moments are undefined. Consequently, the conventional hypothesis tests cannot be performed. Given that the stock prices series has a single unit root, then first differencing can render the series stationary. Thus, providing another reason for the use of returns or first difference of the (natural log) of stock prices.[3] However, long-run information on the interrelationship of the international stock markets that are reflected in the price levels is lost by differencing. This is because return correlations are influenced by both independent short-run trading noises as well as by long-run fundamental relationships among the markets which are induced by their internationalization and liberalization. Consequently, the short-run noise can possibly make the markets appear more independent than they truly are.

However, econometric developments now enable us to determine whether or not a long-run statistical relationship among nonstationary variables exists. In particular, it is now possible to examine the hypothesis of a long-run relationship among levels of national stock market indexes based on the concepts of cointegration and its relationship to error correction as introduced by Engle and Granger (1987). The intuition behind their concept is as follows. If two national stock market indexes each follow a stochastic trend over time, then in general they will wander apart. However, cointegration means that the two nonstationary indexes are tied together by some long-run equilibrium relationship, and thus, they cannot drift apart indefinitely. This in turn implies that the deviations from their equilibrium relationship must be stationary; i.e. the deviations have bounded fluctuations about a fixed level. Mathematically, the long-run equilibrium relationship is given by some linear combination of the two nonstationary variables such that the combination of the two nonstationary series is stationary. If this were the case, then, following Engle and Granger (1987), the two national stock market indexes are said to be cointegrated.

Since it is possible that two stock markets have a long-run relationship with other stock markets as well, then the equilibrium relationship must involve several stock market indexes. If a long-run relationship among these nonstationary price series truly exists, then, the (stationary) deviation from the long-run relationship can only be constructed from a combination of the stock market indexes involved. This is known as multivariate cointegration.

In this study, a finding of a cointegrating relationship among the Philippine stock market index and the national stock market indexes of Taiwan, Japan, Hong Kong, Singapore and the U.S. is interpreted as evidence that these equity markets are integrated. This is because cointegration of national stock market indexes implies that a long-run equilibrium relationship exists among these indexes. In turn, the long-run equilibrium relationship drives the national stock market indexes to move together in the long-run even if they don't in the short-run and even if these indexes are individually nonstationary. Given that long-run co-movement of stock market prices of these countries is suggestive of equity market integration, then cointegration implies market integration. This reasoning is similar to that used by Campbell and Hamao (1992) and Bekaert (1995) except that they conjecture on the co-movements in expected returns instead of co-movements in the levels of the stock market indexes.

It seems reasonable to infer that a finding of common movement in prices suggests integration. Common movement in prices possibly arises from the response of each country to some economic force, perhaps a common world growth factor, which systematically affects the equilibrium prices of the stocks of the different countries. On the other hand, the strength of the co-movement depends on the degree of openness of the international capital markets. This is because the factors that promote market integration, such as liberalization of capital markets and the globalization of securities, also promote international capital mobility. Ripley (1973) argues that, with freer capital mobility, capital flows will tend to reduce interest rate differentials between countries by increasing the supply of capital in the country with the high interest rate, and reducing it in the country with the low interest rate. Given that stock prices are affected by interest rate movements, assuming that the present value model of stock prices holds, the equalization of national interest rates via the interest rate parity condition will result in co-movement between national stock price indexes.

Following Taylor and Tonks (1989), let S_{it} and S_{jt} be the (natural) logarithm of the stock market price indexes of country i and country j at time t, respectively. Suppose that the stock market price indexes of countries i and j are perfectly correlated in the long-run. This implies a linear relationship between S_{it} and S_{jt}, i.e., $S_{it} = a + bS_{jt}$ for some scalars a and b. However, this relationship may be distorted in the short-run by the joint effect of country-specific factors, given by the stationary disturbance e_t; i.e., $S_{it} = a + bS_{jt} + e_t$. By translating the stock market price indexes into short-run stock market returns, the noise in the system is probably increased.[4] Consequently, even though a long-run relationship exists between the levels of the stock market price indexes, only a weak degree of return correlation may be statistically observed. Therefore, using co-movements of short-term (expected) returns on the national stock market indexes, instead of co-movements of the levels of these indexes, may understate the true degree of integration of these national stock markets.

Additionally, because liberalization and globalization of securities can facilitate cross-country investing or arbitrage activities, then the increased participation of foreigners in domestic equity markets can potentially strengthen the linkage between local and foreign markets and cause international stock prices to move together. For example, negative events in foreign countries can affect stock prices in these countries and therefore the liquidity of investors residing in these countries. Consequently, this affects the relative returns of these foreign investors' investment in other countries and induce them to adjust their portfolios. When foreign investors own a substantial proportion of the tradable stocks in the domestic equity markets, then their transactions can significantly influence the domestic equity prices and thus cause co-movements in the stock prices of the foreign and domestic markets. Additionally, it can be the case that domestic investors have no information on why the foreign investors are adjusting their portfolios and so domestic investors will tend to react to such changes. Such reactions can amplify the effect of foreign disturbance on the domestic equity market and thus give rise to co-movement in the foreign and domestic stock markets' prices.

However, a weakness of cointegration as a measure of equity market integration is that the underlying co-movement of stock prices in different countries may be due to factors other than those which facilitate the cross-country investing or arbitrage activities. That is, there are may be some forces which make stock prices in different countries positively correlated even if there are no international financial transactions. Likewise, national stock markets could be segmented but subject to common shocks that move stock prices in these countries in similar fashion. For example, Ripley (1973) cites that "countries whose incomes move in similar manner may have stock prices that also move together." This is because movements in income affect expectations about future economic developments and affect investors' abilities to purchase equities. Thus, similar movement in incomes may result in an indirect link between the stock prices in the two countries even if no foreigner can buy stocks in either country.

Furthermore, there has been recent debate on the implication of cointegration on financial market efficiency. The controversy arises from the error-correction mechanism implied by cointegration and the claim that stock price changes should not be predictable in an efficient market. Note that, following Engle and Granger (1987), if two national stock market indexes are cointegrated, then the relationship between these two variables can be instead expressed in terms of an error-correction model (ECM). An ECM for these stock market indexes relates the changes in the variables to lagged changes in both variables and a lagged linear combination of the levels. The linear combination of levels which enters the ECM is just that combination which is stationary in levels. The ECM can be thought of as the process by which the variables in the system being analyzed respond to the long-run equilibrium error in order to eliminate it. However, this implies that the stock market price changes of at least one of the stock market indexes are predictable from the previous period's linear combination of the two indexes. This is contradictory to the semi-strong form efficient markets hypothesis with constant expectations.

For example, Richards (1995) argues that if markets are efficient, then national stock market indexes cannot be cointegrated. He shows this by imposing the cointegration condition on the stock market indexes of two countries (assumed to contain a unit root) and then assumes that excess returns on the stock market indexes are generated by the CAPM with time-varying risk. However, it is possible that the results of Richards are driven by his assumption of CAPM as the underlying asset pricing model. It is well known that any test of market efficiency is a joint test of the underlying equilibrium asset pricing model and market efficiency. Bossaerts (1988), for example, demonstrates that asset prices can be cointegrated in an economy where a representative agent is governed by rational expectations. He shows that in such an economy, asset returns are predictable, yet each agent is behaving optimally. Furthermore, Dwyer and Wallace (1992), using absence of arbitrage profits as a definition of market efficiency instead of unpredictability of returns, show that there is no general equivalence between market inefficiency and cointegration, or for that matter, a lack of cointegration. That is, the absence of cointegration is neither necessary nor sufficient for market efficiency when efficiency is not defined by the lack of predictability but by the absence of arbitrage profits, i.e., when one cannot realize abnormal profits from the forecast. They illustrate this by using different models and their analysis shows that different models give rise to different implications and that either finding cointegration or a failure to find it can be consistent with market efficiency. A similar argument is used by Baffes (1994) in the case of currency markets. He shows that cointegration between exchange rates does not necessarily imply market inefficiency since market efficiency does not rule out predictable exchange rate movements, but only rules out arbitrage opportunities from predictable exchange rate movements.

2.2 DATA

The empirical analysis in this paper is based on monthly data on national stock market price indexes of the Philippines, Japan, Hong Kong, Singapore, Taiwan and the United States covering the period January 1980 to December 1995. The following value-weighted indexes are used: Philippine Stock Exchange Commercial and Industrial Index (Philippines), Tokyo Stock Exchange Price Index (Japan), Hang Seng Index (Hong Kong), Stock Exchange of Singapore All-Shares Index (Singapore), the Taiwan Stock Exchange Weighted Price Index (Taiwan), and the Standard & Poors' 500 Index (United States).[5] All of these indexes are denominated in local currency. Foreign exchange rate data were collected for the Asian countries in order to transform the local stock market price index series into prices denominated in U.S. dollars. All analysis in this study is based on the natural logarithm of the stock market price indexes in U.S. dollars, denoted PHL (for the Philippines), TWN (for Taiwan), JPN (for Japan), HK (for Hong Kong), SIN (for Singapore) and US (for the United States). The stock market price indexes data are month-end values and exchange rate data are month-end market mid-point rates. Appendix A shows the sources of the data for the various countries in the sample.

Month-end stock price index data are used in order to reduce the possible biases arising from infrequent trading and nonsynchronous trading of some of the component stocks of the stock market index as well as day-of-the-week effects. Such biases may be more pronounced when daily or weekly data are used (Lo and MacKinlay, 1988). Shiller and Perron (1985) and Perron (1991) point out that the power of unit root tests and cointegration tests is mainly a function of the span of the data (i.e., length of time period) and only slightly depends on the number of observations. More specifically, they show that for a given span, additional observations obtained by increasing the frequency of the data (e.g., moving from monthly to weekly or daily) increases the power of the test only marginally, with the rate of increase declining as the sampling interval is decreased. In addition, Hakkio and Rush (1991) stress that since cointegration is essentially a long-run concept, then, it requires long spans of data to give the tests for cointegration much power. They showed that increasing the sampling frequency without increasing the length of the span yields little additional information when testing whether two series are cointegrated, but that the converse is true when the span of the data is increased using the same sampling frequency.

U.S. dollar-denominated stock market price indexes are used not just to make the indexes directly comparable but in order to account for exchange rate fluctuations or risk. Apart from the local stock market returns, exchange rate risk is also important for overseas investors who wish to diversify internationally since they have to transact through the exchange rate mechanism both at the point of time they purchase foreign securities and at the point of time that they sell these same securities. Moreover, we adjust for exchange rate fluctuations since exchange rate fluctuations possibly reflects the impact of reforms aimed at liberalizing foreign exchange regulations, which in turn contribute to capital market integration. Also, the results of this study can be directly compared with the previous studies which have used U.S. dollar-denominated data in examining the degree of integration of the Philippine equity market with the world capital market.

2.3. METHODOLOGY

2.3.1. Cointegration Tests

In this study, we use the maximum likelihood estimation procedure based on Johansen (1988, 1991) and Johansen and Juselius (1990) in testing for cointegration and estimating cointegration relationships among the six national stock market indexes.[6] Cheung and Lai (1993) and Gonzalo (1994) show that this procedure has good finite sample properties. We will refer to this approach simply as the Johansen procedure in the remainder of the text.

Johansen's procedure examines cointegration based on the technique of reduced rank regression in the vector autoregressive (VAR) framework. Let $\mathbf{S}_t$ be the $(n\mathrm{x}1)$ vector system of the (natural logarithm) national stock market price indices in levels, $(S_{1t}, S_{2t}, \ldots, S_{nt})'$, where each national stock market price index is possibly nonstationary. The maintained assumption in this approach is that the vector system, $\mathbf{S}_t$, is generated by a VAR(j) in levels with j lags being sufficient to summarize all the dynamic correlations between the elements of the vector system. That is,

$$\mathbf{S}_t = \boldsymbol{\mu} + \boldsymbol{\Pi}_1\mathbf{S}_{t-1} + \boldsymbol{\Pi}_2\mathbf{S}_{t-2} + \ldots + \boldsymbol{\Pi}_j\mathbf{S}_{t-j} + \boldsymbol{\varepsilon}_t \qquad (1)$$

where $\boldsymbol{\mu}$ is an $(n\mathrm{x}1)$ vector of constants or drift terms, the $(n\mathrm{x}n)$ matrix $\boldsymbol{\Pi}_k$ represents the matrix of autoregressive coefficients for k=1,2,...j, and the innovation sequence is assumed to be an i.i.d. Gaussian process, i.e. $\boldsymbol{\varepsilon}_t \overset{iid}{\sim} \mathcal{N}(\mathbf{0},\boldsymbol{\Omega})$.

Johansen (1988) and Johansen and Juselius (1990) show that, without loss of generality, any VAR of the form given by Equation (1) can be written as

$$\Delta\mathbf{S}_t = \boldsymbol{\Gamma}_1\Delta\mathbf{S}_{t-1} + \boldsymbol{\Gamma}_2\Delta\mathbf{S}_{t-2} + \ldots + \boldsymbol{\Gamma}_{j-1}\Delta\mathbf{S}_{t-j+1} + \boldsymbol{\mu} + \boldsymbol{\Pi}\mathbf{S}_{t-1} + \boldsymbol{\varepsilon}_t, \quad t=1,2,\ldots,T. \qquad (2)$$

where, Δ is the difference operator, T is the number of observations per variable exclusive of the lags. $\boldsymbol{\Pi}$ is an $(n\mathrm{x}n)$ matrix of coefficients with $\boldsymbol{\Pi} \equiv -(\mathbf{I}_N - \boldsymbol{\Pi}_1 - \boldsymbol{\Pi}_2 - \ldots - \boldsymbol{\Pi}_j) = -\boldsymbol{\Gamma}(1)$, $\boldsymbol{\Gamma}(1)$ is the autoregressive matrix polynomial $\boldsymbol{\Gamma}(L) = \mathbf{I}_N - \boldsymbol{\Gamma}_1 L - \boldsymbol{\Gamma}_2 L^2 - \ldots - \boldsymbol{\Gamma}_j L^j$ evaluated at L=1 where L is the lag operator, and the $(n\mathrm{x}n)$ matrices $\boldsymbol{\Gamma}_s \equiv -[\boldsymbol{\Gamma}_{s+1} + \boldsymbol{\Gamma}_{s+2} + \ldots + \boldsymbol{\Gamma}_j]$, for s=1,2,...j-1, of unknown parameters.[7]

Equation (2) is just the traditional VAR in first differences except for the term $\boldsymbol{\Pi}\mathbf{S}_{t-1}$. Within this parameterization, the short-run dynamics are described by the matrices $\boldsymbol{\Gamma}_s$ while all the information on the long-run relationships or cointegrating vectors among the n national stock market price indexes in the vector system $\mathbf{S}_t$ is given by the so-called long-run impact matrix $\boldsymbol{\Pi}$. In this study, the appropriate lag order, j, will be determined using a sequential likelihood ratio statistic with an adjustment for small sample bias (see J. Hamilton, 1994, p. 297), while ensuring that the residuals are uncorrelated.[8]

Johansen's procedure is essentially one that finds the rank of the matrix $\boldsymbol{\Pi}$. Johansen shows that the hypothesis of cointegration can be formulated as the hypothesis of reduced rank of the matrix $\boldsymbol{\Pi}$. Specifically, Johansen shows that the number of distinct cointegrating vectors or stationary relationships which exists among the variables of the vector system $\mathbf{S}_t$, will be given by the rank of the matrix $\boldsymbol{\Pi}$, r. There are three possible cases:

(1) If r=0, then the vector system $\mathbf{S}_t$ is fully nonstationary. In this case the elements in the vector system $\mathbf{S}_t$ are not cointegrated and thus there is no long-run relationship among the six national stock market price indexes. If this were the case, then the traditional VAR in differences (Equation (2) without the term $\boldsymbol{\Pi}\mathbf{S}_{t-1}$) is well-specified.

(2) If $r=n$, then the vector system $\mathbf{S}_t$ is fully stationary. This is the case when each series in the vector system is stationary.

(3) If the $0<r<n$, then there will be only r linear combinations of $\mathbf{S}_t$ that are stationary and thus there are r cointegrating relationships among the six national stock market indexes. In this case, there exists an n x r matrix $\boldsymbol{\alpha}$ such that $\boldsymbol{\Pi}=\boldsymbol{\alpha\beta}'$, where $\boldsymbol{\beta}$ is an n x r matrix of full rank r such that $\boldsymbol{\beta}'\mathbf{S}$ is stationary even though $\mathbf{S}_t$ is nonstationary. Therefore, the cointegrating relations $\boldsymbol{\beta}'\mathbf{S}_t$ can be interpreted as stationary relationships among the nonstationary levels of the variables. The r columns of matrix $\boldsymbol{\beta}$ are the cointegrating vectors $(\mathbf{b}_1, \mathbf{b}_2, \ldots, \mathbf{b}_r)$, which contain information on the equilibrium relationships that dictate the long-run movement of the variables in the system $\mathbf{S}_t$.

Given that r cointegrating relationships are found among the variables in $\mathbf{S}_t$, Equation (2) can be considered as a vector error-correction model and can be written as

$$\Delta\mathbf{S}_t = \boldsymbol{\Gamma}_1\Delta\mathbf{S}_{t-1} + \boldsymbol{\Gamma}_2\Delta\mathbf{S}_{t-2} + \ldots + \boldsymbol{\Gamma}_{j-1}\Delta\mathbf{S}_{t-j+1} + \boldsymbol{\mu} + \boldsymbol{\alpha\beta}'\mathbf{S}_{t-1} + \boldsymbol{\varepsilon}_t, \quad t=1,2,\ldots,T \tag{3}$$

or

$$\Delta\mathbf{S}_t = \boldsymbol{\Gamma}_1\Delta\mathbf{S}_{t-1} + \boldsymbol{\Gamma}_2\Delta\mathbf{S}_{t-2} + \ldots + \boldsymbol{\Gamma}_{j-1}\Delta\mathbf{S}_{t-j+1} + \boldsymbol{\mu} + \boldsymbol{\alpha}\mathbf{z}_{t-1} + \boldsymbol{\varepsilon}_t, \quad t=1,2,\ldots,T. \tag{4}$$

In Equation (4), if $\mathbf{z}_{t-1}=\boldsymbol{\beta}'\mathbf{S}_{t-1}\neq\mathbf{0}$, then, it is interpreted as the long-run equilibrium error that describes the short-run deviations of the variables from the r distinct stationary or long-run equilibrium relationships.[9] The $(n\mathrm{x}r)$ coefficients in the matrix $\boldsymbol{\alpha}=(\mathbf{a}_1, \mathbf{a}_2, \ldots, \mathbf{a}_r)$ can be interpreted as the average rate of reversion or speed of adjustment of the variables in the vector system toward the long-run equilibrium relationships underlying the cointegrating vectors. These coefficients measure the current period's correction of the last period's deviation in order to maintain the long-run equilibrium relationship. A low magnitude indicates slow adjustment while a large coefficient indicates rapid adjustment.[10] The intuition behind the error correction equations is that if the six stock market price indexes in the vector system are cointegrated, then the short-run changes in each country's stock market prices are due to the effects of the lagged changes in own and other countries' stock market prices, the previous period's equilibrium error, and random factors. The last period's equilibrium error enters the error-correction equations to capture the effect of short-term deviations from the long-run equilibrium. As such, the error-correction equations can be interpreted as the process by which the national stock market indexes in the cointegrated system respond to the long-run equilibrium error in order to eliminate it.

Johansen and Juselius (1990), Dickey et al. (1991) and DeFusco et al. (1996) suggest that the results of cointegration test are stronger and more robust if more than one significant cointegrating vector is found. For example, DeFusco et al. (1996) argue that cointegrating vectors can be conceptually interpreted as constraints that an economic system imposes on the movement of the variables in the long run. Thus, for an n-variable system, if there is only one cointegrating vector (or n-1 unit roots), then the system can deviate in n-1 independent directions and is stable in only one direction (i.e. there is only one direction where the variance is finite).

This study will employ two alternative likelihood ratio tests of cointegration suggested by Johansen (1988) and Johansen and Juselius (1990). The first is the *trace test statistic* which tests the null hypothesis that there are at most r cointegrating relationships against the general alternative that there are n cointegrating relationships. An alternative likelihood ratio test statistic is the *maximum eigenvalue test statistic* , which tests the null hypothesis of r cointegrating relations against the alternative of at most r+1 cointegrating relations. A description of these tests is provided in Appendix B1.

In this study, a finding of a cointegrating relationship among the Philippine stock market index and the national stock market indexes of Taiwan, Japan, Hong Kong, Singapore and the U.S. is interpreted as evidence that these equity markets are integrated.

2.3.2. Pre- and Post-Liberalization Subsample Analysis

Since liberalization of the domestic capital market helps promote its integration with other international stock markets, we expect *a priori* that the Philippine stock market will be more integrated in the post-liberalization period than the period prior to its market opening. Given that cointegration suggests integration, the change in the degree of integration of the Philippine stock market can be examined by comparing the number of cointegrating relationships or vectors in subsample periods. Because various policy changes and events relating to the internationalization and liberalization of the Philippine market came into effect during the period January 1980 to December 1995, it is quite difficult to pinpoint an exact date for the regime shift. However, Buckberg (1995), De Santis and Imrohoroglu (1995), and Kim and Singal (1993) identify October 1989 as the *initial* equity market opening up date for the Philippines. On this date, the first closed-end country fund devoted to Philippine securities was admitted in London's stock exchange. Henceforth, more major reforms to open up the domestic capital market have been implemented by the Philippine government as discussed in Chapter 1. As such, changes in the degree of integration of the Philippine stock market into the five other international stock markets will be investigated by examining the changes in the number of cointegrating relationships between two subsample periods: the pre-liberalization subsample covering January 1980 to September 1989 and the post-liberalization subsample covering the period October 1989 to December 1995. A finding of more cointegrating vectors in the second subsample is then taken as an indication that the Philippine stock market has become more integrated with the other five international stock markets.

The approach used here is similar to that of Chou, Ng and Pi (1994) except that in this study, the break in the overall sample is determined solely by events relating to one stock market. However, there are limitations that make this approach imprecise.

First, it is difficult to isolate the impact of liberalization because there may be other confounding events that can potentially contribute to a change in the degree of integration, if ever there is one. Therefore, we cannot attribute any observed change solely to market opening. Secondly, cointegration is a long-run property of the data. Since the process of liberalization in the Philippine capital market since 1989 has been gradual and consequently the impact of liberalization may take time, the results obtained from a relatively limited post-liberalization subsample may not be entirely conclusive. Thirdly, recent studies have suggested that inferences based on the asymptotic critical values may be misleading in small samples. Cheung and Lai (1993), using Monte Carlo simulations, find that Johansen's cointegration tests are biased toward finding cointegration more often than what asymptotic theory suggests. Similarly, Gregory (1994) shows that for small samples and a high number of explanatory variables, the test size (frequency of rejecting the null hypothesis of no cointegration when it is true) of Johansen's cointegration tests is significantly higher than the test size of cointegration tests based on other methods. Specifically, he finds that as the VAR sample size (T) falls, or the number of variables (n) or lags (j) in the system increases, the tests are biased toward finding cointegration more often when the asymptotic critical values are used. As such, they suggested that the asymptotic critical values be adjusted upward. One adjustment method proposed by Reinsel and Ahn (1988, 1992) involves multiplying Johansen's test statistics by a scaling factor given by $(T-nj)/T$ and to compare these adjusted values with their asymptotic critical values. Cheung and Lai (1993) show that an equivalent way is to multiply the asymptotic critical values by a scaling factor given by $T/(T-nj)$. Cheung and Lai (1993) indeed find that the finite-sample critical values obtained using the Reinsel and Ahn method are a very significant improvement over the asymptotic critical values of Johansen's tests. Since the time series of national stock market indexes in both pre- and post- liberalization subsample periods are not relatively long, the finite sample critical values using the adjustment factor suggested by Reinsel and Ahn (1988) will be used in order to minimize the potential small-sample bias.

However imprecise it may be, there seems to be some valid reason to believe that this approach should be able to capture possible significant change in the long-run equilibrium relationship of the Philippine stock market with the other international stock markets. This is because the markets of the United States, Hong Kong, Singapore and Japan have been relatively more open during the entire sample period.[11] On the other hand, despite the opening up of its equity market in January 1991 (see Buckberg, 1995); and, Kim and Singal 1993), access to Taiwanese equity market for foreign investors remains heavily restricted (see, e.g., Euromoney, 1994 , 1995; and, International Society of Securities Administrators, 1994). Most importantly, the market opening event in October 1989 is not the sole event that increased the access of foreign investors into the Philippine domestic equity market. We want to emphasize at the outset that we are not claiming that this is the sole reason for the change in degree of Philippine equity market integration, should there be any. Given that more reforms to liberalize and internationalize the domestic capital market and to reduce the barriers to international capital flows have been implemented by the Philippine government beyond this date, we expect that these events can possibly have an impact on the degree of Philippine equity market integration as well.

2.3.3. Other Hypothesis Tests

Assuming that at least one cointegrating vector is found in the above analysis, the final step in Johansen's cointegration procedure involves the estimation of the error-correction equations given by Equation (3) or alternatively Equation (4), using the maximum likelihood method. A summary of the estimation procedure is provided in Appendix B2. Accordingly, it is possible to test the following hypotheses on the parameters of the estimated error-correction equations. Appendix B3 provides a description of the likelihood ratio test statistics used to test these hypotheses.

To illustrate these tests, consider the trivariate Philippine-Japan-US system with one cointegrating vector (r=1) and two lags (j=2). For this case, the error-correction equations for the stock market indexes of the Philippines (PHL), Japan (JPN) and the US are given by

$$\Delta S_{PHLt} = \Gamma_{11}\Delta S_{PHL,t-1} + \Gamma_{12}\Delta S_{JPN,t-1} + \Gamma_{13}\Delta S_{US,t-1} + \mu_{PHL} + \alpha_1\left(\beta_1 S_{PHL,t-1} + \beta_2 S_{JPN,t-1} + \beta_3 S_{US,t-1}\right) + \varepsilon_{PHLt}$$

$$\Delta S_{JPNt} = \Gamma_{21}\Delta S_{PHL,t-1} + \Gamma_{22}\Delta S_{JPN,t-1} + \Gamma_{23}\Delta S_{US,t-1} + \mu_{JPN} + \alpha_2\left(\beta_1 S_{PHL,t-1} + \beta_2 S_{JPN,t-1} + \beta_3 S_{US,t-1}\right) + \varepsilon_{JPNt} \qquad (5)$$

$$\Delta S_{USt} = \Gamma_{31}\Delta S_{PHL,t-1} + \Gamma_{32}\Delta S_{JPN,t-1} + \Gamma_{33}\Delta S_{US,t-1} + \mu_{US} + \alpha_3\left(\beta_1 S_{PHL,t-1} + \beta_2 S_{JPN,t-1} + \beta_3 S_{US,t-1}\right) + \varepsilon_{USt}$$

Test of the significance of the estimates of the short run parameters in the matrix Γ_i.

The elements of the matrix Γ_i, Γ_{sk}, summarize the short-run price dependence of the stocks traded in the national stock markets in the system. Each coefficient measures the impact on the short-run movements of a particular country's stock market index of lagged changes in own and other countries' stock market price indexes. For example, in the trivariate case above, Γ_{12} and Γ_{13} measure the impact of lagged changes in the stock market index of Japan and U.S. stock market index, respectively, on the current period's change in the Philippine stock market index. On the other hand, Γ_{11} measures own lagged changes on the current period's change in the Philippine stock market index. When the cross-price effects are found to be significant in a given country's error-correction equation, they indicate that the short run changes in a given country's stock market prices are influenced by independent or local information contained in the short-run changes in the stock prices of the other national stock markets. The statistical significance of each of the coefficients of the lagged first differences that appear in each error-correction equation can be tested using the conventional t-test.

Long-Run Exclusion Test: Test of significance of the coefficients of the cointegrating vectors in the matrix β.

As was mentioned above, the cointegrating vectors contain information on the equilibrium relationships that dictate the long-run movement of the national stock market indexes in the system. Although there is no straightforward interpretation of the coefficients of the cointegrating vectors, their relative magnitudes can shed light on the importance of each of the national stock market indexes in obtaining the underlying long-run equilibrium relationships.

Consider the trivariate case. A finding that β_1 is not significantly different from zero together with β_2 and β_3 being statistically significantly different from zero is interpreted as evidence that the Philippine national stock market index is not important in obtaining the long-run relationships underlying the cointegrating vector in the system and that only the Japanese and U.S. stock market indexes are needed to get the cointegration relationship. Alternatively, a zero cointegration coefficient for the Philippine stock market index implies that the long-run movements of this stock market index is not influenced by the equilibrium relationship underlying the cointegrating vector that was found and that this vector is simply picking up the bivariate cointegration relationship between the Japanese and U.S. stock market indexes. The significance of the cointegration coefficient corresponding to a given national stock market index is determined by testing the null hypothesis that the coefficient is not significantly different from zero using a likelihood ratio test.

Weak Exogeneity Test: Tests of restrictions on the adjustment speed coefficients in the matrix α.

As was previously mentioned, the error-correction term $\mathbf{z}_{t-1}$ describes the short-run deviations from the long-run equilibrium relationships underlying the significant cointegrating vectors while the coefficients in the matrix $\boldsymbol{\alpha}$ can be interpreted as the average rate of reversion or speed of adjustment of the national stock market indexes in the system toward the long-run equilibrium relationships.

Consider the trivariate example above. Suppose that all coefficients of the cointegrating vector are statistically significant and so $z_{t-1}=\beta_1 S_{PHL,t-1}+\beta_2 S_{JPN,t-1}+\beta_3 S_{US,t-1}$. Now, α_1 is the rate of reversion of the Philippine stock market index toward the equilibrium relationship governing the long-run movements of the stock market price indexes of the Philippines, Japan and the U.S. If α_1 is not statistically significantly different from zero, the Philippine stock market index is said to be weakly exogenous with respect to the cointegrating vector; i.e., the Philippine stock market index is not influenced by the information on the long-run relationship underlying the cointegrating vector. However, if α_1 is statistically significant, then this implies that short-run changes in the Philippine stock market index partly reflect error-correcting price adjustments that maintain the long-run equilibrium relationship among the three national stock market indexes. In the Johansen framework, the test of weak exogeneity, which is equivalent to the test of the null hypothesis that the coefficient of the error correction term $\mathbf{z}_{t-1}$ in a particular country's error correction equation is not significantly different from zero, is performed using a likelihood ratio test.

Another interpretation of a statistically significant α_1 is that current changes in the Philippine stock market price index are predictable from the previous period's linear combination of the three national stock market indexes, z_{t-1}. As was discussed in the theoretical framework, such predictability is not contradictory with market efficiency given that efficiency is defined by the absence of arbitrage profits. Moreover, Eckbo and Liu (1993) argue that predictability of returns is consistent with the general notion of market efficiency in a setting with time-varying expected returns. In a survey article, Fama (1991) argues that time-variation in expected returns may be a response to innovations which are common across different securities and markets. Among others, empirical studies by Keim and Stambaugh (1986), Fama and French (1989, 1990), Turtle (1991), Turtle, Buse and Korkie (1994), Whitelaw (1994), and Cheung et al. (1995) provide evidence of time-varying expected returns which are induced by predictable components of aggregate real economic activity. Along this line, it is therefore possible that the error-correction term, z_{t-1}, represents the changing market expectations.

2.4. EMPIRICAL RESULTS

2.4.1. Univariate Unit Root Tests

The initial condition for the system of stock market price index levels to be cointegrated is that each stock market price index series be nonstationary. For each country's stock market price index, we use the approaches of Dickey and Fuller (1979, 1981) [Augmented Dickey-Fuller Test (ADF)] and Phillips and Perron (1988) [Phillips-Perron Test (PP)] to test the null hypothesis that the series contains a single unit root. The ADF test assumes that the series follows an autoregressive process with Gaussian i.i.d. innovations. On the other hand, the PP test allows for a wide variety of heterogeneously distributed and weakly dependent disturbances which makes it is robust to the presence of both serial correlation and heteroscedasticity. The critical values of the test statistics of both approaches are, however, identical.

As mentioned above, both the ADF and PP tests are applied in this study. An examination of Figures C.1 through C.6 in Appendix C indicates that the national stock market indexes in the sample exhibit an upward trend. In addition, it is reasonable to expect the average stock market return to be positive. In order to account for the existence of trend and non-zero constant mean in each stock market index series and to properly embed the alternative hypothesis in the test equation, we follow the sequential unit root testing procedure described in Mills (1993, p. 58-59) for both the ADF and PP approaches. This procedure involves initially performing an F-test (labeled constant and trend) and then a t-test (labeled constant no trend).

Table 2.1 shows the results of the unit root tests conducted on the levels of the six national stock market indexes measured in U.S. dollars. The results of the ADF and PP tests which include both a constant and time trend suggest that for both subsamples and for all national stock market indexes, the null hypothesis of a unit root cannot be rejected at the 0.05 level of significance and that there is no evidence of a trend in the first difference series. Since quadratic trend is found to be insignificant, we then test the unit root null hypothesis against the alternative that the levels of a given stock market index is stationary around a linear trend. The results of the ADF and PP tests which include only a constant but no time trend indicate that the null of a unit root in the levels of all national stock market indexes cannot be rejected at the 0.05 level of significance in both subsample periods. Overall, these results suggest that, in both the pre-liberalization and post-liberalization subsample periods, all national stock market indexes are nonstationary.

2.4.2. Multivariate Cointegration Test Results

Given the preceding results, we then conducted Johansen's tests of cointegration for both subsamples. As an initial step, the unrestricted VAR in error-correction form (Equation (2)) was estimated for each subsample using various lag lengths j, beginning with a lag length of one. An unrestricted vector of constants was included in the estimation. Based on the sequential likelihood ratio test procedure, lag lengths of $j = 3$ for the pre-liberalization subsample and $j=2$ for the post-liberalization subsample were found to be sufficient. Table 2.2 summarizes the results of the multivariate and univariate diagnostic tests on the residuals of the estimated unrestricted VAR in error correction form for both subsamples.

For the pre-liberalization period, the results of the multivariate tests of autocorrelation indicate that for the entire system, the null hypotheses of zero first order autocorrelation and of zero fourth order autocorrelation cannot be rejected at the 0.05 level of significance. The evidence of serial correlation-free residuals are also found using the univariate Ljung-Box portmanteau test statistics. However, the multivariate normality test statistic indicates that for the entire system, the null hypothesis of normality can be rejected at the 0.05 level. Likewise, the univariate normality test statistic indicates that the null hypothesis of normality can be rejected at the 0.05 level of significance for each of the six equations. The magnitude and significance of the coefficients on skewness and excess kurtosis suggest that nonnormality of the residuals arises mainly because the innovations are leptokurtic. However, a study by Gonzalo (1994) finds that for cointegration analysis involving more than two variables, the Johansen procedure provides results that are more robust to various deviations from classical assumptions (e.g. nonnormality of errors due to skewness and excess kurtosis) than other methods of estimating cointegration relationships. [12]

For the post-liberalization subsample, both multivariate and univariate tests of the null hypothesis of no serial correlation, first order and higher orders, suggest that the residuals are free of serial correlation. The univariate normality tests suggest that the null hypothesis of normality cannot be rejected at the 0.05 level of significance for three of the six equations, including that for the Philippines. However, the multivariate test indicates that for the entire system, the null hypothesis of normality can be rejected at the 0.05 level of significance. Since all skewness coefficients are not significantly different from zero for each equation, the rejection of normality of the residuals for three of the six equations can be attributed to excess kurtosis. Overall, the error term diagnostic test results suggest that the deviations from the Gaussian i.i.d. innovations assumption underlying the Johansen procedure are less serious in the post-liberalization subsample than in the pre-liberalization. Therefore, we expect the distortions in the test size due to nonnormal innovations to be less serious in the second subsample.

The results of performing the Johansen's cointegration tests for the two subsamples are shown in Table 2.3. Based on both the trace and maximum eigenvalue test statistics, the null hypothesis of no cointegration cannot be rejected at the 0.05 level of significance for the pre-liberalization subsample.[13] In contrast, for the post-liberalization subsample, the null hypothesis of no cointegration is rejected at the 0.05 level of significance while the null hypothesis of at most 1 cointegration relationship is not rejected. The results for the post-liberalization subperiod point to the existence of one cointegrating vector. Considering that we have controlled for the small-sample bias in Johansen's cointegration tests and that the test size bias due to deviations from normality is possibly less serious in the second subsample, then, these results clearly indicate that there is one cointegration relation among the Philippine stock market index and the other five international stock market indexes during the period October 1989 to December 1995.

The results of the cointegration tests imply that the cointegration relation among the Philippine stock market index and those of the other five international stock markets has changed over the two subsample periods. In particular, these results are consistent with the Philippine stock market being cointegrated with the stock markets of Taiwan, Japan, Hong Kong, Singapore, and the United States after, but not before, October 1989. A detailed analysis of the cointegrating relationship should provide additional evidence for this assertion. In turn, the cointegrating relationship implies an underlying equilibrium relationship among these national stock price indexes which dictates their common movement in the long run. However, following DeFusco et al. (1996), the existence of only one cointegrating vector, or equivalently five common unit roots, among the system of stock market indexes in this sample implies that the long-run relationships is stable in only one direction. That is, the system can deviate in five independent directions suggesting that the degree of cointegration relationship is weak.

The weak relationship may be explained by the existence of direct and indirect impediments to the flow of international capital that remain in the Philippine market. These include, among others, restrictions on foreign ownership in some sectors specified in the country's Foreign Investment Act negative list; some degree of political instability which discourages foreign investors from participating in the economy; the relative smallness of the equity market which can have negative implications on market liquidity;

and, the few internationally cross-listed securities. Considering that cointegration and market integration are long-run concepts and that the effect of the liberalization takes time, we do not expect an immediate dramatic impact. This weak integration evidence is consistent with the findings of Buckberg (1995), Bekaert (1995) and Harvey (1995a, 1995b).

The finding of a cointegrating vector among the stock market price series in this study allows us to estimate a vector error-correction model in the form of Equation (3) or Equation (4). Since this formulation includes both levels and first differences, it allows us to examine both the short-run and long-run dynamics of the individual national stock market indexes in the system. In particular, we can gain insight on which countries are important to obtaining this long-run equilibrium relationship and whether this relationship plays an important role in explaining the short-run movement of each country's stock market prices. These insights should provide a clearer picture on the strength of the long-run relationship underlying the cointegrating vector. The details of the estimated error-correction model with the restriction of one cointegration vector imposed [Equation (4)] are summarized in part A of Table 2.4, including the short-run parameters, the normalized coefficients of the estimated cointegrating vector, and the coefficients of speed of adjustment toward the long-run equilibrium relationship underlying the cointegrating vector.[14]

We first examine the long-run dynamics of the estimated cointegrating relationship. The equilibrium error relationship implied by the cointegrating vector is given by

$$z_t = 1.000\Delta PHL - 0.485\Delta TWN + 0.767\Delta JPN - 0.595\Delta HK - 1.242\Delta SIN + 0.293\Delta US \qquad (6)$$

As mentioned earlier, there is no straightforward interpretation of the coefficients of the cointegrating vector. However, their relative magnitude can be used to determine which national stock market indexes are important in obtaining the long-run relationship underlying the cointegrating vector, or equivalently, which national stock market indexes' long run movements are significantly influenced by the underlying long-run equilibrium relationship. This is confirmed by performing a likelihood ratio test to test the statistical significance of each national stock market's cointegration coefficient. The null hypothesis is that the coefficient of a particular country's stock market index is zero in the cointegrating vector. This is equivalent to testing the restriction that only the remaining five stock market indexes are important in obtaining the long-run equilibrium relationship. Under the null, the likelihood ratio test statistic is distributed as $\chi^2(1)$. The results of these tests are shown in Table 2.5.

From part A of Table 2.5, we see that the null hypothesis of zero cointegration coefficient can be rejected at the 0.05 level of significance for all countries except Hong Kong and the U.S.. In the case of Hong Kong, the null hypothesis can only be rejected at the 0.10 level of significance. A test of the joint hypothesis that the cointegration coefficients are zero in the equations of Hong Kong and the U.S. yielded a likelihood ratio test statistic of 5.15. Under the null hypothesis, this test statistic is distributed as $\chi^2(2)$ with critical value of 5.99 at the 0.05 level of significance. Thus, the joint null hypothesis cannot be rejected. These findings suggest that the equilibrium relationship underlying the cointegration vector exerts significant influence on the long-run movements of the stock market prices of the Philippines, Taiwan, Japan, and Singapore. However, the same equilibrium relationship only plays a minor influence on the long-run movement of the stock market prices of Hong Kong and appears unimportant to the U.S. stock market index. That the long-run relationship is not important to the U.S. market suggests that the cointegration relationship is confined to the Asian stock markets. This may be due to the geographical separation of the Asian markets and that of the U.S. market and may be suggestive of the notion of separated financial markets in the Pacific Basin (Asian versus Pacific). This finding is similar to the multivariate cointegration results of Chung and Liu (1994). They find that the Johansen's cointegration tests indicate that cointegrating relationships are shared by the stock markets of U.S., Japan, Hong Kong, Singapore and South Korea. However, their results suggest that the U.S. stock market does not appear to belong to the "common" stock region of the four Asian countries since the cointegrating vector coefficient for the U.S. is not found to be significantly different from zero.

Next, we investigate the importance of the long-run relationship underlying the cointegrating vector to the short-run movements of the national stock markets in the sample. Part B of Table 2.4 shows the results of estimating a VAR in first differences with 2 lags using data for the post-liberalization subsample period. The coefficients on the lagged values of the first differences are generally insignificant. As discussed earlier, the VAR in first differences is similar to the vector error-correction model except for the lagged error-correction terms defined by $\mathbf{z}_{t-1}$, where $\mathbf{z}_{t-1}=\boldsymbol{\beta}'\mathbf{S}_{t-1}$. The estimates of the VAR in first differences are presented, as well, in order to determine the incremental impact of including the error-correction terms. The parameters are estimated using OLS to make it comparable to the estimates of the vector error-correction model. However, as pointed out earlier, given the finding of a cointegrating relationship among the six price series, the traditional VAR in first differences is a misspecified model (see Engle and Granger, 1987).

We find that only 2 out of the 36 coefficients on the lagged values of ΔPHL, ΔTWN, ΔJPN, ΔHK, ΔSIN, and ΔUS are significant at the 0.05 level. In particular, we see that own lagged changes and lagged changes in the non-Philippine stock market indexes do not significantly influence the current period's changes in the Philippine stock market index. Likewise, lagged changes in the Philippine stock market index do not significantly affect changes in any of the other countries' stock market indexes. The generally insignificant cross-price effects suggest that the independent or local information contained in individual country's stock market prices does not appear to influence the stock market indexes of the other countries. We now examine to what extent the information on the long-run equilibrium relationship, that is captured by the cointegrating relationship, helps explain the short-run movements in the stock market prices of the six countries.

We observe from part A of Table 2.4 that, similar to the results of the VAR in first differences, the coefficient estimates on the lagged values of ΔPHL, ΔTWN, ΔJPN, ΔHK, ΔSIN, and ΔUS are generally insignificant with only 4 of the 32 coefficients significant at the 0.05 level. Note, however that the results suggest that the lagged stock market index return of Singapore has a significant effect on the short-run changes in the Philippine stock market when the error-correction term is included in the Philippine equation but it is insignificant under the traditional VAR in first differences. Meanwhile, based on the 't-values, the coefficient of adjustment speed in the equation of the Philippines is significant at the 0.05 level. This implies that short-run movements in the stock market prices are significantly influenced by information about the long-run relationship underlying the estimated cointegration vector or a faster speed of adjustment in the Philippine stock market index toward the long-run equilibrium relationship. However, based on the 't-values', the coefficients on the five remaining international stock markets are insignificant. Consequently, we perform a likelihood ratio test to test the null hypothesis that the adjustment speed coefficient is zero in each of the equations of the non-Philippine stock markets. If the adjustment speed coefficient is zero, this implies that short-run movements in the stock market prices of these countries are not influenced by the information about the long-run equilibrium relationship underlying the estimated cointegrating vector. The results are reported in part B of Table 2.5. We observe that for each of these stock market indexes, the null hypothesis of zero coefficient of speed of adjustment cannot be rejected at the 0.05 level of significance. These results imply that the long-run relationship does not influence the short-run movement of these stock market indexes. A likelihood ratio test of the joint hypotheses that the adjustment speed coefficients are zero in all of the equations of these five international stock markets yielded a test statistic of 9.85. Under the null, this test statistic is distributed as $\chi^2(5)$ with critical value of 11.10 at the 0.05 level of significance. On the other hand, the critical value at the 0.10 level of significance is 9.24, suggesting that the joint hypotheses can only be weakly rejected.

Next, a comparison of the two models' R^2s reveals that adding the error-correction terms produces a substantial increase in the explained variation of ΔPHL from 0.127 to 0.300. This is true as well for ΔTWN and ΔJPN (from 0.099 to 0.138 and from 0.055 to 0.080, respectively). On the other hand, adding the error-correction terms results to modest increases in the explained variation of ΔHK, ΔSIN and ΔUS (from 0.096 to 0.105, from 0.038 to 0.040, and from 0.061 to 0.073, respectively).

The significant coefficient of adjustment speed and the substantial increase in the explained variation as a result of adding the lagged long-run equilibrium error provide evidence on the important influence of the information on the long-run equilibrium relationship on the short-run movements of the Philippine stock market index. Moreover, there appears to be evidence that in the short-run, this long-run equilibrium information is most important to the Philippine stock market. In contrast, the overall evidence indicates that this same relationship plays only a minor role in explaining the short-run movements of the non-Philippine stock market indexes in the sample.

Given that cointegration implies market integration, the results of the cointegration tests and analysis of the significance of the long-run relationship underlying the cointegrating vector lead us to believe that the Philippine stock market has become integrated with the stock markets of its top sources of foreign investment and major trading partners during the subsample period October 1989 to December 1995. However, since there is only one significant cointegrating relationship which seems not to be vital to the Hong Kong and U.S. markets and because of the minor influence of the information on the long-run relationship on the short-run changes in the remaining international stock markets, the degree of integration of the Philippine equity market is taken to be weak. We also conducted a test of the joint hypotheses of zero adjustment coefficients for the equations of Taiwan, Japan, Hong Kong, Singapore and the U.S. and zero cointegration coefficients for Hong Kong and the U.S. This yielded a likelihood ratio test statistic of 23.38. Under the null, this test statistic has a $\chi^2(7)$ distribution with critical value of 14.10 at the 0.05 level. Therefore, the joint hypotheses can be significantly rejected. The last result indicates that imposing these restrictions on the system might be unreasonable.

Considering that more policy changes which eased access by foreigners into the domestic market as well as some reforms that made investing abroad by Filipinos easier were initiated beyond 1989 and that liberalization helps promote market integration, it may be reasonable to deduce from the evidence that market liberalization reforms are partly responsible for its integration into the international stock markets. Similarly, this result implies that the barriers which existed prior to the opening up of the Philippine market may have been effective in restricting the mobility of international capital flows which in turn prevented the market from being integrated. More importantly, these results indicate that the impact of liberalization takes time and therefore its effect on market integration is not immediately substantial.

We would like to stress, however, that the finding of no cointegration among the Philippine stock market index and those of Japan, Hong Kong, Singapore, Taiwan and the U.S. prior to October 1989 does not necessarily imply that these non-Philippine stock market indexes are not integrated into the international stock markets in general. One argument that can be raised is that if the restrictiveness of barriers to international investment is what is preventing the Philippine stock market from being integrated with the other international stock markets, then it should be the case that the stock market indexes of countries which do not have strong restrictions and are freely open should be cointegrated prior to October 1989. However, since the purpose of this study is to examine the potential impact of the liberalization of the Philippine equity market on its major economic partners in the Asia-Pacific region, we did not pursue this issue at it is beyond our focus. Instead, existing literature involving the stock market of Japan, Hong Kong, Singapore and the U.S. provide evidence toward this end. For example, Kasa (1992) finds a strong cointegration relationship among the equity markets in the U.S., Japan, England, Germany and Canada using data for the period 1974-1990. Corhay et al. (1995) find one cointegrating relationship among the stock markets of Japan, Hong Kong, Singapore, Australia and New Zealand are cointegrated using data for the period

1972 to 1992. Hung and Cheung (1995), using data for the period 1981 to 1991, find some cointegrating relationships among the equity markets of Hong Kong, Korea, Malaysia, Singapore, and Taiwan.

In summary, our results indicate that:

(1) The Philippine stock market is not cointegrated with the markets of its major trading partners and investing countries prior to liberalization. However, after its initial market opening, we find one significant cointegrating vector which appears not to include the U.S. market. These suggest that capital market liberalization has resulted in the integration of the Philippine stock market with the Asian markets.

(2) For the post-liberalization subperiod, the return on the Philippine stock market index is significantly related to deviations from the long-run equilibrium relationship underlying the cointegrating vector. This implies that the long-run equilibrium information underlying the cointegrating vector significantly influences the short-run movements of the Philippine stock market index during this period.

(3) For the post-liberalization subperiod, adding the error-correction term in the traditional VAR in returns model substantially increases the explanatory power for the returns on the Philippine stock market index. This implies that the deviations from the long-run equilibrium relationship between the Philippine stock market and the markets of its major economic partners provide incremental information on the movements of Philippine stock market returns. Analogously, useful incremental information is omitted when the long-run stock market price dynamics as reflected in the error-correction term is not incorporated in the model that is used to investigate the short-run dynamics of the Philippine stock market index.

2.5. CONCLUSION

In this study, we investigate the impact of liberalization and internationalization on the degree of integration of the Philippine stock market into the stock markets of its major economic partners in the Asia-Pacific region. We employ a measure of the degree of integration based on the concept of cointegration and its relationship with error-correction, as introduced by Engle and Granger (1987). Based on Johansen's maximum likelihood cointegration tests, the null hypothesis of no cointegration cannot be rejected in the subperiod January 1980 to September 1989 while a single cointegration vector was found in the subperiod October 1989 to December 1995. Given that cointegration implies market integration, these results indicate that the Philippine stock market has become integrated with the stock markets of its major economic partners after its initial market opening on October 1989. This finding can partially be attributed to the major reforms aimed at liberalizing and internationalizing the Philippine capital market that were instituted after October 1989. This is because liberalization and internationalization encourages international capital flows which in turn promotes capital market integration. However, the fact that only one cointegration vector was found to be significant and that the influence of the underlying long-run equilibrium relationship on the non-Philippine stock market indexes is minor imply a weak degree of integration of the Philippine stock market into the stock markets of Taiwan, Japan, Hong Kong, Singapore and the United States. The weak integration of the Philippine stock market can possibly be explained by the fact that the market opening is not yet complete. There are barriers to international investment that continue to prevail in this country. These include, among others, remaining restrictions on foreign equity participation in some sectors of economic activity, some degree of political instability that can discourage participation in the domestic market by overseas investors, the relatively small equity market base, and the dearth of internationally cross-listed domestic securities. The weak evidence of integration in the post-liberalization subperiod also provides an indication that the impact of liberalization takes time and therefore its effect on market integration is not immediately substantial.

Given that cointegration suggests long-run co-movements of national stock market prices, we expect long-run horizon return correlations among the cointegrated international stock market indexes to be higher than the correlations reflected in short-run stock market returns. In turn, this implies limited diversification benefits from investing in the stocks of the cointegrated markets. This is because the presence of common influences limits the amount of independent variation in the national stock market prices. However, since the above results indicate that the Philippine stock market is weakly integrated into the international stock markets in the sample, the potential long-run diversification benefits offered by Philippine equities to overseas investors is still significant.

Finally, our post-liberalization subperiod results indicate that the information contained in the long-run equilibrium relationship between the Philippine stock market and the markets of its major economic partners is helpful in explaining the short-run movements of the Philippine stock market index. This suggests that an appropriate model that seeks to explain the predictable component of Philippine stock market returns should take into account the existence of this cointegrating relationship.

Table 2.1: Results of Unit Root Tests on the Levels of the National Stock Market Indexes for Two Subsamples[a-c]

Country	Pre-Liberalization Subsample: January 1980 to September 1989				Post-Liberalization Subsample Period: October 1989 to December 1995			
	ADF Test		PP Test		ADF Test		PP Test	
	constant and trend	constant no trend	constant and trend	constant no trend	constant and trend	constant no trend	constant and trend	constant no trend
	(Φ)	(τ_μ)	($Z(\Phi)$)	($Z(\tau_\mu)$)	(Φ)	(τ_μ)	($Z(\Phi)$)	($Z(\tau_\mu)$)
Philippines	3.39	0.47	4.61	0.88	4.56	-1.00	4.81	-0.87
Taiwan	3.82	1.88	4.02	1.87	4.37	-2.87	4.11	-2.82
Japan	1.77	0.33	2.00	0.42	5.25	-2.74	3.77	-2.52
Hong Kong	1.48	-1.31	1.71	-1.37	2.26	-1.07	2.27	-1.07
Singapore	3.16	-2.43	2.88	-2.25	4.33	-0.77	3.30	-1.05
U. S.	3.15	-0.42	4.08	-0.23	4.60	0.09	3.74	0.25

[a]The reported ADF test statistics, Φ, are F-statistics on the joint significance of β_1 and β_2 in the regression $\Delta S_{i,t} = \beta_0 + \beta_1 t + \beta_2 S_{i,t-1} + \Sigma_{j=1}^{p} \delta_j \Delta S_{i,t-j}$ while the ADF test statistics, τ_μ, are t-statistics on β_1 in the regression $\Delta S_{it} = \beta_0 + \beta_1 S_{i,t-1} + \Sigma_{j=1}^{p} \delta_j \Delta S_{i,t-j}$. The critical values at the 0.05 level of significance are 6.47 and -2.89, respectively for the sample period January 1980 to September 1989 and 6.61 and -2.91, respectively for the sample period October 1989 to December 1995. The reported PP test statistics, $Z(\Phi)$, are F-statistics on the joint significance of β_1 and β_2 in the regression $\Delta S_{i,t} = \beta_0 + \beta_1 t + \beta_2 S_{i,t-1}$ corrected for serial correlation and/or heteroscedasticity using the Newey West (1987) method while the PP test statistics, $Z(\tau_\mu)$, are t-statistics on β_1 in the regression $\Delta S_{it} = \beta_0 + \beta_1 S_{i,t-1}$ corrected for serial correlation and/or heteroscedasticity using the Newey West (1987) method. The critical values at the 0.05 level of significance are the same as those of the ADF test statistics.

[b] All tests for the sample period January 1980 to September 1989 are conducted using p=3 lags and the tests for the sample period October 1989 to December 1995 are conducted using a truncation lag of 2, based on Diebold and Nerlove's (1990) suggestion of setting the number of lags equal to INT[$T^{0.25}$], where T is the sample size and INT is the integer part of the argument. Higher-order lags where tried as well but the results are similar. Test statistics using various lag orders were also computed but the results were similar.

[c] Superscript ** denotes rejection at the 0.05 level of significance of the null hypothesis of a unit root.

Table 2.2: Error Term Diagnostics[c-h]

Equation for:	LB(1)	LB(4)	Skewness	Excess Kurtosis	B-J Normality	LB(1)	LB(4)	Skewness	Excess Kurtosis	B-J Normality
	Pre-Liberalization Subsample: January 1980 to September 1989[a]					Post-Liberalization Subsample: October 1989 to December 1995[b]				
	Multivariate Test Statistics					Multivariate Test Statistics				
		LM(1)	LM(4)	D-H Normality			LM(1)	LM(4)	D-H Normality	
		30.51	38.34	**44.94****			35.81	33.29	**29.45****	
	Univariate Test Statistics					Univariate Test Statistics				
Philippines	0.10	0.16	**-0.47****	**1.94****	**19.44****	0.67	2.37	-0.20	0.72	1.54
Taiwan	0.09	0.90	**-0.74****	**2.90****	**45.17****	0.02	1.82	-0.55	**3.36****	**32.00****
Japan	0.10	2.92	0.33	0.68	**3.71****	0.09	1.49	0.23	0.28	0.69
Hong Kong	0.00	2.72	**-0.54****	**1.17****	**10.87****	0.00	5.51	0.31	1.00	3.35
Singapore	0.13	1.26	-0.45	**2.07****	**21.30****	0.42	5.41	-0.30	**1.59****	**7.08****
U.S.	0.16	0.17	**-0.52****	**2.14****	**24.02****	0.01	2.13	-0.24	**1.58****	**6.61****

[a] The residuals are based on the estimates of the unrestricted VAR in error-correction form [Equation (2)] with lags $j=3$ and an unrestricted constant. The lag length was determined using a sequential likelihood ratio procedure. The null hypothesis that system of variables S_t is generated by a Gaussian VAR with j lags against the alternative of $j+1$ lags is given by *LR*: $(T-p)\left\{\ln\left|\hat{\Sigma}_{\cdot,j}\right| - \ln\left|\hat{\Sigma}_{\cdot,j+1}\right|\right\}$ where T is the VAR sample size, $p=1+[n(j+1)]$ is the correction for small sample bias. $\hat{\Sigma}_{\cdot,s}$ is the ML estimate of the variance-covariance matrix of the VAR with s lags, $s=j, j+1$. This test statistic has a χ^2 distribution.

[b] The residuals are based on the estimates of the unrestricted VAR in error-correction form [Equation (2] with lags $j=2$ and an unrestricted constant with the lag length determined using the sequential likelihood ratio procedure discussed in note b.

[c] LM(1) and LM(4) are multivariate Lagrange Multiplier tests for first- and fourth-order autocorrelation as proposed by Godfrey (1988). The null hypothesis is that the k-th order autocorrelation is zero in all of the equations in the VAR system. Both test statistics are distributed as χ^2 (36) with critical value of 51 at the 0.05 level of significance.

[d] D-H Normality is the multivariate normality test suggested by Hansen and Juselius (1995). The null hypothesis is that the estimated residuals in all of the equations in the VAR system are randomly drawn from a multivariate normal distribution. This test statistic is distributed as χ^2 (12) with critical value of 21 at the 0.05 level of significance.

[e] LB(1) and LB(4) are the univariate test statistics for testing first-order and fourth order autocorrelations, respectively, as proposed by Ljung and Box (1978). The null hypothesis is that the first k autocorrelations are zero in a given equation in the VAR system. These statistics are distributed as χ^2 (1) and χ^2 (4), respectively. The critical values at the 0.05 level of significance are 3.84 and 9.49, respectively. *Tests for higher-order autocorrelation (beyond four) were conducted but none are significant. Only the first and fourth are reported for parsimony.*

[f] Skewness is the coefficient of skewness and Kurtosis is the coefficient of excess kurtosis as proposed by Kendall and Stuart (1958). The null hypothesis tested here is that each coefficient is zero. Both statistics have a standard normal distribution.

[g] J-B Normality is the univariate normality test suggested by Jarque and Bera (1980). The null hypothesis is that the estimated residuals in a given equation in the VAR system are randomly drawn from a normal distribution. This test statistic is distributed as χ^2 (2) with critical value of 5.99 at the 0.05 level of significance.

[h] The superscript ** denotes rejection at the 0.05 level of significance of the null hypothesis.

Table 2.3: Johansen's Likelihood Ratio Tests Statistics for Cointegration among the National Stock Market Indexes for Two Subsamples

Null Hypothesis	Pre-Liberalization Subsample: January 1980 to September 1989				Post-Liberalization Subsample: October 1989 to December 1995			
	Test Statistics[a]		Small-Sample Critical Values (0.05 level of significance)[c]		Test Statistics[b]		Small-Sample Critical Values (0.05 level of significance)[c]	
	Trace	Maximum Eigenvalue	Trace	Maximum Eigenvalue	Trace[d]	Maximum Eigenvalue[e]	Trace	Maximum Eigenvalue
$r=0$	107.55	41.03	111.80	46.75	133.77**	65.42**	112.67	47.11
$r\leq1$	66.52	29.99	81.37	39.73	68.35	33.71	82.00	40.04
$r\leq2$	36.54	21.37	56.06	32.15	34.65	20.37	56.50	32.40
$r\leq3$	15.17	8.81	35.25	24.90	14.28	7.29	35.52	25.10
$r\leq4$	6.35	5.81	18.30	16.71	6.99	6.81	18.44	16.84
$r\leq5$	0.54	0.54	4.47	4.47	0.18	0.18	4.50	4.50

[a] The test statistics are based on the estimates of the unrestricted VAR in error-correction form [Equation (2)] with lags $j=3$ and an unrestricted constant. Eigenvalues are (0.2735, 0.2235, 0.1935, 0.0867, 0.0644, 0.0118).

[b] The test statistics are based on the estimates of the unrestricted VAR in error-correction form [Equation (2)] with lags $j=2$ and an unrestricted constant. Eigenvalues are (0.5919, 0.3698, 0.2435, 0.0950, 0.0891, 0.0024).

[c] The small-sample critical values are the asymptotic critical values from Osterwald-Lenum (1992, Table 1 Case 1) for a system of six variables and a constant in the VAR multiplied by $T/(T-nj)$, based on the suggestion by Reinsel and Ahn (1988,1992). The correction factor, $T/(T-nj)$, is 1.1875 for the subsample period January 1980 to September 1989 and 1.1967 for the subsample period October 1989 to December 1995.

[d] The superscript ** denotes rejection at the 0.05 level of significance of the null hypothesis of at most r cointegrating vectors against the alternative of six cointegrating vectors.

[e] The superscript ** denotes rejection at the 0.05 level of significance of the null hypothesis of r cointegrating vectors against the alternative of $r+1$ cointegrating vectors.

Table 2.4: Estimation Results: October 1989 to December 1995[a-e]

	A. Vector Error Correction Model						B. VAR in First Differences					
	Dependent Variable						Dependent Variable					
	ΔPHL	ΔTWN	ΔJPN	ΔHK	ΔSIN	ΔUS	ΔPHL	ΔTWN	ΔJPN	ΔHK	ΔSIN	ΔUS
Short-run Dynamics:												
ΔPHL(t-1)	0.084	-0.076	-0.230	**-0.823**	**1.119**	0.365	0.133	0.284	0.032	-0.044	-0.036	0.014
	(0.58)	(-0.75)	(-1.42)	(-3.45)**	(3.07)**	(0.93)	(0.67)	(1.42)	(0.25)	(-0.41)	(-0.41)	(0.27)
ΔTWN(t-1)	0.300	0.188	-0.373	-0.331	0.062	0.3165	0.032	0.129	0.076	-0.007	0.004	0.049
	(1.62)	(1.44)	(-1.78)	(-1.08)	(0.13)	(0.62)	(0.27)	(0.94)	(0.87)	(-0.89)	(0.07)	(1.38)
ΔJPN(t-1)	0.024	0.046	0.041	-0.123	-0.346	0.300	-0.274	-0.348	0.029	-0.286	-0.068	-0.016
	(0.20)	(0.55)	(0.31)	(-0.63)	(-1.15)	(0.92)	(-1.44)	(-1.55)	(0.20)	(-2.34)	(-0.69)	(-0.27)
ΔHK(t-1)	-0.048	-0.022	**-0.280**	-0.249	**0.617**	-0.081	-0.119	-0.452	-0.063	-0.217	-0.161	-0.0303
	(-0.47)	(-0.31)	(-2.42)**	(-1.46)	(2.37)**	(-0.29)	(-1.43)	(-1.40)	(-0.31)	(-1.24)	(-1.41)	(-0.04)
ΔSIN(t-1)	-0.034	0.010	-0.070	-0.149	0.199	0.170	**-0.605**	0.272	-0.450	**0.562**	0.220	0.007
	(-0.41)	(0.17)	(-0.75)	(-1.09)	(0.95)	(0.75)	(-2.21)**	(0.55)	(-1.45)	(2.11)**	(1.03)	(0.06)
ΔUS(t-1)	0.012	0.041	-0.012	-0.020	0.036	-0.180	0.740	0.196	0.359	-0.050	0.159	-0.163
	(0.24)	(1.18)	(-0.22)	(-0.24)	(0.29)	(-1.33)	(1.78)	(0.36)	(1.04)	(-0.17)	(0.67)	(-1.15)
constant	0.034	0.197	**0.259**	**0.213**	**0.278**	**0.109**	0.582	-.006	0.010	0.016	0.009	**0.010**
	(0.43)	(1.92)	(4.72)**	(2.66)**	(4.78)**	(3.24)**	(1.26)	(-0.38)	(0.053)	(1.83)	(1.25)	(2.25)**
Long-run Parameters:												
	Vector of adjustment speeds, α											
z_{t-1}	**-0.365**	0.202	-0.100	-0.053	0.020	-0.028						
	(-4.25)**	(1.83)	(-1.41)	(-0.86)	(0.40)	(-0.95)						
	Cointegrating vector (normalized), β											
	1.000	-0.485	0.767	-0.595	-1.242	0.293						
R^2	0.300	0.138	0.080	0.105	0.040	0.073	0.127	0.099	0.055	0.096	0.038	0.061

[a] Estimate (t-values) with the rank restriction $r=1$ imposed on the vector error-correction model (Equation (2)). The estimates for the subsample January 1989 to September 1989 are not reported since no significant cointegrating vector was found.

[b] PHL, TWN, JPN, HK, SIN, and US are the levels of the (natural logarithm) national stock market price indexes measured in U.S. dollars for the Philippines, Taiwan, Japan, Hong Kong, Singapore, and the United States, respectively.

[c] Δ is the first-difference operator.

[d] The coefficients of the cointegrating vector reported above are simply the coefficients of the corresponding eigenvector normalized by the eigenvector coefficient of the Philippine stock market index. In the Johansen framework, the short-run parameter estimates and test statistics as well as the cointegration test statistics are invariant to the choice of the normalizing variable. The eigenvector is (7.792, -3.780 5.975, -4.634, -9.861, 2.282)

[e] The superscript ** denotes significance the 0.05 level.

Table 2.5: Tests of Restrictions on the Cointegrating Vector and the Vector of Adjustment Speed Coefficients Post-Liberalization Subsample: October 1989 to December 1995 [a,b]

(A) Test of Restrictions on the Cointegrating Vector, β

H_0: The cointegration coefficient is zero in the error correction equation of the individual national stock market index.

Equation for:	Likelihood Ratio Test Statistic
Philippines	19.87**
Taiwan	8.43**
Japan	11.01**
Hong Kong	3.58***
Singapore	7.46**
U. S.	1.31

(B) Tests of Restrictions on the Vector of Adjustment Speed Coefficients, α

H_0: The adjustment speed coefficient is zero in the error correction equation of an individual national stock market index.

Equation for:	Likelihood Ratio Test Statistic
Taiwan	2.54
Japan	1.80
Hong Kong	0.68
Singapore	0.13
U. S.	0.87

[a] The likelihood ratio test statistics are based on Johansen (1988, 1991) and Johansen and Juselius (1990). Under the null hypothesis, both statistics have a $\chi^2(1)$ distribution with critical values of 3.84 and 2.71 at the 0.05 and 0.10 levels of significance, respectively.

[b] The superscript ** denotes that the null hypothesis can be rejected at the 0.05 level of significance.
The superscript *** denotes that the null hypothesis can be rejected at the 0.10 level of significance.

Notes

1. See, e.g., Stulz (1981); Campbell and Hamao (1992); and, Bekaert and Harvey (1995).

2. Taiwan's stock market capitalization stood at US$187.206 billion and market turnover was 174.9% as of 1995. In this same year, the capitalization of the developed and relatively open markets of Hong Kong and Singapore were US$303.705 and US$148.004 billion, respectively. Their corresponding market turnovers were 37.3% and 42.2%. (International Finance Corporation, 1996)

3. A competing hypothesis is that the series is stationary around a deterministic trend. If this is the case, the series is rendered stationary by detrending.

4. It can be shown that when the price indexes are translated into returns, the variance of the corresponding disturbance term, $(e_t - e_{t-1})$, is greater than the variance of e_t whenever the autocorrelation of the original noise term, ρ_1, is less than 0.5. The proof is as follows.

Let $\quad Var(e_t) = \gamma_0$ and $Cov(et - e_{t-1}) = \gamma_1$.
Then $\quad Var(et - e_{t-1}) = 2(\gamma_0 - \gamma_1) = V$.
Now $\quad V > \gamma_0$ when $2(\gamma_0 - \gamma_1) > \gamma_0$.
This holds when $\rho_1 < 0.5$ since $2(\gamma_0 - \gamma_1) > \gamma_0 \Rightarrow \gamma_0 > 2\gamma_1 \Rightarrow 1 > 2\rho_1$ as $\rho_1 = (\gamma_1/\gamma_0)$.

5. Although it would have been more appropriate to use the Philippine Stock Exchange Composite Index, the available data begins only in 1987. However, it may be reasonable to use the Commercial and Industrial index since the component stocks in this subindex account for approximately 92% of the total market capitalization of the stocks in the Composite Index (see Rodrigo, 1993). Moreover, the commercial-industrial sector accounted for 75% of market turnover in 1995 (see Euromoney, 1996). All of the indexes in the sample do not include dividends. It would be ideal to use indexes which include dividends since investors are concerned about total returns. However, due to limitations on dividend data, all analyses are performed on indexes whose component stock prices are not adjusted for dividends. DeFusco et al. (1996) theoretically show that, assuming the discounted cash flow model of asset prices is valid and if expected discount rates and dividend growth rates are stationary processes, then the results of the cointegration tests will be the same whether one uses price indexes excluding dividends or price indexes adjusted for dividends.

6. The cointegration estimation and testing procedures are performed using CATS-PC Version 1.00 and RATS Version 4.2. The estimation procedures in the succeeding chapters are carried out in RATS Version 4.2.

7. We estimate a model with a constant term in order to capture the upward trending behavior of the national stock market price indexes in the sample.

8. The Monte Carlo simulation results of Cheung and Lai (1993) indicate that serial correlation introduces a serious problem for the Johansen procedure. On the other hand. Cushman, Lee and Thorgeirsson (1996) point out that the normality assumption is not as serious as it appears. They argue that for nonnormal ε_t, the Johansen estimators become quasi-ML estimators. Moreover, the asymptotic results for the cointegration test statistics do not change, as long as the distribution for ε_t satisfies the conditions necessary to invoke the functional central limit theorem (e.g., i.i.d. with finite covariance matrix). Gonzalo (1994) finds that the Johansen procedure provides results that are more robust to deviations from normality than those obtained from other methods of estimating cointegrating relationships.

9. The economic interpretation of and intuition underlying the vector error-correction model follows Engle and Granger (1987, 1991), Johansen (1988, 1991), Johansen and Juselius (1990), and Hansen and Juselius (1995).

10. These results have an implication on the specification of VAR models whose variables are nonstationary in the levels. If the nonstationary time series in the vector system of the VAR are cointegrated, a VAR model in levels is inefficient and may lead to spurious regression results, while that in first differences is misspecified. (See Engle and Granger, 1987)

11. It should be noted that, starting from the late 1970s until the mid 1980s, the Japanese government instituted a wave of major reforms that liberalized the Japanese capital market (see, e.g., Korkie and Nakamura, 1997).

12. On the other hand, Cheung and Lai (1993), using a simple Monte Carlo experiment, examine the potential effects of nonnormal innovations, including nonsymmetric and leptokurtic ones, on the size of Johansen's cointegration tests. Among other things, they find that skewness and excess kurtosis produce a statistically significant effect on the test sizes of both the trace and maximum eigenvalue tests. However, they find that while both tests are reasonably robust to nonnormal disturbances, the trace test shows more robustness to both skewness and excess kurtosis in disturbances than the maximum eigenvalue test.

13. The analysis was also performed with a dummy variable for the international stock market crash of October 1987. The results are similar to the ones reported in this study in which a dummy variable is not included. A problem with including this dummy variable, however, is that it changes the limit distribution of the cointegration test statistics and therefore it is not appropriate to compare them with the critical values reported in Osterwald-Lenum (1992) which were simulated without such dummy variable.

14. Since their values are not uniquely defined, Johansen (1988) suggested normalizing the coefficients of the cointegrating vectors before any inferences about them can be made. An advantage of the Johansen procedure is that the results and implications are

invariant to the chosen normalizing variable. In this study, normalization is performed using the coefficient on the Philippine stock market index.

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Chapter 3

U.S. Investors' Response to Philippine Capital Market Liberalization: Evidence from the First Philippine Fund

3.1. Purpose of the Study

This study investigates how U.S. investors view Philippine barriers to international investments and the recent steps taken by the Philippine government in liberalizing these restrictions. In particular, we use data on the First Philippine Fund (FPF), a closed-end country fund traded at the New York Stock Exchange, to provide evidence on how existing international investment restrictions have effectively segmented the Philippine capital market from the international capital markets. We test whether restrictions on international investments in the Philippines are effective and whether the announced relaxation of these restrictions are deemed important by U.S. investors by examining if announcements of *changes* in the investment restrictions in the Philippines are related to *changes* in the premiums and discounts of the FPF closed-end country fund.

3.1.1. The First Philippine Fund

One of the country funds designed for overseas investors wishing to gain access into the Philippine capital market is the First Philippine Fund (FPF). The FPF is the largest of five closed-end country funds investing in Philippine securities and the only one listed on the New York Stock Exchange. Launched in November 8, 1989, this nondiversified, publicly traded management investment company invests primarily in equity securities of Philippine companies.[1] As was mentioned in Chapter 1, prior to the implementation of the Philippine Foreign Investments Act of 1991, foreign equity participation was limited to 40 percent in most economic activities. Most companies that fall into these restricted areas generally classify their shares into two categories: "A" shares and "B" shares. "A" shares are reserved for Filipino nationals, while "B" shares can be purchased by both foreign and local investors.[2] Other than this ownership restriction, there are no distinctions between the rights, preferences and limitations of the two classes of shares. However, the FPF is the only country fund permitted by the Philippine government to invest in "A" shares of domestic companies that are otherwise available only to Philippine nationals. This feature makes the FPF an easily accessible alternative to direct investment in the restricted Philippine capital market.

3.1.2. Theoretical Framework and Previous Empirical Studies

Similar to their domestic counterparts, closed-end foreign country funds trade at premiums or discounts over their Net Asset Values (NAVs). However, in contrast to domestic closed-end funds, the foreign country fund's NAV is not determined in the same market as its share price. Its NAV is determined by the prices of the underlying securities traded on the foreign market. Given that country funds and their underlying assets are close substitutes, then, if capital markets are integrated internationally, a closed-end country fund's shares and its underlying assets should have similar risk. However, Eun and Janakiramanan (1986) and Hietala (1989) argue that barriers to international investment can cause the expected returns on assets of equal risk to differ across countries. Based on these models, non-zero country fund premiums imply some market segmentation.

Eun and Janakiramanan (1986) and Hietala (1989) assume quantitative limits on cross-ownership of assets as the form of international investment barrier. In their models, a foreign country has two classes of shares: (a) restricted shares that only the foreign country's nationals can buy and (b) unrestricted shares that can be purchased by both the foreign country's nationals and overseas investors. The foreign country's government imposes limits on the fraction of the unrestricted shares. They show that when these limits are binding, the unrestricted shares sell at a premium relative to the restricted shares with the premium depending on the covariance matrix of returns and investor preferences. The assets underlying the closed-end country funds are analogous to the restricted shares, while the country funds' shares themselves can be considered as the unrestricted shares. Thus, these models suggest that imposition of binding quantitative restrictions will increase the price-to-NAV ratio of the fund investing in that country above the level prevailing in the absence of such restrictions.[3]

An intuitive explanation of the preceding inferences is as follows. Suppose that a particular country legally prohibits foreign investors from directly purchasing its local equity securities. Assume that the only means by which a foreign investor can gain access to this country's equity market is through a closed-end fund, which is allowed to invest in the local securities. This fund will, most likely, have value to diversification-minded foreign investors and possibly sell at a premium over its NAV.[4] Therefore, when the restrictions are relaxed and direct purchase of the securities underlying the fund becomes easier, the fund is likely to have lesser value for the foreign investor. Consequently, the demand for the fund's shares decreases and thus the fund's shares are likely to sell at a lesser premium than before. At the same time, it is possible that foreign investors shift their capital from the country fund to direct purchases of the host country's equities as a result of liberalization. This increases the demand for the host country's equities which in turn increases the NAV of the country fund. This reinforces the effect of reducing the premium or increasing discount on the country fund.[5]

In summary, the preceding models imply that the price-to-NAV ratios of country funds can be affected by barriers to international investments if these restrictions are effective. This allows us to test whether changes in investment restrictions are associated with changes in the country fund's premiums or discounts. In particular, the preceding models suggest that , *ceteris paribus*, an announcement of a tightening of existing barriers should increase the premium or reduce the discount on a closed end country fund investing in a country if this country's international investment restrictions are effective.

Similarly, an announcement of a liberalization of the restrictions should reduce the premium or increase the discount on the fund. Tests of these hypotheses do not necessitate an underlying asset pricing model nor do they require measures of the effectiveness of the barriers to international investments. This is because when international capital markets are fully integrated, the shares of a closed-end country fund and its underlying assets should have similar risk. Consequently the fund's share price should be priced like domestic funds.

Using this theoretical framework, Bonser-Neal, Brauer, Neal and Wheatley (1990) examine whether a relation exists between announcements of changes in investment restrictions and changes in closed-end country funds' premiums and discounts using weekly data from May 1981 to January 1989 for five funds trading in New York. For four country funds in their sample, they find a significant decrease in the fund's premiums (or decrease in discounts) either in anticipation of or during the three weeks surrounding the announcement of a liberalization of investment restrictions. Overall, their results indicate that changes in country fund premiums are sensitive to announcements of changes in foreign country regulations that restrict investments. They find that across all country funds an announcement of a relaxation of investment restrictions is significantly associated with a 6.8% decline in the price-net asset value ratio during the event period. This suggests that government-imposed barriers to international investments have been effective in segmenting international capital markets. This is because announced changes in international investment restrictions, on average, would have had no impact on fund premiums if the restrictions had not been effective.

Although not conclusive, there is some evidence that country funds that invest in markets with difficult access have relatively high premiums. For example, Bonser-Neal et al. (1990) find that closed end country funds investing in markets which restrict foreign access have traded on average at premiums while funds investing in the less restricted markets have traded on average at discounts. However, they doubt if the relationship between the severity of barriers to international investments and the level of a country fund's premium is monotonic since some funds investing in countries which impose restrictions on foreign investment have traded on average at discounts. Likewise, Bodurtha, Kim and Lee (1995) find that, while most country funds in their sample trade at an average discount, some funds that operate in countries, which have very strict foreign ownership restrictions have traded at average premiums. Moreover, they find that funds investing in securities of countries with greater foreign ownership restrictions tend to have higher premiums or smaller discounts. However, they find that some funds investing in countries with strict foreign ownership restrictions, including the Philippines, exhibit discounts on average.

3.1.3. Scope and Limitations of the Study

We would like to emphasize at the outset that the focus of this study is only on how regulatory changes in Philippine international investment restrictions have affected the premiums and discounts of the FPF closed-end country fund. This paper does not seek to explain why the FPF closed-end country fund trades at a premium or discount nor does it investigate the determinants of this fund's premium or discount and the extent of international diversification benefits that the fund offers. Readers are referred to the studies of Chang, Eun and Kolodny (1995), Bodurtha et al. (1995), Hardouvelis, La Porta and Wizman (1994), Johnson, Schneeweis and Dinning (1993), and Diwan, Errunza and Senbet (1993) which address these issues.

As was mentioned in Chapter 1, there are other country funds devoted to investing in Philippine securities and which are traded in the London stock exchange. It would have been interesting to examine how European investors view the announced changes in the international investment restrictions in the Philippines as well. However, data on these country funds are not readily available.

3.2. DATA DESCRIPTION AND SAMPLE CHARACTERISTICS

The initial sample comprises weekly closing prices and NAVs of the FPF covering the period November 24, 1989 to December 29, 1995.[6] Both fund share price and NAV are reported in US dollars and are collected from The Wall Street Journal. Data on the amount of dividends and capital gains distributions, including the announcement and ex-dividend dates, were obtained from Standard & Poors NYSE Stock Reports. Like other closed-end country funds, the FPF's NAV is valued in local currency as of Friday's close in the foreign country and translated into US dollars using the exchange rate in effect at that time. The fund's weekly (percentage) premiums over the net asset value are constructed as:

$$PD_t = \left[\frac{SP_t - NAV_t}{NAV_t}\right] x100$$

where PD_t = premium (discount) of the fund at the end of week t

SP_t = stock price of the fund at end of week t

NAV_t = net asset value of the fund at end of week t

The reported fund prices and net asset values are only approximately synchronous because a difference of 17 hours exist between exists between the Philippine stock exchange close and New York's close.

Figure 3.1 plots the fund's premium over the initial sample period. The vertical bars correspond to the weeks of April 5, 1991, November 27, 1992 and March 3, 1995, respectively, when the fund did not report its NAV. The procedure for estimating these missing values is discussed later in this section. The plot shows that during the first four months after launch (from November 24, 1989 to March 23, 1990), the FPF wastrading at a premium after which the fund was and has since been selling at a discount over its NAV.

The FPF was launched in November 1989 when the Philippine market was booming amid hopes that the country was finally set to join the ranks of Asia's newly industrialized countries. More importantly, as discussed earlier, the FPF is the only country fund permitted by the Philippine government to invest in "A" shares of companies that are otherwise available only to Philippine nationals. This possibly explains the premium when the fund was launched. However, within several weeks of the launching of the fund, right wing factions of the military attempted to overthrow the Philippine government. This adversely affected the Philippine stock market causing the Manila Stock Exchange Composite Index to fall by 26% within one week after trading resumed. In response to the coup attempt, combined with the perception that prices of Philippine securities had been inflated by speculators in anticipation of the fund's entry into the market, the FPF adopted a policy of proceeding cautiously into the market. The fund remained primarily in cash (non-peso cash and cash equivalents as US Treasury bonds) such that total investments in Philippine common stocks stood at 0.3% of total net assets of the fund as of December 31, 1989, gradually increasing to 24.5% as of June 30, 1990, and then to 27.4% as of December 31, 1990.[7] Clearly, changes in premium during the first four months had more to do with investor sentiment in the US than with the economic fundamentals in the Philippines.[8]

Therefore, following Johnson et al. (1993), we exclude from the sample the four-month period immediately following the initial public offering of the FPF. By doing so, the fund's share price (and consequently the fund's percentage premium/discount) is thus not biased by initial marketing efforts and speculation by local holders of Philippine securities. Moreover, changes in the premium confounded by the effect of the December 1989 attempted coup is avoided. Consequently, the adjusted sample used for this study covers the period March 30, 1990 to December 29, 1995.

Based on the adjusted sample, the missing observations on the NAV were estimated as follows (see Beveridge, 1992). First, the NAVs are adjusted to include dividends and capital gains distributed during the period.[9] Secondly, autoregressive (AR) models were estimated for the NAV series immediately prior to the first missing observation. Similarly, AR models were estimated for the series of NAV immediately after the first missing observation up to the observation immediately before the second missing observation and for the series of NAV immediately after the second missing observation up to the observation immediately before the third missing observation. Using the Schwarz Information Criterion (SIC), an AR(1) was found to be the best model in each case. In each case, the estimate of the AR(1) coefficient is significant and very close to 1 and the residual autocorrelations of the estimated model are all statistically insignificant at the 0.01 level. These suggest that the NAV series follows a random walk. To confirm this, each series was first differenced. The autocorrelations of each of the first difference series are all statistically insignificant. Therefore, the best estimate (minimum mean squared error) of each of the three missing values is obtained by taking a simple average of the NAV observations, with dividends and capital gains payments included, immediately before and after the missing value and then deducting the dividends and capital gains payments.

Figure 3.2 shows the FPF's weekly discount over the adjusted sample period March 30, 1990 to December 29, 1995. On average, the FPF has traded at a discount of 19% over this sample period. The plot suggests a sizable variation in the fund's discount over time. The following section discusses the procedure for testing whether some of this variation can be explained by announcements of changes in the Philippines' international investment restrictions.

3.3. METHODOLOGY

3.3.1. Identification of Events

The criteria for selecting the events related to changes in barriers to international investment in the Philippines is as follows. Following Bonser-Neal et al. (1990), we consider two types of regulatory changes: (a) changes in restrictions that directly affect or signal changes in the ability of foreign investors to acquire the shares of Philippine companies or the ability of local investors to invest outside the Philippines (e.g., capital controls affecting direct investment and portfolio investment) and, (b) changes in restrictions that affect the ability of investors to obtain the currency required to purchase local or foreign assets (e.g., capital controls affecting nonresident accounts and resident foreign exchange accounts).[10] An initial list of the events is obtained from the International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions. If the announcement dates for the identified events are not in this source, then the announcement dates are collected from The Wall Street Journal. An event is dropped from the list if its announcement date could not be found. Likewise, events are dropped from the initial list if multiple announcements of changes in investment restrictions occurred within less than six weeks of each other. Five events, all of which happen to entail a liberalization of international investment restrictions, satisfied the preceding criteria. A description of these events is provided in Appendix D.

3.3.2. Tests of the Effects of Changes in International Investment Restrictions

This section describes the procedure for testing whether announcements of changes in the foreign investment restrictions in the Philippines are associated with changes in the FPF's premiums or discounts.

If the existing international investment barriers prior to the regulatory changes are effective, an announcement of a liberalization of investment restrictions should be associated with an increase in the discount of the FPF. The null hypothesis is that announcements of liberalization of international investment restrictions in the Philippines do not affect the FPF's discounts. The alternative hypothesis is that announcements of liberalization of international investment restrictions increase the discount of the fund. We only consider the impact of announcements related to a relaxation of investment restrictions since all of the events in the sample happen to involve some form of liberalization.

We test this hypothesis using the regression model:

$$\Delta PD_t=\beta_0+\beta_1 D_{1t}+\beta_2 D_{2t}+\beta_3 D_{3t}+\varepsilon_t \tag{1}$$

where ΔPD_t is the change in the fund's discount in week t, $D_{1t}=1$ if t is between two and seven weeks before the announcement of a relaxation of the Philippines' investment restrictions and 0 otherwise, $D_{2t}=1$ if t is between one week before and one week after the announcement of a relaxation of the Philippines' investment restrictions and 0 otherwise, and $D_{3t}=1$ if t is between two and seven weeks after the announcement of a relaxation of the Philippines' investment restrictions and 0 otherwise.[11] A three-week window is used as the event period in order to reduce the potential for bias in the estimates of the coefficients in Equation (1) due to the effects of nonsynchronous trading, lagged reporting of the fund's price and NAV and possibly lagged reporting of the event itself. Table 3.1 shows that there are some positive and statistically significant noncontemporaneous cross-correlations between the fund's share price changes and changes in NAV. In particular, the statistically significant cross-correlation coefficient of 0.14 at lag -1 indicates that a change in the fund's share price over one week predicts the change in the fund's NAV over the next week. On the other hand, the cross-correlation coefficient of 0.23 at lag 1 suggests that a change in the NAV over one week predicts the change in the fund's share price over the next week. These are consistent with reporting lags or nonsynchronous trading which cause recorded prices and NAVs to respond at different times to new information.[12]

The parameters β_1, β_2, and β_3 measure the effects on the FPF's discount changes of announced changes in international investment restrictions in the Philippines. The coefficient β_1 measures the average weekly change in the fund's discount prior to the announcement of regulatory changes; β_3 measures the average weekly change in the fund's discount after the announcement while β_2 measures the average weekly change in the fund's discount during the three-week period surrounding the announcement. These parameters are estimated using ordinary least squares and their statistical significance are determined based on Newey and West (1987) adjusted standard errors and t-statistics which are robust to serial correlation and heteroscedasticity.[13] Holding all other things constant, the coefficient β_2 should not be significantly different from zero under the null hypothesis. On the other hand, under the alternative hypothesis, this coefficient should be negative and statistically significant if the barriers to international investments that existed before the announced liberalizations have effectively restricted foreign access to the Philippine capital market..

Prior to estimating Equation (1), we adjust the fund's discount changes to remove any dividend/capital gains payment announcement effect and ex-dividend/capital gains effect. The details of the adjustment procedures are discussed in the Appendix B of Bonser-Neal et al. (1990).[14]

3.4. EMPIRICAL RESULTS

Table 3.2 shows the results of estimating Equation (1). The t-ratios reported in parentheses below the estimated coefficients are for one-tailed tests of the null hypothesis that $\beta_i \geq 0$ against the alternative that $\beta_i < 0$, $i=1$, 2 and 3.

The estimate of the coefficient β_2 indicates that, on average, an announcement of a relaxation of investment restrictions in the Philippines is associated with a 0.45% increase in the fund's discount. However, while the estimate of the coefficient β_2 is of the expected sign, the null hypothesis that the announcement of a liberalization of investment restrictions has no effect on the fund's discount during the three weeks surrounding the announcement cannot be rejected at the conventional levels of significance. This result suggests that U.S. investors did not react to the announced liberalizations during the event period.

Table 3.2 also reports the results of testing the null hypotheses that discounts do not increase during the weeks before and after the announcement period. The hypothesis that $\beta_1 \geq 0$ cannot be rejected at the conventional levels of significance. This indicates that U.S. investors did not react prior to the announcement period. Likewise, the hypothesis that $\beta_3 \geq 0$ cannot be rejected at the conventional levels of significance, suggesting that there is no delayed response to the announced regulatory changes.[15]

Overall, the results indicate that U.S. investors did not respond to the aggregate announcement of relaxations in international investment restrictions during the sample period. This finding suggests either that U.S. investors perceived the prior restrictions as ineffective or that they viewed the announced regulatory changes as unimportant (i.e. not a major relaxation of existing restrictions).

That the insignificant announcement effect suggests that the prior international investment restrictions in the Philippines have been viewed by U.S. investors as ineffective is somewhat surprising since prior to the major liberalization of the Philippine foreign investment policy in November 1991, foreign investors perceived the then existing restrictions as impediments to foreign investments. In particular, foreign investors have expressed that the foreign equity ownership restrictions of the Philippines is the most stringent among all ASEAN countries (see Unite, 1995). As was discussed in Chapter 1, foreign participation was limited to 40% of equity in most businesses in the Philippines prior to this policy change. Ownership restrictions are most often effective for these firms since most companies that fall into these restricted areas generally classify their shares into two categories: "A" shares and "B" shares. That this restriction is effective is evidenced by the fact that the Central Bank of the Philippines can monitor stock purchases by foreigners as they are legally allowed only to purchase "B" shares. Moreover, the Central Bank requires that such acquisitions be registered in order to qualify for repatriation of dividends and the proceeds resulting from subsequent sale. On the other hand, before the liberalization of the banking sector, entry of foreign banks and equity ownership of domestic banks and financial institutions by foreigners were highly regulated by the Central Bank of the Philippines via the General Banking Act and other laws under the supervision of the Central Bank. Moreover, under prior foreign exchange regulations, repatriation of capital and remittance of dividends and interest require approval by the Central Bank and were staggered from three to nine years.

Previous studies using closed-end country funds to gauge the impact of capital market liberalization have concentrated on analyzing the effect of the aggregate announcements of such regulatory changes. It is possible that when such studies find insignificant announcement effects, it could have been because they did not differentiate between announcements which are more likely to be important to foreign investors wishing to directly participate in the domestic stock market and those which are not.[16] Therefore, it is possible that a significant announcement effect is observed only if the restrictions are effective and at the same time U.S. investors perceive the announced liberalization of the restriction as important (i.e., a major relaxation). Consequently, the prior international investment restrictions in the Philippines may have been effective but the significant effect of important announcements on the FPF's discount changes are washed out by the insignificant effects of announcements which are deemed unimportant by investors. This possibly resulted to the overall announcement effect being insignificant when all announcements are considered collectively. We discount the possibility that the announced changes were fully anticipated since the pre-announcement coefficient is found to be insignificant.

In order to test this hypothesis, we classify the events in the sample into three groups: (a) announcements related to a major relaxation of foreign equity participation limits via the Foreign Investment Act of 1991 (events dated 6/6/91 and 6/22/94), (b) announcements related to relaxation of foreign exchange restrictions (events dated 1/3/92 and 8/10/92), and (c) announcements related to the liberalization entry of foreign banks to operate in the Philippines which is not covered by the Foreign Investment Act of 1991 (event dated 10/14/94). Although both involve a major relaxation of foreign equity participation limits, the last category was treated separately from the first one because it applies more to direct equity investors, who seek a degree of control over the local company, than to individual portfolio investors.

The new regression model is:

$$\Delta PD_t = \alpha_0 + \alpha_1 FIA_{1t} + \alpha_2 FIA_{2t} + \alpha_3 FIA_{3t} + \alpha_4 FX_{1t} + \alpha_5 FX_{2t} + \alpha_6 FX_{3t} + \alpha_7 BK_{1t} + \alpha_8 BK_{2t} + \alpha_9 BK_{3t} + u_t \quad (2)$$

where ΔPD_t is the change in the fund's premium in week t, FIA_{1t}=1 if t is between two and seven weeks before the announcement of a liberalization of the foreign equity participation limits in economic areas other than banking and 0 otherwise, FIA_{2t}=1 if t is between one week before and one week after the announcement of a liberalization of the foreign equity participation limits in economic areas other than banking and 0 otherwise, and FIA_{3t}=1 if t is between two and seven weeks after the announcement of a liberalization of the foreign equity participation limits in economic areas other than banking and 0 otherwise; FX_{1t}=1 if t is between two and seven weeks before the announcement of a liberalization of foreign exchange restrictions and 0 otherwise, FX_{2t}=1 if t is between one week before and one week after the announcement of a liberalization of foreign exchange restrictions and 0 otherwise, and FX_{3t}=1 if t is between two and seven weeks after the announcement of a loosening of the foreign exchange restrictions and 0 otherwise; BK_{1t}=1 if t is between two and seven weeks before the announcement of liberalization of entry of foreign banks and 0 otherwise, BK_{2t}=1 if t is between one week before and one week after the announcement of liberalization of entry of foreign banks and 0 otherwise, and BK_{3t}=1 if t is between two and seven weeks after the announcement of liberalization of entry of foreign banks and 0 otherwise. Longer windows for the pre- and post-announcement periods were also considered but they produced similar results.

The coefficients α_2, α_4 and α_6 measure the average weekly change in the fund's discount during the three-week period surrounding the announcement of regulatory changes in foreign equity participation limits on economic areas other than banking, foreign exchange restrictions, and foreign banks entry restrictions, respectively. α_1, α_4 and α_7 measure the average weekly effect on the fund's discount before the announcement of regulatory changes on foreign equity participation limits on economic areas other than banking, foreign exchange restrictions and foreign banks entry restrictions, respectively. The coefficients α_3, α_6 and α_9 capture the effects of changes in the fund's discount after the announcement of regulatory changes on foreign equity participation limits on economic areas other than banking, foreign exchange restrictions and foreign banks entry restrictions, respectively.

Table 3.3 summarizes the results of estimating Equation (2). The t-ratios reported in parentheses below the estimated coefficients are for one-tailed tests of the null hypothesis that $\alpha_i \geq 0$ against the alternative that $\alpha_i < 0$, i=1 to 9.

The estimate of the coefficient α_2 indicates that during the three-week event period, an announcement of a liberalization of foreign equity participation limits in economic areas other than banking is on average associated with a 1.53% increase in the fund's discount. The Newey-West adjusted t-ratio suggests that the null hypothesis that the announcement of a relaxation of foreign equity participation restrictions has no effect on the fund's discount during the three weeks surrounding the announcement can be rejected at the 1 percent level of significance.

On the other hand, although the estimate of the coefficient corresponding to announcements of relaxation of foreign exchange restrictions, α_4, is of the expected sign, it is statistically insignificant, suggesting that announcement of a liberalization of foreign exchange restrictions has no effect on the fund's discount during the three weeks surrounding the announcement. Meanwhile, the estimate of the coefficient corresponding to the announcement of the liberalization of entry of foreign banks in the Philippines, α_6, is positive, contrary to what is expected. However, this estimated coefficient is statistically insignificant suggesting that the announcement of the liberalization of entry of foreign banks in the Philippines has no effect on the fund's discount.

For each group of announcements, the results of testing the null hypothesis that the fund's discounts do not increase during the weeks before the event period are also reported in Table 3.3. The hypothesis that $\alpha_1 \geq 0$, $\alpha_4 \geq 0$ or $\alpha_7 \geq 0$, cannot be rejected at the conventional levels of significance. These results suggest that changes in Philippine investment restrictions on each of the three groups of announcements have not been anticipated by U.S. investors. These results also indicate that the insignificant effects for announcements related to regulatory changes in foreign exchange restrictions and liberalization of entry of foreign banks is not a consequence of the announcements having been anticipated by U.S. investors. Likewise, the null hypotheses that the FPF's discounts do not fall during the weeks after the event period for each group of announcements are also tested. The null hypothesis that $\alpha_3 \geq 0$, $\alpha_6 \geq 0$, or $\alpha_9 \geq 0$ cannot be rejected at the conventional levels of significance indicating that there is no delayed response to each group of announcements.

The finding of a significant effect for announcements related to the relaxation of foreign equity participation in most areas of economic activity other than banking suggests that U.S. investors view these regulatory changes as important and the existing restrictions as effective. In fact, the passage of the Foreign Investment Act of 1991 which opened virtually all areas of economic activity to up to 100% foreign ownership is considered as the most resolute step taken by the Philippine government to reverse its once unfriendly attitude towards foreign investors.

On the other hand, the insignificant effects of announcements related to the liberalization of foreign exchange restrictions and relaxation of restrictions on entry of foreign banks suggest that U.S. investors perceive the announced changes as relatively unimportant. Prior to the announced foreign exchange liberalization which allowed full and immediate repatriation of foreign investment proceeds without need for prior approval by the Central Bank of the Philippines, full repatriation and remittance privileges for foreign investments were already allowed though on a staggered basis and subject to approval by the Central Bank. The announced liberalization of entry of foreign banks effected via a purchase of 60% of the voting stock of an existing domestic bank or through a new banking subsidiary incorporated in the Philippines may have been viewed by individual portfolio investors as unimportant. This is because banking liberalization mostly affects institutional investors who seek control of the domestic enterprise through direct investment than individual portfolio investors who seek potential global diversification benefits via country funds. Bodhurta et al. (1995) document that as of December 1990, institutional ownership in the First Philippine Fund only constitute 12% of the total shares of the fund. Alternatively, the U.S. investors may have perceived this announcement to be of minor importance relative to the announced opening up of other sectors of economic activity.

The events in the sample were also classified simply into two groups: announcements related to the liberalization of foreign equity participation limits (Foreign Investment Act of 1991 and banking liberalization combined) and those related to a liberalization of foreign exchange restrictions. The results, reported in Table 3.4, are similar to those of the second model, though weaker in terms of statistical significance. On average, an announcement of relaxation of foreign equity limits in general are associated with a 0.93% increase in the discount of the FPF country fund during the three week period surrounding the announcement. This announcement effect is statistically significant at the 0.07 level, although weaker than when announcements related to the Foreign Investment Act of 1991 are classified in a separate group. On the other hand, the estimated coefficient corresponding to the announcement of relaxation of foreign exchange restrictions is positive, contrary to what is expected. However, this coefficient is statistically insignificant. The test of the hypothesis that the fund's discounts rise during the weeks prior to the announcement period can be rejected at the conventional levels of significance for each group of announcements. This implies that the announcements have not been anticipated by investors. Likewise, there are no indications of delayed response to the announced regulatory changes.

The finding that announcements related to the relaxation of foreign equity participation limits is significant suggests that the existing barriers in this category effectively restrict foreign investors access to the Philippine equity market. However, that the announcement effect is weakly significant when the banking liberalization is included in the announcements related to the Foreign Investment Act of 1991 suggests that the impact on the fund's discount is stronger only when the foreign equity ownership other than banking is relaxed.

3.5. CONCLUSION

In this study, we investigate the impact of liberalization of international investment restrictions in the Philippines on the discounts of the First Philippine Fund closed end country fund. We test whether announcements of changes in investment restrictions are associated with changes in the fund's premiums and discounts. If the barriers to international investments are effective, announced liberalizations of restrictions should reduce the premium or increase the discount of the country fund.

The overall results suggest that there is evidence supporting the hypothesis that changes in the FPF's discounts are associated with announcements of changes in international investment restrictions. However, although there are indications that the existing barriers are effective, a significant relationship appears to hold only when announcements are deemed important by U.S. investors. Specifically, the results suggest that announcements of liberalization of investment restrictions that limit foreign equity participation in areas of business other than banking and financial institutions is significantly associated with an increase in the fund's discount. On the other hand, the announcements related to the relaxation of foreign exchange restrictions (in particular the removal of restrictions on the ability of foreign investors to repatriate investments and dividends) and liberalization entry of foreign banks to operate in the Philippines seem to be viewed by individual portfolio investors as relatively unimportant. There are no indications that the investors fully anticipated these announcements.

The findings of the study provide evidence that the Philippine barriers to international investments represented by foreign equity ownership limits in most economic activities have been effective and that announced liberalization of this restriction is deemed important by U.S. investors. The results also indicate that the foreign equity ownership restriction has been effective in segmenting the Philippine equity market. One implication of this evidence is that, all else constant, the foreign equity ownership restrictions raised the required return on Philippine equities. To the extent that Philippine companies finance new investment projects through the stock market, ownership restrictions increased the cost of capital for the domestic firms. Therefore, the finding that the FPF's discount increases with the liberalization of ownership restrictions implies a reduction in the cost of raising capital in the Philippine stock market.

Table 3.1: Sample Cross-Correlations Between Fund Share Price Changes and Net Asset Value Changes of the FPF Closed-end Country Fund Computed Using Weekly Data from March 30, 1990 to December 29, 1995[a]

Lag												
-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
0.07	0.03	0.01	0.06	-0.02	**0.14**	**0.54**	**0.23**	0.04	**0.2**	-0.01	-0.08	-0.05
(1.26)	(0.55)	(0.10)	(1.05)	(0.30)	**(2.48)***	**(11.07)***	**(4.08)***	(0.64)	**(3.48)***	(0.25)	(1.42)	(0.89)

[a] Figures in parentheses are t-ratios
The superscript * denotes significance at the 0.01 level.

Table 3.2: Test of the Effect of Changes in Philippine International Investment Restrictions on the FPF Closed-end Country Fund Discount Using Weekly Data from March 30, 1990 to December 29, 1995[a]

$$\Delta PD_t = \beta_0 + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \varepsilon_t$$

where ΔPD_t is the change in the FPF's discount in week t

$D_{1t}=1$ if t is between two and seven weeks before the announcement of a loosening of the Philippines' investment restrictions and 0 otherwise

$D_{2t}=1$ if t is between one week before and one week after the announcement of a loosening of the Philippines' investment restrictions and 0 otherwise

$D_{3t}=1$ if t is between two and seven weeks after the announcement of a loosening of the Philippines' investment restrictions and 0 otherwise.

Parameter	Estimate
β_0	-0.034
	(-0.23)
β_1	0.188
	(0.33)
β_2	-0.449
	(-0.83)
β_3	0.05
	(0.09)
$\bar{R}^2$	0.0015

[a] Figures in parentheses are t-ratios for tests of the hypotheses $\beta_i \geq 0$ against the alternative that $\beta_i < 0$, $i=0, 1, 2, 3$, based on OLS regression with standard errors computed using the Newey-West (1987) correction for heteroscedasticity and 3rd-order serial correlation.

Table 3.3: Tests of the Effect of Changes in Philippine International Investment Restrictions by Category of Regulatory Change on the FPF Closed-end Country Fund Discount Using Weekly Data from March 30, 1990 to December 29, 1995 [a]

$$\Delta PD_t = \alpha_0 + \alpha_1 FIA_{1t} + \alpha_2 FIA_{2t} + \alpha_3 FIA_{3t} + \alpha_4 FX_{1t} + \alpha_5 FX_{2t} + \alpha_6 FX_{3t} + \alpha_7 BK_{1t} + \alpha_8 BK_{2t} + \alpha_9 BK_{3t} + u_t$$

where ΔPD_t is the change in the FPF's discount in week t

FIA_{1t}=1 if t is between two and seven weeks before the announcement of a loosening of the foreign equity participation limits in economic areas other than banking and 0 otherwise

FIA_{2t}=1 if t is between one week before and one week after the announcement of a loosening of the foreign equity participation limits in economic areas other than banking and 0 otherwise

FIA_{3t}=1 if t is between two and seven weeks after the announcement of a loosening of the foreign equity participation limits in economic areas other than banking and 0 otherwise:

FX_{1t}=1 if t is between two and seven weeks before the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

FX_{2t}=1 if t is between one week before and one week after the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

FX_{3t}=1 if t is between two and seven weeks after the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

BK_{1t}=1 if t is between two and seven weeks before the announcement of liberalization of entry of foreign banks and 0 otherwise

BK_{2t}=1 if t is between one week before and one week after the announcement of liberalization of entry of foreign banks and 0 otherwise

BK_{3t}=1 if t is between two and seven weeks after the announcement of liberalization of entry of foreign banks and 0 otherwise.

Parameter	Estimate
α_0	-0.034
	(-0.23)
α_1	0.473
	(0.44)
α_2	**-1.529**
	(-2.88)*
α_3	0.055
	(0.07)
α_4	-0.325
	(-0.48)
α_5	0.28
	(0.36)
α_6	0.49
	(0.69)
α_7	0.646
	(0.66)
α_8	0.254
	(0.47)
α_9	-0.842
	(-0.75)
R^2	0.0103

[a] Figures in parentheses are t-ratios for tests of the hypotheses $\alpha_i \geq 0$ against the alternative that $\alpha_i < 0$, i=0, 1,2,...,9, based on OLS regression with standard errors computed using the Newey-West (1987) correction for heteroscedasticity and 3rd-order serial correlation.

The superscript * denotes significance at the 0.01 level.

Table 3.4: Tests of the Effect of Changes in Philippine International Investment Restrictions by Category of Regulatory Change on the FPF Closed-end Country Fund Discount Using Weekly Data from March 30, 1990 to December 29, 1995[a]

$$\Delta PD_t = \gamma_0 + \gamma_1 FIABK_{1t} + \gamma_2 FIABK_{2t} + \gamma_3 FIABK_{3t} + \gamma_4 FX_{1t} + \gamma_5 FX_{2t} + \gamma_6 FX_{3t} + \eta_t$$

where ΔPD_t is the change in the FPF's discount in week t

$FIABK_{1t}=1$ if t is between two and seven weeks before the announcement of a loosening of the foreign equity participation limits in economic areas including banking and 0 otherwise

$FIABK_{2t}=1$ if t is between one week before and one week after the announcement of a loosening of the foreign equity participation limits in economic areas including banking and 0 otherwise

$FIABK_{3t}=1$ if t is between two and seven weeks after the announcement of a loosening of the foreign equity participation limits in economic areas including and 0 otherwise:

$FX_{1t}=1$ if t is between two and seven weeks before the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

$FX_{2t}=1$ if t is between one week before and one week after the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

$FX_{3t}=1$ if t is between two and seven weeks after the announcement of a loosening of the foreign exchange restrictions and 0 otherwise

Parameter	Estimate
γ_0	-0.034
	(-0.23)
γ_1	0.531
	(-0.67)
γ_2	**-0.934**
	(-1.55)* **
γ_3	-0.244
	(-0.36)
γ_4	-0.325
	(-0.48)
γ_5	0.280
	(0.36)
γ_6	0.490
	(0.69)
R^2	0.0068

[a] Figures in parentheses are t-ratios for tests of the hypotheses $\gamma_i \geq 0$ against the alternative that $\gamma_i < 0$, $i=0, 1, 2, \ldots, 6$, based on OLS regression with standard errors computed using the Newey-West (1987) correction for heteroscedasticity and 3rd-order serial correlation.

The superscript *** denotes significance at the 0.07 level.

Figure 3.1. First Philippine Fund Weekly Premium(Discount)
November 24, 1989 to December 29,1995

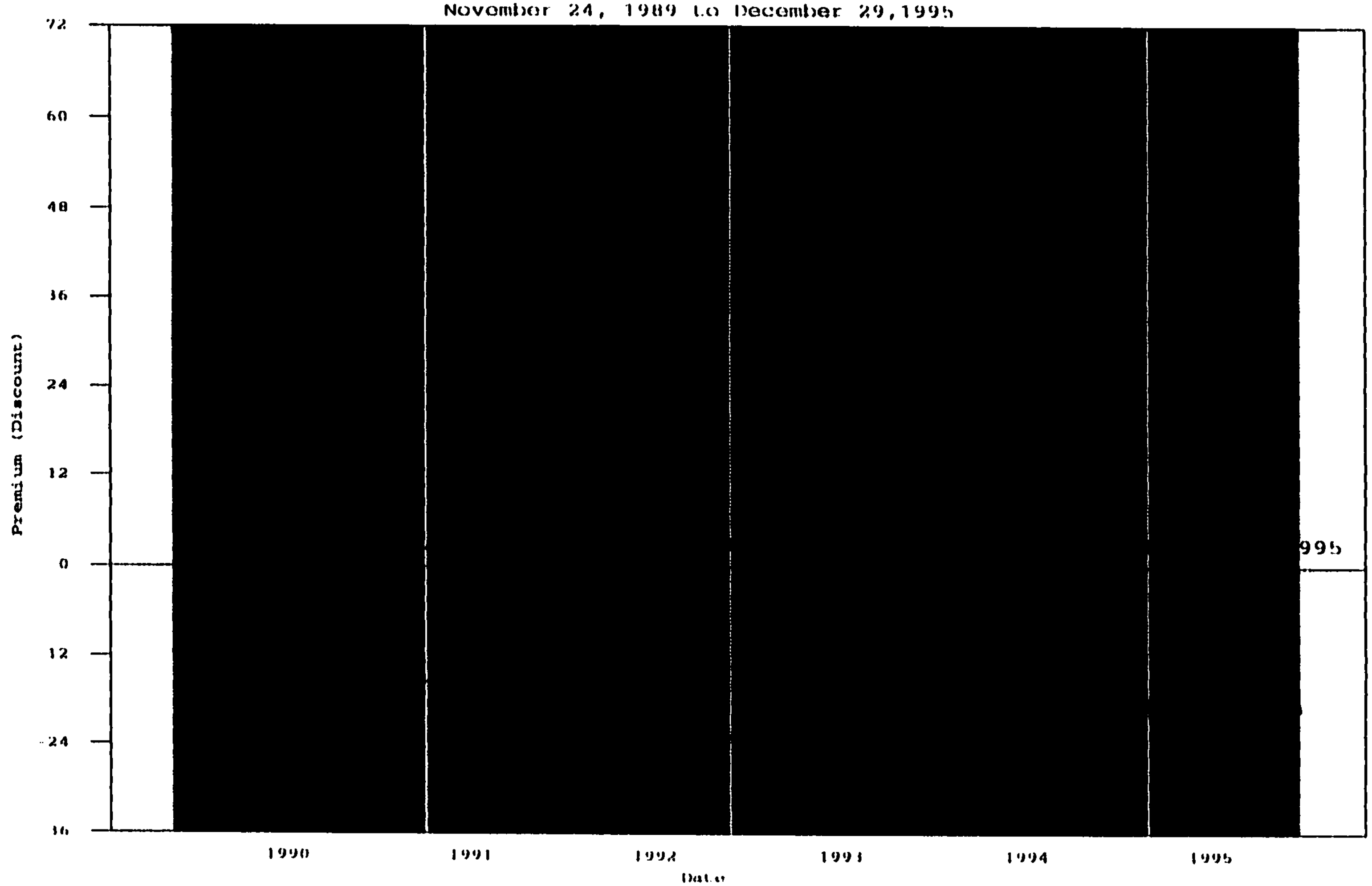
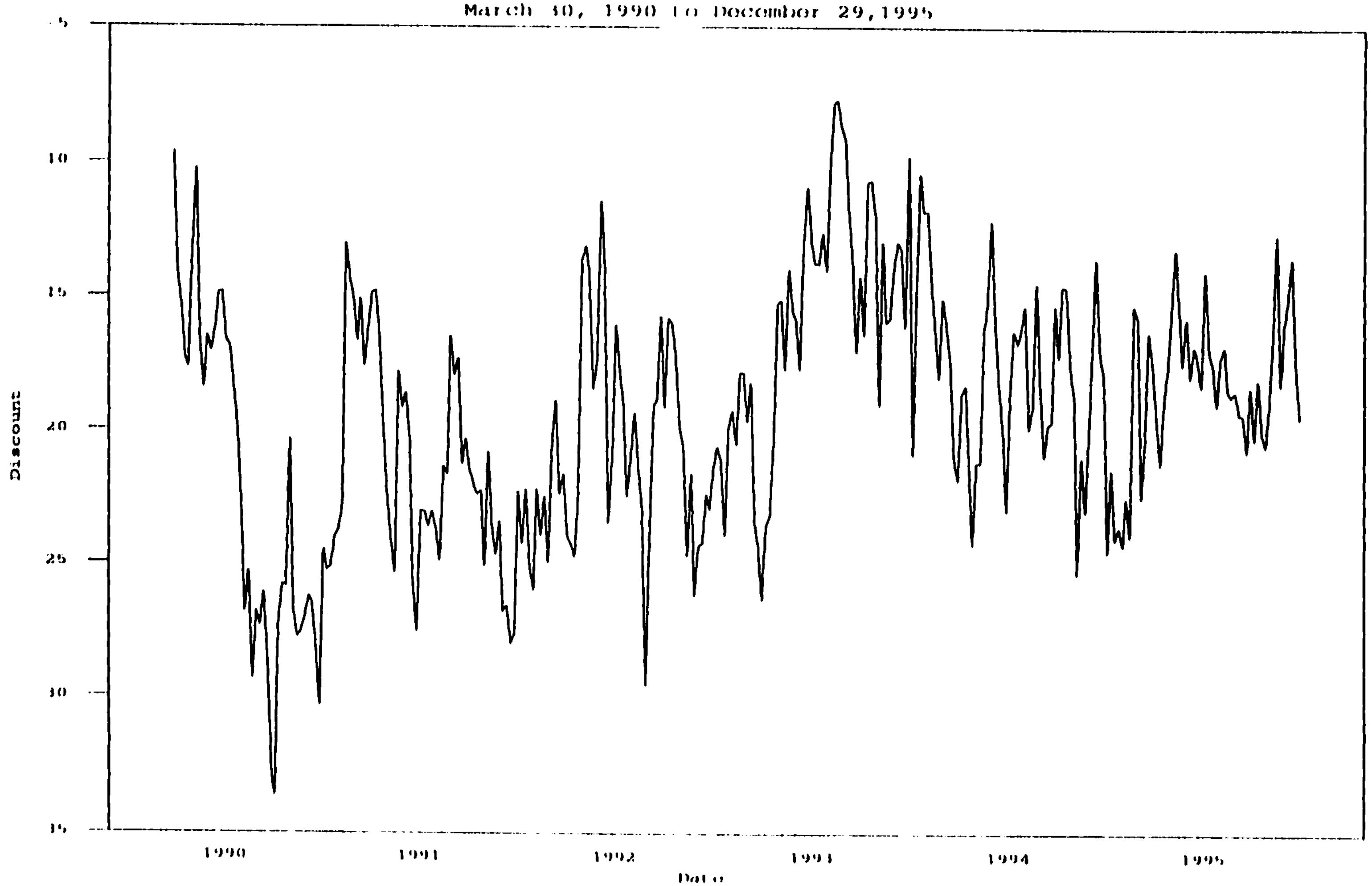


Figure 3.2. First Philippine Fund Weekly Discount

March 30, 1990 to December 29,1995



Notes

1. Nondiversified means that the country fund is not limited by the US Investment Company Act of 1940 in the proportion of its assets that it may invest in the securities of a single issuer (Standard & Poor's, 1989).

2. It must be noted, however, that not all companies follow this "A" share/"B" share convention. Exceptions include (a) companies that are not involved in restricted areas of business and do not own land and (b) companies that float a sufficiently small percentage of their shares so that even if all those floated shares were purchased by foreigners it would not violate foreign ownership restriction (see Rodrigo, 1993).

3. In addition, the international asset pricing models of Black (1974) and Stulz (1981) provide implications on the relationship between barriers to international investments and country funds' price-to-NAV ratios. However, the models of Eun and Janakiramanan (1986) and Hietala (1989) seems to capture better the nature of investment restrictions in the Philippine equity market. Black (1974) and Stulz (1981) assume that international investment barriers take the form of a tax on holdings of foreign risky assets by domestic investors which make it costly to hold foreign securities relative to domestic securities. The restriction essentially places a limit on the amount of capital that domestic investors can export. Both models predict that the expected return on long positions on foreign assets will exceed the expected return on a domestic asset of the identical risk by the rate at which such holdings are taxed thereby ensuring that after-tax expected returns on the two assets are the same. The closed-end country funds, whose underlying shares are foreign risky assets, are analogous to long positions on foreign risky assets indirectly taken by domestic investors while the country funds' shares themselves can be considered as domestic assets of about the same risk. Therefore, these models suggest that international investment restrictions that make it costly for a domestic investor to hold foreign assets relative to domestic assets will increase the required return on the country funds' underlying assets relative to the required return on the funds' shares themselves. Consequently, the imposition of effective or binding restrictions in a country will increase the price-to-NAV ratio investing in that country by an amount related to the tax exacted.

4. Chang, Eun and Kolodny (1995), Johnson, Schneeweis and Dinning (1993), and Diwan, Errunza and Senbet (1993) provide evidence of international diversification benefits through investment in closed-end country funds, especially the funds devoted to emerging markets' securities.

5. Stylized facts seem to support this argument. For example, Mullin (1993) reports that during the mid-1980s, closed-end country funds were the primary, and in some cases only available, means through which foreign portfolio investors 'purchased' emerging market equities. However, the issuance of such funds peaked in 1990 at US$3.4 billion and then declined to US$1.2 billion in 1991. This decline is in contrast to the observed rapid increase of international placements and direct equity portfolio inflows during the

same period. He cites that an apparent reason for the dampened demand for closed-end country fund shares and acceleration of direct equity portfolio inflows can be attributed to capital market liberalization reforms instituted by several developing countries, which reduced the impediments to direct equity purchases by foreigners. To support this argument, Mullin (1993) provides an inventory of liberalization of restrictions on foreign access to the equity markets of developing countries including Argentina, Brazil, Chile, Mexico, Korea, Taiwan, Malaysia, Thailand and India which have occurred during the period 1989 to 1992.

6. Although the FPF was listed on November 8, 1989, it began trading only on November 15, 1989 (Standard & Poor's, 1990).

7. Note, however, that investments in Philippine equities represented 57.3% of net assets of the fund as of June 30, 1991 and at 96.2% as of June 30, 1995 (Standard & Poor's NYSE Stock Reports, 1991 and 1995).

8. Hardouvelis et al. (1994) examine the extent to which the noise-trader model of asset prices (De Long, Shleifer, Summers and Waldman, 1990) can explain the empirical regularities of the weekly price behavior of 35 country funds that traded on the New York and American stock exchanges between 1986 and 1993. A feature of the noise trader model is the variation in the demand of noise traders arising from shifts in sentiment or misperceptions of fundamental value. Among other things, they find that like their domestic counterparts, country funds are typically issued at a premium and that the premium declines by approximately 20% over the 24 weeks following the initial public offering. They argue that this is consistent with the predictions of the noise-trading model. One prediction of this model is that a new fund will be issued only when sentiment for the fund is high. The premium at the initial offering of a country fund is then explained by the ability of fund organizers to time the issuance of funds to coincide with positive investor sentiment (e.g., bullish investor sentiment for a country). On the other hand, the subsequent deterioration in the premium is explained by mean-reversion in investor sentiment.

9. Per closed-end fund reporting conventions, dividends and capital gains are deducted from reported NAV when the shares go ex-dividend and not on the dividend payment date.

10. Direct investments are investments which give the investor some degree of control over the funds invested (e.g. acquisitions of 10-25% of voting shares of a company) while portfolio investments are not afforded such control (e.g. purchases of bonds and equity ownership of less than 10-25% of voting shares) (see International Monetary Fund, 1977).

11. A similar model is employed by Bonser-Neal et al. (1990).

12. Bonser-Neal et al. (1990) and Bodurtha et al. (1995) argue that the positive cross-correlations in the price and NAV of country funds could be an artifact of nonsynchronous SP and NAV measurements due to the timing differences between the foreign country stock market and the NYSE. As mentioned earlier, there is a 17-hour difference between the Philippine Stock Exchange close and New York's close. This might introduce a bias in the results if the event window is confined to the announcement week. The potential for bias can be illustrated as follows. As discussed in the Theoretical Framework, *ceteris paribus*, the introduction of binding restrictions will increase a country fund's price-to-NAV ratio above the level prevailing in the absence of such restrictions by approximately the amount the investor is willing to pay to avoid the restrictions. Say, the Philippine government announces a relaxation of its foreign investment restrictions. Since the removal of investment barriers that reduces the cost for the U.S. investor of directly holding Philippine equities will reduce the required return on the fund's underlying assets relative to the required return on the fund's shares, the price and NAV of the FPF rise in response to the announcement. If the prevailing restrictions prior to the announced liberalization are binding, the fund's price-NAV ratio will fall; i.e. the fund's premium decreases or the discount increases. However, if NAVs are reported with some lag, the fund's price will change before its NAV changes and the fund's premium will rise (discount will decrease) in the announcement week. The decrease in premium (or increase in discount) would only become evident the following week, when both the fund price and its NAV would have completely adjusted.

13. The sample autocorrelations of the first 6 lags of the changes in percentage discounts for the FPF are -0.19, -0.07, -0.12, -0.03, -0.03 and 0.01, respectively. The first- and third- order autocorrelation coefficients are found to be significant at the 0.05 level while coefficients at higher-order lags are all insignificant. These suggest that the residuals of regression model (1), as well as the other models considered in this study, are likely to be serially correlated. The pattern of the regression models residuals' autocorrelations confirms our initial diagnostics. It is also possible that, as a result of the various liberalization announcements, the fund's discount changes may not be homoscedastic. Consequently, we employ a heteroscedasticity and autocorrelation consistent estimate of the variance-covariance matrix of the OLS estimates based on the procedure proposed by Newey and West (1987).

14. Four discount changes are adjusted because they cover dividend announcement and ex-dividend periods. The adjusted discount change series has about the same mean though slightly higher standard deviation than the unadjusted discount change series. The mean of the adjusted discount change series is -0.030 compared to -0.033 for the unadjusted series. The standard deviation of the adjusted discount change series is 3.035 compared to 2.998 for the unadjusted series. We also estimated Equation (1) using the unadjusted discount changes but there is a very minor difference in the results compared to those reported in this paper.

15. The results of using longer pre- and post- announcement windows are not very much different from those reported here.

16. For example, Bonser-Neal, et al. (1990) find the effect of aggregate announced regulatory changes to be insignificant in the case of the Taiwan Fund.

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Chapter 4

Philippine Capital Market Liberalization and International Transmission of Stock Market Movements

4.1. Purpose of the Study

This paper examines the short-run dynamic relationships among the stock markets of the Philippines and its major economic partners, namely, Taiwan, Japan, Hong Kong Singapore, and the United States during the period 1980 to 1995. In particular, we investigate (a) whether there is transmission of returns and returns volatility from each of the foreign stock markets to the Philippine stock market and (b) the impact of the recent liberalization of the Philippine capital market on the responsiveness of the Philippine stock market to such spillovers. The analysis is performed in the multivariate framework using the multivariate Generalized Autoregressive Conditional Heteroscedasticity (MGARCH) family of statistical models.

4.1.1. Theoretical Framework and Previous Empirical Studies

There are several reasons why the returns and returns volatilities of the Philippines and those of Taiwan, Japan, Hong, Kong, Singapore and the United States may be related.[1] One possible reason for such interdependence arises from the linkage of the Philippine economy to these countries through international trade and foreign investment.[2] As mentioned in Chapter 2, these economies are the Philippines' major trading partners and sources of foreign investments so that any news about the economic fundamentals in these countries will most likely influence the Philippine market fundamentals. Consequently, if stock market movements in these markets are caused by the arrival of fundamental news, then such news originating from the foreign markets will eventually be reflected in the domestic stock prices as rational investors, stock brokers and portfolio managers in the Philippines respond to observed price changes in these other markets. Under this reasoning, we should observe return and return volatility spillovers among the Philippines and the foreign markets of interest whether or not there is cross-country stock trading.

Secondly, models of international asset pricing, e.g. Stulz (1981) and Errunza and Losq (1985), can allow for correlations of stock returns in different countries. Under these models, barriers to international investments that are imposed by countries may effectively segment these countries' capital markets from those of the open markets. Suppose developments in country A lead to changes in this country's asset prices. These models imply that countries whose capital markets are not segmented from that of country A will also experience asset price changes as asset returns equalize between country A and the other countries. Equalization of returns may be achieved via cross-country investing or arbitrage activities since there are no effective barriers to international capital flows in integrated markets. On the other hand, countries whose capital markets are segmented from those of country A will not exhibit asset price changes since effective barriers to capital flows which segment these countries' markets can isolate these countries' capital markets from forces which tend to equalize returns across integrated markets. Based on this reason, we expect transmission of stock price movements from the other international markets in this study to the Philippine market since the cointegration results in Chapter 2 suggest that the Philippine equity market has become integrated with these international markets possibly as a result of recent liberalization and internationalization of the domestic capital market. The following studies also tend to support this reasoning.

Bailey (1990) examines the effect of U.S. money supply announcements on the U.S. stock market and 9 Pacific Rim stock markets, including the Philippines, Hong Kong, Japan, Singapore, and Taiwan over the period October 1977 to September 1985. He finds that the stock market indexes of countries with relatively few barriers to portfolio investment flows, such as Hong Kong, Singapore and Japan, react in a manner similar to the U.S. stock market index. That is, unexpectedly high (low) M1 growth in the U.S. is associated with negative (positive) stock returns in these countries. On the other hand, the stock market indexes of the Philippines, Korea, Taiwan, and Thailand are uncorrelated with U.S. M1 shocks. He notes that during the period 1977 to 1985 Korea and Taiwan imposed severe capital flow barriers while the Philippines and Thailand have significant capital flow barriers. Moreover, he finds that the differing effect of U.S. M1 surprises across the Pacific Rim countries cannot be explained by differences in the levels of exports of these countries to the U.S.

Ng, Chang and Chou (1991) investigate the transmission of volatility from the U.S. stock market to the stock markets of Japan, Korea, Taiwan, and Thailand over the period January 1985 to December 1987. Using daily national stock market index returns data, they estimate a univariate GARCH(1,1) model for the conditional return volatility process with first-order moving average in the mean return equation and an ARCH-in mean term for the U.S. stock market. They estimate a similar model for each of the Asian markets except that their conditional return volatility equations include previous period's U.S. squared residuals as a measure of volatility spillovers from the U.S. market. Their results suggest volatility spillover from the U.S. to Japan and Thailand but not to Korea and Taiwan. Korea and Taiwan are the two markets with the most severe restriction on cross-country investing. In addition, they investigate the impact of institutional changes aimed at reducing foreign entry barriers to the equity markets of Japan and Thailand on volatility spillover from the U.S. market to these Asian stock markets. They find evidence of an increase in volatility spillover from the U.S. market to the stock markets of Japan and Thailand after changes which facilitated cross-country investing in these countries have been instituted. Altogether, they take their results as suggesting that cross-country trading itself is necessary for volatility spillover to occur and that simply receiving past information about the U.S. market is not enough to induce volatility spillover.

Chowdhury (1994) investigates the interdependencies among the daily returns on the stock market indexes of four Asian Newly Industrializing Economies (NIEs) and those of Japan and the U.S. over the period 1986 to 1990. Using variance decomposition and impulse response functions analysis based on the vector autoregression (VAR) model, he finds a significant transmission of stock price movements from the markets of Japan and the U.S. to the stock markets of Hong Kong and Singapore but not to those of Korea and Taiwan. He argues that a possible reason for this is that the stock markets of Taiwan and Korea have severe restrictions on cross-country investing, in contrast to the relatively open markets of Hong Kong and Singapore. Moreover, his results suggest a bi-directional price spillover between the U.S. and Japanese markets. None of the Asian markets, except Japan, have any impact on the U.S. stock market.

Rogers (1994) examines the relationship between international investment barriers and the international transmission of daily stock price changes (i.e. returns) among 10 international stock markets, including Japan, the U.S., Hong Kong, Singapore. Taiwan, Korea and Thailand. Using variance decomposition and impulse response functions analysis based on a VAR model, he finds that return spillovers occur only into markets with relatively weak barriers to international investments. In particular, he finds no returns spillovers from Japan and the U.S. to the markets which have the most restrictive barriers to international investments such as Taiwan and Korea. However, the countries with the least entry barriers as Hong Kong and Singapore show significant spillovers from Japan and the U.S.. He argues that the observed price spillovers are due to relatively low transaction costs in markets with least entry barriers and that in markets such as Taiwan and Korea, foreign entry barriers make transaction costs so high that it does not induce price spillovers.

Kim and Rogers (1995) examine the impact of the opening up of the Korean stock market to foreigners on its short-run relationships with the stock markets of Japan and the U.S.. To capture the mechanism of transmission of stock market movements, they estimate univariate GARCH (1,1)-in mean models using daily opening and closing prices of the major stock market indexes of these countries. Like Ng et al. (1991), the conditional mean and conditional variance equations for the U.S. and Japan are estimated as independent processes. The model for Korean stock market returns is similar to those of Japan and the U.S. except that both the conditional mean and conditional volatility equations have the once lagged squared residuals from the models of Japan and the U.S. as explanatory variables that measure volatility spillovers. Their results indicate that volatility spillovers significantly increased after market liberalization using close-to-open returns data.

A third possible reason for correlations of stock price movements across international markets is market contagion, a concept introduced by King and Wadhwani (1990). Under the market contagion scenario, rational agents attempt to infer information from price changes in other national stock markets. Consequently, stock prices in one country may be influenced by changes in the stock prices of another country beyond what is conceivable by informational linkages through economic fundamentals.

According to this hypothesis, stock price movements driven by overreaction, speculation, noise trading or even a 'mistake', e.g. failure of market mechanism, in one market may be transmittable to other markets.

On the other hand, the following reasons motivate our focus on volatility and the use of time-varying volatility in this study. First, there is a large body of evidence in the finance literature indicating that most financial time series exhibit volatility clustering, i.e., there is a tendency for large changes to be followed by large changes of either sign, and that periods of high volatility alternate with periods of relative calm (see, e.g., Bollerslev Chou and Kroner (1992) for a survey of the literature). These are consistent with time-varying conditional volatility. Therefore, if the volatility of price changes in the national stock market indexes included in this study vary over time in a related manner, the finding of significant relationships among international stock market returns may be an artifact of specification error.[3] Second, Ross (1989) shows that it is the volatility of the asset price, not the absolute price change, that is related to the rate of information flow to a particular market. Similarly, the theoretical model of Kyle (1985) suggests that information is revealed in return movements that are reflected in the volatility of returns. Based on these models, the interdependence among the return volatility of each national stock market can be ascribed to the dissemination of information flow across these markets. One implication of this is that a finding of cross-market interdependence in price changes may suggest only inconclusive evidence on how information flows to the international equity markets. Therefore, the use of time-varying conditional volatility of returns on the national stock market indexes considered in this study provides an alternative way of measuring the flow of information among these markets.

4.1.2. Scope and Limitations of the Study

To our knowledge, this is the first study to investigate the issues of stock return and return volatility spillovers from international stock markets to the Philippine stock market as well as the impact of recent liberalizations in the Philippine capital market. While the study is descriptive in nature, we believe that it can provide further insight into the importance of information contained in the behavior of foreign stock market returns in the determination of return and volatility in emerging markets like the Philippines. Moreover, this study can provide additional evidence on the implications of capital market liberalization on the transmission of stock market movements among international stock markets.

This study differs from the earlier works involving Asian markets cited in the previous section in the following respects. First, we examine the international transmission of stock market movements among the national stock markets in the sample by studying joint spillovers of returns and returns volatility. Second, our methodology of studying the transmission mechanism is different in that we employ a multivariate generalized autoregressive conditional heteroscedastic (MGARCH) model. Compared to the studies which use univariate GARCH models (e.g. Kim et al., 1995 and Ng et al., 1991), an advantage of simultaneously estimating the conditional volatility process of the six stock market indexes in the sample is that it allows for any potential interactions or multilateral volatility spillovers that may be occurring among these markets, especially in the case of the stock markets of the Philippines and the other Asian markets. This is also an improvement over the models that utilize the traditional VAR methodology which ignores the time-varying conditional volatility of returns and the international spillovers of these return volatilities that might be occurring at the same time.

We want to emphasize that the focus of our analysis is on the Philippine stock market. Accordingly, we examine the impact of capital market liberalization on the transmission of stock market movements from the foreign markets to the Philippines by dividing the overall sample into the pre- and post- liberalization subsample periods as in Chapter 2. Since the break in the sample is determined with respect to an event that is associated with only the Philippine market, we do not claim that any observed changes in the behavior of the conditional first and second moments of the returns of the other markets to be a result of the market liberalization in the Philippines.

4.2. DATA DESCRIPTION AND SAMPLE CHARACTERISTICS

The data consists of time series of closing stock market index values, in U.S. dollar terms, of the Philippines, Taiwan, Japan, Hong Kong, Singapore, and the United States covering the period from the first week of January 1980 to the last week of December 1995. The national stock market indexes and exchange rates used in this study are the same as those in Chapter 2. These include the Philippine Stock Exchange Commercial and Industrial Index, the Taiwan Stock Exchange Weighted Price Index, the Tokyo Stock Exchange Price Index, the Hang Seng Index, the Stock Exchange of Singapore All-Shares, and the Standard and Poors' 500 Index. The sources of these data are found in Appendix A. Following Engle and Susmel (1993), we use weekly data to reduce if not eliminate the bias arising from nonsynchronous trading in the assets that comprise the stock market index and short-term correlations due to noise which are more pronounced in the case of daily data. U.S. dollar-denominated indexes are used in order to make the various national stock market index returns directly comparable and to account for exchange rate fluctuations or risk.

The national stock market indexes are transformed into weekly rates of return. Following Lo and MacKinlay (1988), we use closing stock market indexes on Wednesday to represent the weekly stock market prices for the Asian markets. On the other hand, we use Tuesday closing index values to denote weekly stock market prices for the U.S. market (as represented by the New York Stock Exchange). The first difference of the (natural) logarithm of the weekly closing values of each national stock market index series is used as a measure of return.

The weekly indexes of the Asian markets and that of the U.S. are not matched by calendar date in order to adjust for real time differences that arise because the Asian stock markets and the New York Stock Exchange operate in different time zones. In terms of hourly time difference, the Philippines, Taiwan, Hong Kong and Singapore are 13 hours ahead of New York time (Eastern Standard Time) while Japan is 14 hours ahead of New York time. Table 4.1 shows the operating hours of the six national stock markets in terms of local hours and in terms of New York time. Figure 4.1 illustrates the operating hours of these markets based on New York time.

We can see from Figure 4.1 that while the Asian stock markets have periods of trading activity which overlap in both real time and calendar day, this is not the case for the U.S. market. The markets of the Philippines and Taiwan are the first to close, followed by Japan, then Hong Kong, and then Singapore. However, all the Asian markets are closed before the New York Stock Exchange opens until the time it closes on the same calendar day. This implies that on a given calendar day, the closing market values of the Asian markets are predetermined relative to the U.S. market. On the premise that the closing time of one market does not overlap with the opening time of the other market, one would expect that, on a given calendar date, the flow of information contained in returns and volatility is from the former to the latter. Therefore, the closing stock indexes values of the Asian markets cannot be influenced by the closing values of the U.S. stock market index which are recorded later on the same calendar date. Hence, if ever any of the Asian markets are influenced by developments in the U.S. stock market, the Asian markets would not be able to respond to new information on the U.S. market in the same calendar date. Instead, the response of Asian markets occurs with a one day lag. On the other hand, because the operating hours of the Asian markets precede those of the U.S. market, the U.S. market would be able to respond to new information on the Asian markets on the same calendar day.

However, if we want to examine contemporaneous spillover from the U.S. market to the Asian markets, the logical setup would be to use Tuesday as the representative weekly price for the U.S. stock market and Wednesday for the Asian stock markets. But then, in this set up, we would expect to find stronger (contemporaneous) weekly spillover from the U.S. market to the Asian markets and weaker transmission from the Asian markets to the U.S. market, if ever there is a bi-directional spillover between the U.S. and Asian markets. This is because the preceding setup allows for contemporaneous spillover from the U.S. market to the Asian markets for all 5 days and only 4 of the 5 days for the case of spillover from the Asian markets to the U.S. market. A similar argument can be made for lagged returns and volatility spillovers. One might argue that the above procedure introduces a bias in the results of the study. However, this might not really bias our results considering that previous studies generally find that the U.S. market appears to lead the Asian markets. For example, Chowdhury (1994) finds that none of the Asian markets in his sample, except Japan, have any impact on the U.S. stock market. Cheung and Mak (1992) examine the relationship between weekly returns on the national stock market indexes of eight Asian emerging markets, including the Philippines, and those of the developed markets of Japan and the U.S. over the period

1977 to 1988. Using the concept of causality introduced by Granger (1969, 1980), they find that a significant causal relationship between the U.S. market and most of the Asian emerging markets including the Philippines, with the U.S. market leading these emerging markets.

In addition, an empirical regularity of studies investigating transmission of stock market price movements among major stock markets of the world, which include Hong Kong, Singapore and Japan, is that the U.S. markets appear to lead the other markets as well. For example, Eun and Shim (1989) investigate the transmission of stock market movements among nine major markets, including Hong Kong, Japan and the U.S.. Using a vector autoregression (VAR) model for the nine market system, they find that, during the period 1980 to 1985, a substantial amount of multilateral interaction exists among the nine national stock markets with the U.S. stock market being the most influential. In particular, their results indicate that stock price changes in the U.S. market are transmitted to other markets whereas none of the other markets can significantly explain the U.S. market movements. Hamao, Masulis and Ng (1990) examine the short-run interdependence of stock price changes and price volatility across three major national stock markets, including the U.S. and Japan over the period April 1985 to March 1988. Using univariate GARCH models to explore these pricing relationships, they find, among other things, evidence of volatility spillovers from New York to Tokyo but not from Tokyo to New York. Theodossiou and Lee (1993) examine the transmission mechanism of returns and return volatility among the stock markets of five industrial countries, including Japan and the United States, using weekly stock market index return data over the period 1980 to 1991. They utilize a multivariate GARCH-in mean model to capture the mechanism by which innovations in stock returns in one market affect both the conditional market returns and conditional market volatility of the other market and to investigate the extent to which conditional volatility in the five national stock markets affects expected returns. Among other things, they find no return spillovers from the U.S. market to the Japanese market and vice-versa. However, their results indicate strongly significant volatility spillover from the U.S. to Japan but not the other way around.

Lee, Pettit and Swankoski (1990) examine the contemporaneous correlations of returns on the stock markets of Japan, Hong Kong, Singapore, Taiwan, Korea and the U.S. for the period 1980 to 1988. In order to account for the time zone difference between the U.S. and the Asian markets, they compute contemporaneous returns correlations with respect to the U.S. market by allowing the U.S. stock market index (Standard & Poors' 500) to lead the Asian markets by one day. They find that allowing the U.S. index to lead by one day causes the daily correlations with the U.S. market to increase, especially in the markets of Hong Kong, Japan, and Singapore. However, their results indicate that the tendency for the U.S. market to 'lead' these markets is not strong. Moreover, the correlations between the U.S. market and the relatively closed markets of Taiwan and Korea are not affected by this 'adjustment' as they find virtually no correlation on a daily basis between Korea and the U.S. and between Taiwan and the U.S. with and without the adjustment. Furthermore, they find that when weekly returns are used, the 'leading' effect implied by the correlations with the U.S. market is eliminated.

4.2.1. Adjustments in Return Observations During and the Week After the Stock Market Crash of October 1987.

An examination of the weekly return series for each national stock market index reveals two extreme and influential observations - returns during the week of the October 1987 stock market crash and the returns the week after. Instead of eliminating these observations from the sample, we estimate their values net of the effect of the October crash.[4]

The procedure involves regressing the weekly return series of each stock market i covering the pre-liberalization subperiod January 1980 to September 1989, r_{it}, on its own lags, r_{it-j} , a dummy variable, $CRASH1_t$, which takes a value of 1 during the week of the crash and zero otherwise and another dummy variable, $CRASH2_t$, which takes a value of 1 the week after the crash and zero otherwise. That is, we run the regression:

$$r_{it} = c_i + \sum_{j=1}^{p} \phi_{ij} r_{i,t-j} + d_1 CRASH1_t + d_2 CRASH2_t + \varepsilon_{it} \quad (1)$$

The autoregressive or AR terms are included to take into account any serial correlation in the stock market index return data. The number of lags, p, is chosen such that the estimated coefficients on the AR terms, ϕ_{ij}, are significant and the residuals, ε_{it}, are serially uncorrelated. The significance of these coefficients are determined based on the standard errors which are robust to autocorrelation and heteroscedasticity and obtained using the Newey and West (1987) technique. Based on the procedure described, we find that $p=0$ for the stock market return series of Japan, $p=1$ for each of the stock market return series of the U.S., Philippines, and Taiwan, and $p=2$ for the stock market return series of Hong Kong and Singapore. The estimates of the coefficients of the two dummy variables are found to be significant in each estimated equation. The adjusted series, $\hat{r}_{it}$ is then obtained by computing the fitted values as follows:

$$\hat{r}_{it} = \hat{c}_i + \sum_{j=1}^{p} \hat{\phi}_{ij} r_{i,t-j} + \hat{\varepsilon}_{it} \quad (2)$$

where $\hat{c}_i$ and $\hat{\phi}_{ij}$, are the estimated coefficients and $\hat{\varepsilon}_{it}$ is the residual of the estimated Equation (1). This procedure results in adjusted values that are identical to the original return values for observations other than the returns during and the week after the crash of October 1987.[5]

4.2.2. Summary Statistics, Autocorrelations and Cross-Market Correlations of Weekly Returns and Squared Returns on the National Stock Market Indexes

As in Chapter 2, we identify October 1989 as the *initial* equity market opening up date for the Philippines. Consequently, we define the pre-liberalization subsample as the series of observations from the first week of January 1980 to the last week of September 1989 and the post-liberalization subsample as the series of observations from the first week of October 1989 to the last week of December 1995.

Table 4.2 summarizes the univariate summary statistics for the weekly returns on the six national stock market indexes for the pre- and post- liberalization subperiods. These summary statistics include the sample mean, variance, skewness and excess kurtosis coefficients. It can be observed that weekly mean returns are not significantly different from zero for most of the national stock markets, especially in the post-liberalization subperiod. The coefficients of skewness and excess kurtosis indicate that, for each national stock market, the unconditional distribution of weekly returns is not normally distributed. There are some significant negative skewness, especially in the post-liberalization subperiod, and the null hypothesis of no excess kurtosis is rejected at the 1 percent level of significance for all returns series and for both subperiods. In particular, the significant excess kurtosis in all six stock market returns indicates that their weekly return series has a fat-tail distribution possibly arising from time-varying conditional volatility. This issue is further explored below.

4.2.3. Autocorrelation Analysis and ARCH Tests

Table 4.2 also reports the first-order sample autocorrelation functions and Ljung-Box (LB) portmanteau test statistics for up to 6 lags for both returns and squared returns series. For the returns series, the sample autocorrelations are generally small, especially in the post-liberalization subperiod. The LB statistics, which test for higher-order serial correlation, indicate that the null hypothesis of uncorrelated returns can be rejected at the 5 percent level of significance for Taiwan, Hong Kong and Singapore in the pre-liberalization period. However, except for the U.S. stock market returns, there is no evidence of higher-order serial correlation in the returns series for the Asian markets in the post-liberalization period. These results indicate that the serial correlation possibly induced by nonsynchronous trading of the component stocks in the national stock market indexes is not as serious for the post-liberalization subsample.

For the squared returns series, the first-order autocorrelations are generally significant, especially in the pre-liberalization period. Furthermore, the LB test statistics for up to 6 lags indicate that the null hypothesis of no serial correlation in squared returns can easily be rejected at the 1 percent level of significance for all markets and for both subperiods.

The significant autocorrelations for the squared returns series may be taken as evidence of nonlinear dependence in the returns series that arise possibly because of time-varying conditional variance.[6] One implication of this is that a model for the returns generating processes of the national stock markets in the sample should allow for higher-order dependence in the returns. One such class of models that closely approximates dependence in second-order moments is the autoregressive conditional heteroscedasticity (ARCH) model introduced by Engle (1982). Note that although the ARCH process itself captures nonlinear dependence, the conditional volatility is linear. For ARCH processes, the first and second moments are allowed to depend on its past values. We employ such models to describe the returns generating process for each national stock market in this study. Following Engle (1982), we use the squared returns as an approximation to each country's volatility and formally test for the presence of ARCH by regressing each squared return series on a constant and four lags. The test statistic is arrived at by multiplying the uncentered R^2 by the sample size. Under the null hypothesis of no ARCH, this statistic is distributed as $\chi^2(4)$. The results of these tests, labeled ARCH(4), are reported in Table 4.3. Following Engle and Susmel (1993), we also conduct multivariate ARCH (MARCH) tests. The MARCH test is constructed in a similar manner as the univariate ARCH test except that it uses a multivariate information set. Each market's squared returns are regressed on own past squared returns and the past squared returns of the other markets. The results of these tests are reported in Table 4.3 and labeled as MARCH-1 and MARCH-2. MARCH-1 uses squared returns lagged once as regressors while MARCH-2 tests are the same tests but with two lags. The test statistic has a χ^2 distribution with degrees of freedom equal to the number of regressors used. The results of the univariate information ARCH tests indicate that for both subperiods, all of the markets in the sample show evidence of conditional heteroscedasticity. Likewise, the multivariate ARCH tests provide evidence of ARCH effects in all six national stock markets.

The preceding results indicate that all of the stock market returns series exhibit conditional heteroscedasticity and that a GARCH model might be an appropriate mechanism to characterize their behavior over time. We employ such models to describe the returns generating process for the national stock market indexes in the sample.

4.2.4. Cross-market Correlation Analysis

The early studies examining the international stock market linkages among developed countries and developing countries have used correlations between national stock market indexes returns as a measure of the degree of their interdependence. A low correlation between returns has been usually interpreted as indicative of potential benefits from international diversification.[7] Some of the common findings in these studies are: (a) relatively higher stock market return correlations between major industrial countries, (b) relatively lower return correlations between the developing country markets and those of major industrial countries, and (c) even lower correlations between the stock market returns of developing countries.

The correlations between the weekly stock market returns of the Philippines and the returns on each of the other five national stock markets as well as the correlations between their squared returns are tabulated in Table 4.4. The intuition underlying the analysis of squared returns correlations is similar to the intuition behind ARCH. It may be the case that international stock markets are uncorrelated in returns but they might not be independent since it is possible that they are related through their volatilities.

Table 4.4 shows that for the pre-liberalization subperiod, the contemporaneous, lead and lag returns correlations between the Philippine stock market and the five other national stock markets are generally positive but closer to zero. In particular, contemporaneous correlation is significant only with respect to Hong Kong and Singapore implying that simultaneous price changes tend to occur only between the stock markets of the Philippines and Hong Kong and between the Philippines and Singapore. On the other hand, only the lagged returns on the stock market indexes of Singapore and the U.S. appear to have some power to forecast current Philippine stock market index returns given that lag 1 correlations with respect to Singapore and the U.S. are statistically significant at the 0.05 level. The leading cross-correlations, which suggest predictability from Philippine stock market returns to the foreign stock market returns, are all insignificant, except for the correlation with respect to the U.S. market. In contrast, the contemporaneous cross-market correlations during the post-liberalization subperiod are generally higher. Except for the correlation with respect to the stock market of Japan, the contemporaneous correlations are all significant. The highest return correlation coefficient, 0.349, is between the markets of the Philippines and Singapore. On the other hand, the lag effects of Taiwan and Hong Kong have become significant while that of the U.S. seems to have disappeared in the post-liberalization subperiod. As in the pre-liberalization subperiod, the leading cross-correlations between the Philippine stock market returns and those of the five other markets are not significantly different from zero.

Table 4.4 also reports the contemporaneous, lead and lag squared returns correlations between the Philippine stock market and each of the five remaining national stock market for both subperiods. As mentioned previously, these correlations represent a rough indicator of cross-market interdependence in volatility. For the pre-liberalization subperiod, both contemporaneous and lag cross-correlations between the squared returns of the Philippine market and the other national stock markets are generally small and are all not significantly different from zero. In contrast, these correlations are generally higher in the post-liberalization subperiod. Except for the correlation with respect to Japan, all contemporaneous squared correlations between the Philippine market and those of the foreign stock markets are significantly different from zero. On the other hand, the lag correlation with respect to Taiwan has become statistically significant as with the leading correlations between the Philippine market and those of the markets of Taiwan, Singapore and the U.S.

The contemporaneous cross-correlations among the other five national stock market index returns and squared returns are reported in Table 4.5. These markets exhibit significant returns cross-correlations in both subperiods and these coefficients are generally higher in the post-liberalization subperiod. The squared returns correlations also suggest that the volatilities of price changes in these markets are related, more so in the post-liberalization subperiod. As mentioned earlier, we do not claim that the changes in the magnitude and significance of these correlations are a result of the Philippine capital market liberalization. However, these results confirm that interdependence in returns as well as volatilities also exist among these markets.

The preceding findings seem to suggest that the cross-market influences are manifested not only on stock market price changes but on the volatility of price changes as well. Furthermore, it appears that for the Philippine market, such cross-market influences, especially the volatility cross-effects, are more apparent in the post-liberalization subperiod than in the pre-liberalization subperiod. This is consistent with the view that barriers to international investments in the Philippines might have effectively segmented the Philippine market from the international stock markets. Although these results are only preliminary, they indicate the importance of constructing an international stock market movement transmission mechanism that captures both returns and returns volatility spillovers.

4.3. METHODOLOGY

The foregoing analysis of the time series properties of the returns on the national stock market indexes of the Philippines, Taiwan, Japan, Hong Kong, Singapore and the U.S. suggests that a model of the short-run dynamic relationships among these markets should be able to capture interdependencies in both returns and returns volatility as well as the time variation of the conditional volatility of returns. In order to address these, we consider a family of statistical models based on the ARCH methodology developed by Engle (1982) and generalized (GARCH) by Bollerslev (1986) which seek to describe the dynamic behavior of volatility. Briefly, these models posit that volatility can be decomposed into a forecastable component and an unpredictable component. The forecastable component is hypothesized to depend on past information that are available at a particular point in time. Bollerslev, Chou and Kroner (1992) provide a comprehensive literature review that documents the successful application of univariate versions of these models in financial time series, including stock returns. In particular, we utilize these models in their multivariate form as such formulation allows for intermarket interactions in the returns generating processes of the national stock markets in our study. Among others, the studies of Koutmos (1996), Karolyi (1995), Theodossiou and Lee (1993), Engle and Susmel (1993), Kroner and Lastrapes (1993) and Chan, Chan and Karolyi (1991) have successfully applied multivariate versions of ARCH and GARCH processes of asset returns.

4.3.1. The Multivariate GARCH (MGARCH) Model

Our analysis is based on the following multivariate GARCH models for the joint process followed by the weekly returns on the stock market indexes of the Philippines, Taiwan, Japan, Hong Kong, Singapore and the U.S.. We estimate these models for both the pre-liberalization and post-liberalization subperiods.

First, we assume that the national stock market index conditional mean returns follow a VAR process, as used in the previously cited studies on international transmission of stock market movements; i.e.,

$$\mathbf{r}_t = \boldsymbol{\mu} + \sum_{l=1}^{L} \boldsymbol{\Phi}_l \mathbf{r}_{t-l} + \boldsymbol{\varepsilon}_t, \qquad \boldsymbol{\varepsilon}_t | I_{t-1} \sim N(\mathbf{0}, \mathbf{H}_t) \tag{3}$$

where $\mathbf{r}_t = [r_{1,t}, r_{2,t}, r_{3,t}, r_{4,t}, r_{5,t}, r_{6,t}]'$ is the vector of weekly returns on the stock market indexes of the U.S. (1), Philippines (2), Taiwan (3), Japan (4), Hong Kong (5), and Singapore (6); $\boldsymbol{\mu}=[\mu_1, \mu_2, \ldots, \mu_6]'$ is a vector of constants; $\boldsymbol{\Phi}_l$ is the matrix of autoregressive coefficients for the l-th lagged returns; and, $\boldsymbol{\varepsilon}_t=[\varepsilon_{1t}, \varepsilon_{2t}, \ldots, \varepsilon_{6t}]'$ is the vector of innovations. This multivariate specification allows us to determine the intermarket lagged returns spillover. Specifically, this structure enables us to measure the effect on a given country's stock market index returns of a change in its own lagged return and those of the other national stock markets. For example, the ij-th element of the matrix $\boldsymbol{\Phi}_l$, ϕ_{ij}, measures the impact on the current weekly returns on the stock market index of country i of a change in the stock returns on market j that occurred l weeks ago.

Conditional on this mean returns specification, the vector of innovations $\boldsymbol{\varepsilon}_t$ is multivariate normally distributed with a time-varying conditional variance-covariance matrix $\mathbf{H}_t$ given past information I_{t-1}. This is in contrast with the traditional VAR where the vector of residuals $\boldsymbol{\varepsilon}_t$ is assumed to follow a white noise process with a variance-covariance matrix that is invariant over time; i.e., $\mathbf{H}_t = \mathbf{H}$.

Various formulations of $\mathbf{H}_t$ have been put forward in the economic literature (see Engle and Kroner (1995) for examples). One of the more parsimonious multivariate GARCH specifications is the positive definite GARCH model due to Engle and Kroner (1995) (EK). In its general form, the EK model is constructed to allow $\mathbf{H}_t$ to be a linear function of its own P past values, $\mathbf{H}_{t-p}$, and the Q past values of the squared innovations, $\boldsymbol{\varepsilon}_{t-q}\boldsymbol{\varepsilon}'_{t-q}$. By construction, this specification allows lagged own-market and cross-market influences in each market's conditional variance and covariance through the squares and cross-products of both past period's conditional variances and innovations of all markets. Karolyi (1995) employed this specification in examining the international transmission of stock returns and volatility between the U.S. and Canadian markets. An important advantage of the EK model is that it guarantees the positive definiteness of the conditional covariance matrices. However, a multivariate GARCH parameterization with higher order lags, i.e., P and/or Q greater one, might not be feasible for our six-market system since such specification would require estimation of a large number of coefficients while our pre- and post-liberalization data set is relatively small. In fact, in the case where P=Q=1, 93 coefficients have to be estimated excluding the mean return coefficients. Moreover, Diebold (1988) notes that GARCH effects tend to decrease by temporal aggregation as the distribution of returns tends toward normality. Considering that this study employs weekly observations, it might be reasonable to expect many of the coefficients on the higher order lags not to be strongly significant, if not insignificant. As such, we consider only the first-order processes where P=Q=1. We will maintain this parameterization for the other conditional variance specifications for the purpose of consistency.[8] For P=Q=1, the EK model, denoted MGARCH(1,1)-EK, is written as:

$$\mathbf{H}_t = \mathbf{K}^* + \mathbf{F}'\boldsymbol{\varepsilon}_{t-1}\boldsymbol{\varepsilon}'_{t-1}\mathbf{F} + \mathbf{G}'\mathbf{H}_{t-1}\mathbf{G}. \qquad (4)$$

$\mathbf{K}^*=\mathbf{K}_0'\mathbf{K}_0$ is a (6 x 6) symmetric parameter matrix for the constants, where $\mathbf{K}_0$ is restricted to be upper triangular. **F** and **G** are (6 x 6) unrestricted parameter matrices with elements f_{ij} and g_{ij}, respectively. The lm-th element of $\mathbf{H}_t$ is given by $h_{lm,t} = k + \sum_{i=1}^{6}\sum_{j=1}^{6} f_{il}f_{jm}\varepsilon_{i,t-1}\varepsilon_{j,t-1} + \sum_{i=1}^{6}\sum_{j=1}^{6} g_{il}g_{jm}h_{ij,t-1}$. A necessary and sufficient condition for this type of multivariate GARCH process to be covariance stationary is that all the eigenvalues of $(\mathbf{F}\otimes\mathbf{F}) + (\mathbf{G}\otimes\mathbf{G})$ are less than one in modulus, where $\otimes$ denotes the Kroneker product.

A second multivariate GARCH specification that we consider, which is more parsimonious than the EK model, is the constant conditional correlation model previously used by Karolyi (1995) and Chan, Chan and Karolyi (1991). For P=Q=1, the constant conditional correlation model, denoted MGARCH(1,1)-CCK, specifies the conditional variances and conditional covariances as:

$$\mathbf{h}_t = \mathbf{c} + \mathbf{A}\boldsymbol{\varepsilon}^2_{t-1} + \mathbf{B}\mathbf{h}_{t-1}$$

and (5)

$$h_{ij,t} = \rho_{ij}\left[h_{ii,t}h_{jj,t}\right]^{1/2}, \; -1\leq\rho_{ij}\leq 1, \text{ for } i,j=1,2,\ldots,6 \text{ and } i\neq j$$

where $\mathbf{H}_t = [h_{ij,t}]$, $\mathbf{h}_t = \left[h_{11t}, h_{22t}, \ldots, h_{66t}\right]'$, $\mathbf{c}=\left[c_1, c_2, \ldots, c_6\right]'$ is a vector of constants, and **A** and **B** are (6 x 6) parameter matrices with elements a_{ij} and b_{ij}, respectively. In this representation, the conditional variance of the returns on each national stock market index is modeled as a linear function of the past period's conditional variance and squared innovation of this market as well as the past period's conditional variances and squared innovations of the remaining five markets. For example, the conditional variance of market i is given by $h_{ii,t} = c_i + \sum_{i=1}^{6} a_{ij}\varepsilon^2_{jj,t-1} + \sum_{j=1}^{6} b_{ij}h_{jj,t-1}$. However, this model assumes that the conditional correlation between any two markets i and j is constant over time; i.e., $\rho_{ijt} = \rho_{ij}\ \forall t$. This is equivalent to an assumption that all the variations in the conditional covariances over time are accounted for by changes in each of the corresponding two conditional variances. This representation guarantees that the matrix $\mathbf{H}_t$ is positive semidefinite.

The final specification for the conditional variance-covariance matrix that we consider is the constant conditional correlation model previously employed by Theodossiou and Lee (1993) in examining the mean and volatility spillovers among the stock markets of the U.S., Japan, U.K., Canada and Germany. This specification is the same as the MGARCH(1,1)-CCK model except that it restricts the parameter matrix **B** in the above equation to be diagonal, with i-th diagonal element b_{ii}. In this representation, which we denote by MGARCH(1,1)-CCTL, the conditional variance of the returns in each market is modeled as a linear function of this market's past period's conditional variance and squared innovation as well as the past period's squared innovations of the remaining five markets. Thus, this model allows cross-market influences in the conditional covariances only through the past period's squared innovations which are taken to represent the past volatility shocks in the other markets. For example, the conditional variance of market i is given by $h_{ii,t} = c_i + \sum_{i=1}^{6} a_{ij}\varepsilon^2_{ii,t-1} + b_{ii}h_{ii,t-1}$. A necessary and sufficient condition for the constant conditional correlation type of multivariate GARCH process to be covariance stationary is that all the eigenvalues of $(\mathbf{A} + \mathbf{B})$ lie inside the unit circle.

We also consider a more general specification of the returns process which allows expected stock market returns to be a function of contemporaneous own market return volatility. One motivation for this specification comes from the fact that most asset pricing models posit a relationship between a stock's expected return and risk, with some variable measuring risk. For example, the asset pricing models of Sharpe (1964), Lintner (1965) and Black(1972) postulate that a stock's expected excess return is a linear function of the covariance between its return and the return on a market portfolio. In turn, this implies that the expected excess return on a stock market portfolio is a linear function of its own variance. Campbell (1993) shows that this linear relationship between expected returns and volatility holds in an intertemporal setting if a log-linear approximation is used for the intertemporal budget constraint. In particular, we employ a multivariate extension of the ARCH-in Mean (ARCH-M) model introduced by Engle, Lilien and Robins (1987), which parameterizes the conditional mean return as an explicit function of the conditional variance. The ARCH-M model is apt in dealing with the issue of risk and expected return tradeoffs in a time series context with time-varying risk. Although there is a general consensus in finance literature that expected excess returns and risk are positively related within a given time period, Glosten, Jagannathan and Runkle (1993) argue that the sign for the covariance between a stock's conditional expected excess returns and its conditional variance could be negative or positive across time.[9]

Strictly speaking, a formal test of whether stock market-specific risk is rewarded requires a measure of conditional excess returns (i.e., expected market return less the risk free rate). However, weekly data on the risk-free rate is not available for the Asian markets in our sample. Consequently, we interpret the significance of the coefficient of own-market risk term in the mean return equation as evidence for a relationship between the mean stock market index returns and a measure of conditional volatility of those returns.

Although Pagan and Schwert (1990) argue that the standard deviation form of the -in Mean term is possibly best for our returns series, we find that it is not a viable specification for the pre-liberalization subperiod. On the other hand, there is no general concensus in the finance literature as to which is the most appropriate form of the -in Mean term (see, e.g., Engle et al., 1987; French, Schwert and Stambaugh, 1987; and. Baillie and DeGennaro, 1990). Therefore, we choose the functional form based on best fit using the SIC. In particular, we consider alternative functional forms of the -in Mean term, which include the conditional standard deviation, conditional variance, and the logarithm of conditional standard deviation of the stock market index returns.

Using the conditional standard deviation, i.e., the square root of the conditional variance, as a measure of risk, we re-write Equation (1) as:

$$\mathbf{r}_t = \boldsymbol{\mu} + \sum_{l=1}^{L} \boldsymbol{\Phi}_l \mathbf{r}_{t-l} + \mathbf{D}\mathbf{h}_t^{1/2} + \boldsymbol{\varepsilon}_t, \qquad \boldsymbol{\varepsilon}_t | I_{t-1} \sim N(\mathbf{0}, \mathbf{H}_t) \tag{6}$$

where $\mathbf{D}$ is a (6 x 6) diagonal parameter matrix with elements δ_{ii} and $\mathbf{h}_t = [h_{11t}, h_{22t}, \ldots, h_{66t}]'$. The corresponding multivariate GARCH models conditional on this mean return specification are denoted as MGARCH(1,1)-M1-EK, MGARCH(1,1)-M1-CCK and MGARCH(1,1)-M1-CCTL. The models with conditional variance, $\mathbf{h}_t$, instead of $\mathbf{h}_t^{1/2}$ in Equation (6) are denoted as MGARCH(1,1)-M2-EK, MGARCH(1,1)-M2-CCK and MGARCH(1,1)-M2-CCTL. Finally, the models with the log of conditional standard deviation, log($\mathbf{h}_t$), instead of $\mathbf{h}_t^{1/2}$ in Equation (6) are denoted as MGARCH(1,1)-M3-EK, MGARCH(1,1)-M3-CCK and MGARCH(1,1)-M3-CCTL.

As was discussed in the Chapter 2, the traditional VAR model in first differences is valid only if the levels of the variables in the vector system are not cointegrated. Otherwise, if the variables are cointegrated in the levels, then error-correction terms should be included in the model in first differences in order to capture the long-run equilibrium relationship among the variables in the system. Since our results indicate that the Philippine stock market index is not cointegrated with the five other national stock market indexes in our sample during the pre-liberalization subperiod, then the traditional VAR in returns (first differences of the natural logarithm of the stock market indexes) is well specified for this period. However, since we found a significant cointegrating relationship among these stock market indexes in the post-liberalization subperiod, then we need to impose this long-run relationship in the MGARCH models for this subperiod.[10]

Given these previous findings, the mean return equations in the MGARCH models for the post-liberalization subperiod are modified to include the error-correction term based on the (unnormalized) cointegrating vector obtained in Chapter 2. The first specification of the mean returns processes given in Equation (3) for the post-liberalization subperiod is now:

$$\mathbf{r}_t = \boldsymbol{\mu} + \sum_{l=1}^{L} \boldsymbol{\Phi}_l \mathbf{r}_{t-l} + \boldsymbol{\alpha} z_{t-1} + \boldsymbol{\varepsilon}_t, \qquad \boldsymbol{\varepsilon}_t | I_{t-1} \sim N(\mathbf{0}, \mathbf{H}_t) \tag{7}$$

where $\boldsymbol{\alpha}=[\alpha_1, \alpha_2, ..., \alpha_6]$ is the vector of speeds of adjustment of the weekly national stock market price indexes to the long-run equilibrium relationship underlying the cointegrating vector given by [2.282, 7.792, -3.780, 5.975, -4.634, -9.681], $z_{t-1} = 2.282S_{1,t-1} + 7.792S_{2,t-1} - 3.780S_{3,t-1} + 5.975S_{4,t-1} - 4.634S_{5,t-1} - 9.681S_{6,t-1}$ is the long-run equilibrium error describing the short-run deviations of the stock market price indexes from the long-run equilibrium relationship, and $S_{i,t}$ is country i's weekly stock market price index in levels. The specification of the mean returns processes given in Equation (6) is accordingly modified as:

$$\mathbf{r}_t = \boldsymbol{\mu} + \sum_{l=1}^{L} \boldsymbol{\Phi}_l \mathbf{r}_{t-l} + \boldsymbol{\alpha} z_{t-1} + \mathbf{D}\mathbf{h}_t^{1/2} + \boldsymbol{\varepsilon}_t, \qquad \boldsymbol{\varepsilon}_t | I_{t-1} \sim N(\mathbf{0}, \mathbf{H}_t). \tag{8}$$

As in the pre-liberalization subperiod, we also consider $\mathbf{h}_t$ and log($\mathbf{h}_t$), instead of $\mathbf{h}_t^{1/2}$, in Equation (8) as alternative specifications of the mean returns process for the post-liberalization subperiod.

4.3.2. Estimation and Model Selection Procedure

Before jointly estimating the parameters of the mean returns equations and conditional variance-covariance matrix of each of the MGARCH models, we first determine the optimal lag order, L, of the VAR process for the mean returns using the multivariate Schwarz Information Criterion (SIC). Using the chosen lag order, we then re-estimate the VAR using heteroscedasticity-consistent standard errors (Newey and West (1987). Robust standard errors are used since the preliminary statistics provide evidence on the presence of conditional heteroscedasticity in each stock market return series. The significance of the lagged returns regressors in each country's mean return equation are determined using these robust standard errors. For a parsimonious representation, only the lagged returns regressors, which are found to be significant at the 0.10 level, are eventually included in the joint estimation of the mean return and conditional variance parameters of all MGARCH models. Since the preliminary diagnostics indicate that volatility spillover rather than returns spillover is the more interesting issue for the Philippines, paring down the 'full' VAR specification to include only the potentially significant lagged returns regressors might not really be a major concern. For the post-liberalization subperiod, we also include the error-correction term z_{t-1} in the VAR. This error-correction term is likewise retained in the joint estimation of the mean return and conditional variance-covariance parameters of the six national stock markets.

Under the assumption of conditional normality, the log-likelihood function for the MGARCH models is given by

$$L(\Theta)= 3T\log(2\pi)-\frac{1}{2}\sum_{t=1}^{T}\left(\log\left|\mathbf{H}_t\right|+\boldsymbol{\varepsilon}_t'\mathbf{H}_t^{-1}\boldsymbol{\varepsilon}_t\right) \tag{9}$$

where T denotes the sample size and Θ represents all the unknown parameters in ε_t and $\mathbf{H}_t$. The parameters of the mean returns and conditional variance equations of each of the MGARCH models considered in this study are jointly estimated by numerical maximization of the conditional log-likelihood function given in Equation (9) using the Berndt, Hall, Hall and Hausman (1974) algorithm.

Finally, for each subperiod, we use the SIC to choose the final MGARCH model that will be the basis of the mean return and volatility spillovers analysis. We also conduct a series of misspecification tests to assess the general validity of the chosen model for each subperiod.

4.4. EMPIRICAL RESULTS

4.4.1. Preliminary Results from the Vector Autoregression (VAR) Specification

As mentioned in the previous section, we first determine the optimal VAR lag order in the mean returns equations of the six national stock markets in the system. Based on theSIC, the optimal VAR lag length (i.e., at which SIC is minimum) is one for both the pre- and post- liberalization. Tables 4.6 and 4.7 report the estimates for the VAR(1) in returns for both subperiods.

An examination of the results for the pre-liberalization subperiod in Table 4.6 indicates that for the Philippine stock market returns equation, none of the coefficient estimates for the first-order lags are significant. This implies that there are no lagged own nor cross-market return spillovers from the other five markets to the Philippine market during this period. Lagged cross-market return spillovers seem to occur from the Philippines to the U.S. and from Singapore to Hong Kong, although these are significant only at the 0.10 level. On the other hand, own-lagged return coefficients are statistically significant only for the markets of Taiwan and Hong Kong. That past Philippine stock market returns affect U.S. stock market returns is quite surprising given the relatively small Philippine market. For the post-liberalization subperiod, all the lagged returns coefficients in the mean return equation are still insignificant indicating that past changes in the stock market prices of the other market do not influence the stock returns in this market. Moreover, the coefficient of the error-correction term is significant only in the Philippine mean return equation. The only cross-market return spillovers that appear to be statistically significant, although quite weak, are those from the Philippines to Hong Kong and from Japan to the U.S. The only significant own-lagged returns coefficient is found for the U.S. market.

The preceding VAR results suggest that, in general, there is no transmission of short-run stock market price changes from the markets of the Philippines' major economic partners to the Philippine stock market. Furthermore, the liberalization of the Philippine capital market seems to have no impact on the responsiveness of the mean returns on the Philippine stock market index to changes in the stock prices of the other five markets. Finally, very little lagged cross-market returns spillovers occur in the other markets in both pre- and post- liberalization subperiods. However, this method ignores the potential cross-market spillovers of these volatilities that may be occurring at the same time. These are taken into account in the MGARCH models.

As discussed in the previous section, we use the VAR results to determine which lagged returns series to include in the joint estimation of the mean return and conditional variance parameters of the MGARCH models considered in this study. Tests of the null hypothesis that the coefficients of the lagged returns which were found to be insignificant are all zero were likewise conducted. The results of these tests, reported in Tables 4.6 and 4.7, indicate that the null hypothesis cannot be rejected at the conventional levels of significance for each country's mean return equation. Therefore, only the following lagged returns are included in the parsimonious representation of the mean returns processes of the six national stock market indexes. For the pre-liberalization subperiod, we include Philippine lagged returns for the U.S. mean equation, none for the mean return equations of the Philippines, Japan and Singapore, own lagged returns for the equation of Taiwan, and own lagged returns and lagged returns of the Singapore stock market index for the mean return equation of Hong Kong. For the post-liberalization subperiod, we include own lagged returns and lagged returns of the Japanese stock market index for the U.S. mean equation, Philippine lagged returns for the equation of Hong Kong, and none for the equations of the Philippines, Japan, Taiwan and Singapore. Otherwise, all parameters in the mean returns equations are restricted to be zero. In addition, the error-correction term representing the adjustment of these national stock market indexes to their long-run equilibrium relationship are included in the post-liberalization subperiod mean return equations.

4.4.2. Results from the Multivariate GARCH Specification

The twelve MGARCH versions considered in this study were estimated using the preceding mean returns parameterization. Allowing the specification of the -in Mean term to be free and selecting the model on the basis of best fit result in the MGARCH(1,1)-M2-CCTL being chosen as the best model for the pre-liberalization subperiod and the MGARCH(1,1)-M1-CCTL for the post-liberalization subperiod. As mentioned earlier, both of these models allow for own and cross-market volatility spillovers through past squared innovations and assumes that the conditional correlations between the returns of any two markets are constant over time. The only difference between these two models is the specification of the -in Mean term that appears in the mean return equation of each national stock market. In the MGARCH(1,1)-M2-CCTL model, the expected return on each national stock market in our study is specified as a linear function of its own contemporaneous conditional variance. The eigenvalues of this model are 0.9833, 0.9345, 0.8169, 0.7096, and 0.6004, which indicate that the process is covariance stationary. On the other hand, in the MGARCH(1,1)-M1-CCTL model, the expected return on each market is specified as a linear function of its own contemporaneous conditional standard deviation. The eigenvalues of this model are 0.9717, 0.9567, 0.9474, 0.8915, 0.5511, and 0.5511, which is an indication that the process is covariance stationary.[11]

The joint estimation results for the multivariate GARCH models, obtained under the auxiliary assumption of conditional normality, for the pre- and post-liberalization subperiods are reported in Tables 4.8 and 4.9, respectively. Each of these tables include the estimated coefficients and asymptotic t-values.[12]

Prior to discussing the results, we reiterate that since the break in the overall was determined solely by events relating to the Philippine market, we do not claim that any observed changes in the own- or cross-market influences in return and return volatility for the other markets are attributable to Philippine capital market liberalization.

Mean Return Spillovers

Since the analysis based on the traditional VAR methodology reveals that there is very little cross-market return spillovers occurring between six the national stock markets and that no return spillovers occur from the other five markets to the Philippine market in both pre- and post-liberalization subperiods, we simply focus on the differences in the mean equation parameter estimates between this methodology and those obtained using our chosen multivariate GARCH model.

It can be observed from Table 4.8 that, for the pre-liberalization subperiod, the lagged mean return spillover from the Philippine stock market to the U.S. stock market, measured by the coefficient $\phi_{PHL,US}$, has become more significant (from 0.10 to 0.05 level) after accounting for the GARCH-in mean effects and the potential cross-market volatility spillover that might be simultaneously occurring. That past Philippine stock returns significantly affect the U.S. market is quite surprising given the relatively small size of the Philippine stock market. On the other hand, the coefficient estimate of own-market lagged returns of Hong Kong, $\phi_{HK,HK}$, as well as the lagged mean return spillover from the Singapore market to the stock market of Hong Kong, $\phi_{SIN,HK}$, which were significant under the VAR specification, have become insignificant under the multivariate GARCH model. Moreover, the coefficients on own-conditional variance, δ_{ii}, in all mean return equations are statistically insignificant, providing no evidence for a relationship between mean market returns and market risk in each of the six national stock markets.

On the other hand, Table 4.9 shows that for the post-liberalization subperiod. the coefficient estimate measuring lagged return spillovers from the Philippine market to the stock market of Hong Kong, $\phi_{PHL,HK}$, has become insignificant under the multivariate GARCH specification. The lagged mean return spillover from the market of Japan to the U.S. market, $\phi_{JPN,US}$, remains to be weakly significant (0.10 level) under the multivariate GARCH model. On the other hand, the estimates of the coefficients of short-run adjustments toward the cointegrating relationship among the six markets, are now statistically significant for the markets of the Philippines (α_{PHL}) and Singapore (α_{SIN}) under the multivariate GARCH parameterization. The evidence of short-run adjustments toward the cointegrating relationship in the Taiwan market is weak given that the estimate of the coefficient α_{TWN} is only significant at the 0.10 level. Given that the error-correction term is significant in only 2 of the equations, one may raise the issue that the misspecification induced by excluding the error-correction term, z_{t-1}, from Equation (8) is mild or not serious. However, the results of performing a likelihood ratio test of the null hypothesis that all the coefficients α are jointly zero in Table 4.9 suggests strongly that the error-correction term should be maintained.[13]

It is noticeable that the intercept for the Philippine mean return equation, μ_{PHL}, is negative. At first glance, this suggests that when volatility is close to zero then the returns on the Philippine stock market index will fall by about one-half of 1% per week. However, the average value of the error-correction series, z_{t-1}, over the post-liberalization sample is -40.6. This implies that the error-correction mechanism raises Philippine returns by approximately half a percent per week on average and thus offsets the impact of a period of negligible volatility.

Turning to the estimates of the impact of conditional volatility on each market return series, we find that the positive coefficient estimate on the conditional standard deviation of Philippine stock market returns, $\delta_{PHL,PHL}$, is statistically significant during the post-liberalization subperiod. The coefficient estimate on the conditional standard deviation of returns on the U.S. and Hong Kong stock market indexes, $\delta_{US,US}$ and $\delta_{HK,HK}$, respectively, are also statistically significant, although these are of a negative sign. Given that the coefficient on the conditional standard deviation is an appropriate measure of market risk, the preceding results provide evidence for a significant time-varying risk-return relationship in the Philippine stock market. This evidence of positive and significant conditional market volatility-conditional expected market return relationship is consistent with the findings of Campbell and Hentschel (1992) and French, Schwert and Stambaugh (1987) for the U.S. market. In contrast, De Santis et al. (1995) find this relationship to be negative, although statistically insignificant, in their univariate GARCH(1,1)-in Mean estimation of weekly returns on the Philippine stock market index over the period January 1989 to September 1994. However, they cite the lack of power of their univariate test as one possible reason for the strong rejection of the hypothesis that country-specific volatility affects expected returns. They point out that studies which use a multivariate analysis based on a similar approach, e.g., Bollerslev, Engle and Woolridge (1988), cannot reject the hypothesis that country-specific risk is priced. Therefore, it is possible that the different results obtained in this study is a result of our multivariate framework which uses a relatively richer information set. On the other hand, the negative and statistically significant relationship between the conditional market volatility and conditional expected market returns of the U.S. and Hong Kong stock markets is similar to the results of the studies using U.S. stock market data by Fama and Schwert (1977), Campbell (1987), Pagan and Hong (1991), Breen, Glosten and Jagannathan (1989), Turner, Startz and Nelson (1989), and Nelson (1991).

The finding of no lagged return spillovers from the other markets to the Philippine stock market in both pre- and post- liberalization subperiods should not be misconstrued as indicating that the short-run dynamics of this market are independent of the stock price movements of the other five markets. Nor should we interpret the overall finding of very few mean return spillovers among the six national stock markets as suggestive that their short-run stock market movements are entirely independent. As mentioned earlier, it is possible that intermarket volatility spillovers may be occurring at the same time. One possible reason for the weak mean return spillover results is the rapid rate of transmission of stock market price changes (i.e., returns) between markets. For example, Eun and Shim (1989), Koch and Koch (1991), Chowdhury (1994), and Karolyi (1995) find that, using daily stock market returns series of industrialized countries, these intermarket responses are rapidly transmitted across markets and tend to be completed within one or two days. Therefore, such intermarket responses may not be apparent in our study since we employ weekly data. Theodossiou et al. (1993) also use weekly data for five major world stock markets and they find very few significant mean return spillovers among these markets.

Nevertheless, whether daily or weekly data are used, these results may not at all be surprising considering the arguments of Kyle (1985) and Ross (1989) that much of the information would be revealed in the volatility of an asset's price rather than the price change itself. Hence, a more interesting issue is whether volatility is correlated across the six national stock markets; i.e., whether volatility spillovers occur between these markets given that they adjust to new market information.

In summary, our return spillover analysis indicates that,

(1) Before accounting for ARCH effects, we find very little and weakly significant lagged return spillovers among the Philippine stock market and the five other national stock markets in both pre- and post-liberalization subperiods. In particular, we find no return spillovers from the foreign stock markets to the Philippine stock market.

(2) In general, we find no significant cross-market return spillovers after controlling for ARCH effects in both subperiods. One possible reason for this finding is the rapid rate of intermarket transmission of stock market price changes. Previous studies find that such intermarket returns spillovers tend to be completed within one or two days. Such intermarket responses may not be apparent in our study given that we employ weekly data.

Volatility Spillovers

Tables 4.8 and 4.9 also report the results of joint estimation of the conditional volatility processes for the six national stock markets for the pre- and post- liberalization subperiods, respectively. The parameter estimates of the conditional variance and conditional covariance equations of each market are shown in the second up to the seventh columns of these tables. It should be noted that in this multivariate GARCH parameterization, own- and cross-market past squared innovations are assumed to represent the own- and cross-market volatility spillover variables, respectively.

Pre-liberalization Subperiod. The overall results for the pre-liberalization subperiod indicate evidence for time-varying conditional volatility of returns on the six national stock markets. Table 4.8 shows that for the pre-liberalization subperiod, the estimated coefficients on the past period's own-market conditional variance, b_{ii}, are all statistically significant at the 0.01 level, except for that of Japan, suggesting high volatility persistence in these markets. Also, own-market lagged volatility spillovers, measured by the coefficients a_{ii}, are all statistically significant at the 0.01 level, except for that of the U.S. market. However, the results indicate that, in general, there is no evidence of lagged volatility spillovers among the non-Philippine stock markets during the pre-liberalization subperiod. There is some evidence of volatility spillover from the stock market of Singapore to the U.S. market, although this is quite weak. The coefficient estimate of $a_{SIN,US}$, which captures this spillover effect, is significantly different from zero only at the 0.10 level.

Turning to the results involving the Philippine stock market, we find that lagged volatility spillover occurs from the stock markets of the U.S., Taiwan and Japan to the Philippine market, as indicated by the estimates of the coefficients $a_{US,PHL}$, $a_{TWN,PHL}$, and $a_{JPN,PHL}$ which are significant at least at the 0.05 level. The evidence of volatility spillover from the Hong Kong market to the Philippine market is weak given that the coefficient estimate of $a_{HK,PHL}$ is significantly different from zero only at the 0.10 level. The magnitude of volatility spillover from the U.S. market is largest (0.2627), followed by Taiwan (0.1221), then Japan (0.0996), and finally Hong Kong (-0.0068). In general, there is no evidence of volatility spillover from the Philippine market to the other markets. In particular, there is only weak evidence of lagged volatility spillover from the Philippine market to the U.S. market. This volatility spillover effect is captured by the coefficient $a_{PHL,US}$, which is significant only at the 0.10 level. The generally uni-directional volatility spillover to the Philippine market is expected given the small size of this national stock market. An interesting result for this subperiod is that the magnitude of lagged own-market volatility spillover for the Philippines, 0.6500, is definitely larger than the magnitudes of volatility spillover originating from the markets of the U.S., Taiwan, Japan and Hong Kong. In fact, this is also the largest own-market volatility coefficient among the six markets. One implication of this finding is that the influence of own past innovations on the conditional volatility of Philippine stock market returns is greater than the influence of volatility shocks in the foreign markets. This possibly reflects the effect of barriers to foreign capital flows that existed in the Philippine market during the pre-liberalization subperiod. Such restrictions could have insulated the domestic stock market returns from international influences, making it responsive largely to local developments. Evidence for this argument is provided by the results in the post-liberalization subperiod.

The finding of some evidence of lagged volatility spillover to the Philippine market during the pre-liberalization supports the argument that international transmission of stock market movements can occur, even in the presence of impediments to cross-country investing, between countries with strong economic linkage. It should be recalled that the foreign countries in this study are the Philippines' major trading partners and investors. In particular, the U.S. has historically been the main economic partner of the Philippines and thus, the significant influence of innovations of the U.S. stock market on the conditional volatility of Philippine stock market returns might have been a result of the high degree of dependence of the Philippine economy on the U.S. economy. Consequently, any news about that affects the economic fundamentals in the U.S., which are reflected in the volatility of U.S. stock market returns, are most likely to influence the Philippine market fundamentals and consequently the volatility of Philippine stock market returns.

Post-Liberalization Subperiod. The results for the post-liberalization subperiod, shown in Table 4.9, also provide evidence of time-varying conditional volatility of returns for the six markets. For all six markets, the estimated coefficients on past own conditional volatility are all significantly different from zero at the 0.01 level. The estimates of the coefficients on own-market volatility spillover are all significantly different from zero at least at the 0.05 level, except those of the Philippines and Singapore. Lagged volatility spillovers among the non-Philippine stock markets occur from Taiwan to Singapore and from Singapore to Japan, as indicated by the estimates of the coefficients $a_{TWN,SIN}$ and $a_{SIN,JPN}$, which are significantly different from zero at the 0.05 level. There is weak evidence of volatility spillover from the stock market of Taiwan to the U.S. market, given that the coefficient estimate of $a_{TWN,US}$ is significantly different from zero only at the 0.10 level.

In general, the results involving the Philippine stock market suggest that significant volatility transmission occurs from all the five other markets to the Philippine market, although evidence of volatility spillover originating from the stock market of Taiwan is relatively weak. The estimates of the coefficients $a_{US,PHL}$, $a_{JPN,PHL}$, $a_{HK,PHL}$ and $a_{SIN,PHL}$, which capture the lagged volatility spillover from the U.S., Japan, Hong Kong and Singapore, respectively, are all significantly different from zero at the 0.01 level. However, the coefficient estimate of $a_{TWN,PHL}$, which measures volatility spillover originating from the stock market of Taiwan is significantly different only at the 0.10 level. As in the pre-liberalization subperiod, volatility spillover is generally uni-directional toward the Philippine market. The evidence of volatility spillover from the Philippine market to the markets of the U.S. and Hong Kong are quite weak given that the estimates of the coefficients $a_{PHL,US}$ and $a_{PHL,HK}$ are significantly different from zero only at the 0.10 level. In absolute terms, the magnitude of volatility spillover from

Singapore is largest (0.5231), followed by that from the U.S. market (-0.3284), then Hong Kong (-0.1641), then Japan (-0.0761), and finally, that from Taiwan (0.0694). These results, combined with the fact that the own-market volatility spillover for the Philippines has become insignificant during the post-liberalization subperiod, implies that conditional volatility of Philippine stock market returns has become more responsive to information reflected in the past innovations of the foreign stock markets. This is in contrast with the pre-liberalization subperiod results in which local information contained in past own-market innovations had a greater influence on the conditional variance of Philippine stock market returns than the information reflected in past innovations of the foreign stock markets.

Furthermore, a comparison of Tables 4.8 and 4.9 reveals that the conditional correlations are, in general, slightly higher in the post-liberalization subperiod. However, the absolute increase in the conditional correlations is much more pronounced in the case of the conditional correlation of the Philippine stock market returns with the returns on each of the remaining five national stock markets. In fact, except for the conditional correlation with respect to Japan, all conditional correlations of the Philippine market with the other markets have become statistically significant in the post-liberalization subperiod. In particular, the highest absolute increase in conditional correlation of Philippine returns with foreign market returns (0.1974) is that with respect to Singapore, then that with respect to Hong Kong (0.1700), then Taiwan (0.1515), then the U.S. market (0.1474), while the lowest absolute increase (0.0780) is that with respect to Japan.

That the magnitude of volatility spillover from Singapore to the Philippines is largest and that the conditional correlation is strongest between the markets of the Philippines and Singapore may be due to the geographical proximity of these countries and the fact that both countries are members of the Association of Southeast Asian Nations (ASEAN) and the ASEAN Free Trade Association (AFTA). As members, they have more economic policy coordination in terms of intra-regional trade and investment. In fact, while the U.S. has historically been the traditional major economic partner, there has been stronger emphasis on intra-ASEAN trade and investment activities among the ASEAN countries in recent years. This might explain why the volatility spillover originating from Singapore has become significant only during the post-liberalization subperiod. In addition, Singapore is the leading financial center in Southeast Asia. These factors translate to a greater economic linkage between the two countries and might have contributed to the greater responsiveness of the Philippine stock market to movements in the stock prices of the Singapore market. This also helps explain the finding that short-run adjustments to the long-run equilibrium relationship among the six markets are significant only in the case of the returns on the stock markets of the Philippines and Singapore.

The finding of stronger evidence of lagged volatility spillovers from the other national stock markets to the Philippine market during the post-liberalization subperiod possibly reflects the impact of the removal of barriers to international investments that occurred during this period. This is consistent with the results of Kim et al. (1995) and Ng et al. (1991). As was discussed in the Theoretical Framework, the removal of international investment barriers also promotes the international transmission of stock market movements. This is because capital market liberalization facilitates cross-country investing and arbitrage activities by both local and foreign investors which are necessary to bring about equalization of asset returns in these international markets. Moreover, this view implies that market liberalization increases the importance of the information contained in the volatility of international stock market returns on domestic stock market movements. These results are also consistent with the results in Chapter 2 which suggest that capital market liberalization increased the degree of integration of the Philippine equity market with the markets of its major economic partners. Consequently, this increased the sensitivity of the volatility of the returns on Philippine equities to information that is contained in the return volatility of foreign equities.

In summary, our volatility spillover analysis indicates that:

(1) Significant lagged volatility spillovers occur from some foreign national stock markets to the Philippine stock market during the pre-liberalization subperiod. This is consistent with the view that international transmission of stock market movements can occur among countries with strong economic linkage, even in the presence of barriers to international investments. The strong economic linkage between economies potentially creates an informational link across their respective equity markets. News that is revealed in one country is perceived by investors as informative to the price fundamentals of equities in another country.

(2) Significant lagged volatility spillovers occur from all foreign national stock markets to the Philippine stock market during the post-liberalization subperiod. The stronger evidence of cross-market volatility transmission in this subperiod possibly reflects the impact of the removal of significant barriers to international capital flows in the Philippines. This is consistent with the view that capital market liberalization facilitates cross-border investing and arbitrage activities which, in turn, increases the sensitivity of domestic stock market movements to global developments.

(3) Volatility spillover is uni-directional toward the Philippine stock market in both pre- and post-liberalization subperiods. This is expected given that the Philippine equity market is small relative to those of the five foreign stock markets.

(4) The finding of significant lagged volatility spillovers to the Philippine market despite not detecting any significant lagged return spillovers from the foreign markets to this same market is consistent with the view that information is more likely to be revealed in the volatility of an asset's price than on its simple price changes.

It should be noted that although the maximum likelihood estimates of the volatility spillover coefficients in Tables 4.8 and 4.9 are indicative about how a shock in one market influences the future weekly volatility in the Philippine stock market, these estimates do not provide the precise answer. Consider the post-liberalization results. Suppose that there is a shock in the U.S. market. Then, the impact of the U.S. disturbance will influence the weekly Philippine volatility through a direct effect in the Philippine conditional volatility equation and an indirect effect through the increased weekly volatility in the Hong Kong market. The dynamic reactions of a particular national stock market to own- and other-market return shocks is provided by the impulse response functions of conditional volatility. Specifically, the precise impact of a unit returns shock (the squared return innovation) originating from market j at date t on market i at date $t+s$ can be obtained from the impulse response functions of conditional volatility. The mechanics and results of applying this technique to our multivariate GARCH system is discussed below.

Impulse Responses of Conditional Stock Market Volatility

Following Lin (1997) and Engle, Ito and Lin (1990), the impulse response functions for conditional volatility of both MGARCH(1,1)-M2-CCTL and MGARCH(1,1)-M1-CCTL models for the six-national stock market system are given by

$$\mathbf{R}_{s,6} = \partial \mathbf{h}_{t+s|t} / \partial \mathbf{u}_t \tag{10}$$

where $\mathbf{R}_{s,6}$, a 6x6 matrix, measures the response of future volatility of the six-market system to a one-unit shock in $\mathbf{u}_t$; $\mathbf{u}_t = \left[\varepsilon_{1t}^2, \varepsilon_{2t}^2, \cdots, \varepsilon_{6t}^2\right]'$; $\mathbf{h}_{t+s|t}$ is the prediction of $\mathbf{h}_{t+s}$ conditional on the information set available at time t, ψ_t, where $\psi_t = \left\{\boldsymbol{\varepsilon}_{t-j}\right\}_{j=0}^{j=\infty}$; and, $\mathbf{h}_t$ is as defined in Equation (5).

Now,

$$\mathbf{R}_{s,6} = \left[R_{s,ij}\right]_{6\times 6} = \left[\partial h_{ii,t-s|t} / \partial \varepsilon_{j,t}^2\right]_{6\times 6} \tag{11}$$

where $R_{s,ij}$ is the s-periods-ahead impulse response coefficient of conditional volatility of market i to the squared innovation of market j that occurs at time t, $i,j=1,2,\ldots,6$. Following Lin (1997), we obtain the s-step impulse response functions of $\mathbf{h}_t$ to $\mathbf{u}_t$ as

$$\mathbf{R}_{1,6}=\mathbf{A}, \qquad \text{for } s=1$$

and (12)

$$\mathbf{R}_{s,6}=(\mathbf{B}+\mathbf{A})^{s-1}\mathbf{R}_{1,6}, \qquad \text{for } s\geq 2$$

where $\mathbf{A}$ and $\mathbf{B}$ are 6 x 6 parameter matrices defined earlier. Because of the symmetry of the conditional volatility process employed in this study, the impulse responses of each national stock market return series' conditional volatility to a positive shock and to a negative shock are equal. The standard errors of the impulse response coefficients can be computed based on the following procedure.

Lin (1997) shows that, $\mathrm{vec}\mathbf{R}_{s,6}$, evaluated at the maximum likelihood estimates, $\hat{\boldsymbol{\theta}}$, is asymptotically normally distributed with mean $\mathbf{0}$ and variance $T^{-1}\mathbf{G}_{s,6}\boldsymbol{\Sigma}_{\theta}\mathbf{G}'_{s,6}$, where $\boldsymbol{\theta}=[\mathbf{A},\mathbf{B}]_{6\times 12}$, vec is the vector operator that stacks the columns of the matrix, $T^{-1}\boldsymbol{\Sigma}_{\theta}$ is the variance-covariance matrix of $\mathrm{vec}\hat{\boldsymbol{\theta}}$, and $\mathbf{G}_{s,6} = \nabla_{\mathrm{vec}\theta}\mathrm{vec}\mathbf{R}_{s,6} = \partial\mathrm{vec}\mathbf{R}_{s,6}/\partial\mathrm{vec}\boldsymbol{\theta}$. Following the procedure of Lin (1997), we obtain

$$\mathbf{G}_{1,6} = (\mathbf{I}_6 \otimes \mathbf{I}_6)\mathbf{A}_{\theta}, \quad \text{for } s=1$$

and (13)

$$\mathbf{G}_{s,6} = [\mathbf{I}_6 \otimes (\mathbf{A}+\mathbf{B})]\mathbf{G}_{s-1,6} + (\mathbf{R}'_{s-1,6} \otimes \mathbf{I}_6)(\mathbf{A}_{\theta} + \mathbf{B}_{\theta}), \quad \text{for } s\geq 2$$

where $\mathbf{A}_{\theta} = \nabla_{\mathrm{vec}\theta}\mathrm{vec}\mathbf{A} = \mathbf{e}_{1,2} \otimes \mathbf{I}_{36}$, $\mathbf{B}_{\theta} = \nabla_{\mathrm{vec}\theta}\mathrm{vec}\mathbf{B} = \mathbf{e}_{2,2} \otimes \mathbf{I}_{36}$, and $\mathbf{e}_{m,2}$ is a 1x2 vector with one in th m-th element and zero elsewhere. The standard errors of the impulse response coefficients are computed as the square root of the appropriate diagonal elements of the matrix $T^{-1}\mathbf{G}_{s,6}\boldsymbol{\Sigma}_{\theta}\mathbf{G}'_{s,6}$.

By applying the preceding expressions to our maximum likelihood estimates of the parameter matrices **A** and **B**, we can keep track of the impact of the weekly conditional volatility in one market on the weekly conditional volatility of the other markets over time and examine the speed at which the impulse response of the conditional volatility of a given market dies out. We only report the results for the Philippine stock market.

Tables 4.10 and 4.11 report the s-weeks ahead impulse response coefficients and their corresponding t-ratios for the pre- and post-liberalization subperiods, respectively, over a 52-week horizon. Figures 4.2.1 through 4.2.6 show the plots of the time paths of the impulse response functions of conditional volatility of Philippine stock market returns to a one-unit shock (i.e., squared innovation) in its own-market returns and in the stock market returns of each of its major economic partners for the pre-liberalization subperiod. Figures 4.3.1 through 4.3.6 show the corresponding plots for the post-liberalization subperiod. Each plot shows how weekly volatility in the Philippine stock market is affected by a one-unit shock in the weekly returns of a particular stock market. For each plot, the horizontal axis represents the number of weeks which have transpired from the week of the shock in a particular market. On the other hand, the vertical axis measures the conditional volatility increment from the initial impact.

The impulse response curves in Figures 4.2.1 through 4.2.6, plotted based on the coefficients reported in Table 4.10, indicate that innovations in own-market returns and returns on the stock market indexes of the U.S., Taiwan and Japan have a significant short-run dynamic effect on the conditional volatility of Philippine stock market returns. In particular, it can be observed that own-market return innovation has the largest initial (1-week ahead) impact on the predicted conditional variance of Philippine stock market returns, relative to the impact of return innovations originating from the foreign stock markets. An examination of the speed at which the impact of an initial return shock in each market on Philippine conditional variance dies out reveals some interesting results. Based on the standard errors and corresponding *t*-ratios of the impulse response coefficients, as reported in Table 4.10, the impact of an initial shock in own-market returns on Philippine conditional volatility remains significant up to 4 weeks into the future, using a 0.05 level of significance cut-off point. On the other hand, the dynamic impact of an initial U.S. market return innovation on Philippine conditional volatility remains significant up to 6 weeks into the future. The impact of an initial innovation in Taiwan stock market returns becomes statistically insignificant only after 7 weeks. The dynamic effect of an initial innovation in the Japanese stock market returns lasts up to 4 weeks. On the other hand, Figures 4.2.5 and 4.2.6 suggest that the conditional volatility of Philippine stock market returns has relatively trivial dynamic response to the return innovations of Hong Kong and Singapore stock markets. Table 4.10 shows that the initial impact of a unit return innovation in the Hong Kong market is significant only at the 0.10 level and does not display any significant incremental effect after 1 week. Meanwhile, a unit return shock in the stock market of Singapore does not have any significant impact on the future conditional volatility of Philippine stock market returns. The results also suggest that although own-market return innovation has the largest initial impact on Philippine conditional volatility, a return shock in the stock markets of Taiwan and the U.S. tend to be more persistent, with the effect of a shock in the Taiwan market being the most persistent.[14]

The results for the post-liberalization subperiod reveal some interesting observations. It can be seen from Figures 4.3.1 through 4.3.6 and Table 4.11 that the conditional variance of Philippine stock market returns exhibit significant dynamic response to a return innovation in all five foreign markets, but not with respect to its own-market return shock. The initial impact of a return shock in the foreign stock markets on Philippine conditional variance are all larger than the initial effect of own-market return innovation. For this subperiod, the largest initial impact on the predicted conditional variance of Philippine stock market returns is displayed by an innovation in the stock market returns of Singapore, followed by that of the U.S., then Hong Kong, then Japan, and finally Taiwan. An inspection of Table 4.11 indicates that the effect of the initial return shock in the Singapore market on future Philippine conditional volatility remains significant up to 3 weeks, using a 0.05 level of significance cut-off point. On the other hand, the impact of a one-unit shock in the U.S. stock market returns becomes insignificant after 1 week. An initial market return shock originating from Hong Kong dies out after 2 weeks. Finally, while the one-week ahead impact of a unit innovation in the stock market return of Taiwan is only weakly significant and is the lowest among the five foreign markets in terms of magnitude, its effect on future Philippine stock market return conditional volatility remains significant at the 0.05 level up to 6 weeks into the future. As in the pre-liberalization subperiod, the Taiwan stock market return shock has the most persistent effect on Philippine conditional volatility during the post-liberalization subperiod.

The results of the analysis of the impulse response of the conditional volatility of Philippine stock market returns reinforce the findings and conclusions arrived at in the previous section. Significant volatility spillover effects occur from the stock markets of the major economic partners of the Philippines to the Philippine stock market, with the evidence apparently stronger during the post-liberalization subperiod. In addition, the impulse response analysis provides important information on the dynamic reaction of the conditional volatility of Philippine returns beyond that which can be inferred from the estimated coefficients reported in Tables 8 and 9. In particular, the preceding results indicate that the volatility spillover effect from the foreign markets display a dynamic impact on the future conditional volatility of Philippine stock market returns. For the foreign markets for which the volatility spillover effect is statistically significant, the impact of an initial return shock originating from the foreign stock market on Philippine conditional volatility generally persists from 1 up to 7 weeks into the future. Compared to the empirical findings on the impulse response of domestic stock market conditional mean returns (e.g., Hamao et al., 1990; and, Karolyi, 1995), our results suggest that the impact of foreign stock market return innovations on domestic market conditional volatility is more persistent. There is no way of comparing our results with previous studies on international transmission of stock market movements since these studies did not examine the impulse responses of conditional volatility. However, evidence from studies which examined volatility transmission among foreign exchange markets indicate that a shock to conditional volatility appears to be quite persistent. For example, Engle et al. (1990) find that the impulse response functions of conditional volatility of the exchange rates in their sample die out only after approximately two weeks. On the other hand, Lin (1997) finds that, for the set of exchange rates in his sample, the impulse response functions generally do not die out, suggesting a persistent effect of exchange rate shock on conditional volatility.

Moreover, two important findings emerge from this dynamic analysis. First, a comparison of the two subperiod results indicate that all of the cross-market impulse responses of Philippine conditional volatility are generally larger than its own-market impulse response in the post-liberalization subperiod than those in the pre-liberalization subperiod. For the pre-liberalization subperiod, the impact of own-market return innovations on future Philippine conditional volatility are larger in magnitude than the impulse response to a foreign market return shock. This suggests that the degree of dependence of Philippine stock market return volatility on the market return volatility of its major economic partners has increased during the post-liberalization subperiod, possibly as a result of the capital market liberalization reforms instituted over this time interval. Secondly, a return shock to Philippine volatility emanating from its own-market and from the foreign stock markets is generally less persistent during the post-liberalization subperiod than during the pre-liberalization subperiod (i.e., shocks take longer to die out during the pre-liberalization subperiod than during the post-liberalization subperiod.).

It is interesting to note that the post-liberalization subperiod results indicate a fundamental difference between the dynamic impacts on Philippine conditional volatility of stock market innovations from the U.S., Japan and Hong Kong and those originating from Taiwan and Singapore. On the one hand, Philippine conditional volatility exhibits a positive dynamic response to innovations originating from Taiwan and Singapore markets. This implies that an increase in volatility in these markets brings about an increase in future volatility of Philippine stock market returns. On the other hand, the volatility spillover from the U.S., Japan and Hong Kong to the Philippine stock market shows an attenuating effect. In other words, an increase in volatility in these markets in week t, either due to good or bad news, reduces volatility in the Philippine stock market in subsequent weeks, $t+s$. This latter finding appears to be counterintuitive.

Intuitively, we would expect a positive relationship in conditional volatilities of national stock markets whose economies are related through trade and investment and/or whose capital markets are integrated. This is because, as discussed in the Theoretical Framework section, countries with strong economic linkages and which are integrated with international capital markets are likely to be exposed to factors that cause common movements in international asset prices. Consequently, we expect such markets to react to news, possibly revealed in return volatility, in a similar fashion. Moreover, Ito, Engle and Lin (1992) argue that linkage of real economies through world-wide news, stochastic policy coordination, gradual dissemination of private information into asset prices, or market failures such as fad, bubbles or bandwagons (contagion effect argument of King and Wadhwani, 1990) can result into volatility clustering of stock returns across markets. This results in a positive correlation, contemporaneous as well as lagged, of return volatilities between stock markets. It should be recalled that the five foreign countries in this study are the Philippines' major economic partners. Also, our post-liberalization subperiod results in Chapter 2 indicate evidence of integration of the Philippine stock market with the stock markets of these countries. Therefore, it is quite surprising to find that, over time, an inverse relationship exists between Philippine volatility and the volatility of stock market returns of the U.S., Japan and Hong Kong. Similar effects have been found in the MGARCH models of Engle et al. (1990) and Lin (1997) in the foreign exchange market. However, these authors did not expound on why spillover effects are negative for some of the markets in their study.

French (1980) and French and Roll (1986) argue that trading activity causes volatility. Volatility appears to be caused by information revealed through trading. Moreover, several studies provide evidence for a positive relationship between trading (volume) and volatility in the (domestic) stock market (see, e.g., Karpoff 1987; Schwert 1989; Lamoureux and Lastrapes, 1991; Gallant, Rossi and Tauchen, 1992). Gallant et al. (1992) also find evidence that large stock market price movements are followed by high trading volume. Given these findings, we conjecture that not only does trading cause volatility but that volatility encourages trading. In addition, we hypothesize that foreign investors from countries with relatively large stock markets will move some of their portfolio investments back to their home markets, when these markets become more volatile. Moreover, it is possible that the local investors re-channel some of their investments to these foreign stock markets as well. Consequently, if the portfolio equity investments of these investors represent a significant proportion of the total domestic stock market funds and if the local market is relatively small, then their withdrawal of trading will reduce future return volatility of the local stock market. That is, the withdrawal of trading effect overwhelms any positive linkages of the local market return volatility and the return volatilities of these foreign markets. These may explain the negative impulse response of Philippine stock market return conditional volatility to stock return innovations emanating from the markets of the U.S., Japan and Hong Kong.

Stylized facts seem to support our premise. As mentioned in Chapter 1, the Philippine stock market is still considered as relatively thin compared to those of its Asian neighbors. Furthermore, portfolio equity investments by foreigners represent majority of funds in the Philippine stock market especially in recent years. Official statistics as to the breakdown of percentage share of total foreign portfolio equity investments in the Philippine stock market by nationality is not available. The only statistics we were able to obtain are those with respect to cumulative registered foreign direct investment, which includes equity investments undertaken to acquire a lasting interest in domestic corporations and projects. As of end of 1992, the U.S. accounted for 47.41% of the total inward direct foreign equity investment stock, followed by Japan with 21.04%, and then Hong Kong with 6.58%. On the other hand, Taiwan and Singapore accounted for 0.90% and 0.95%, respectively, of total inward foreign direct investments.[15] A Wall Street Journal (October 5, 1992) account states that of the US693 million new foreign investments during the first 8 months of 1992, US$490 million went to purchase of listed securities. Moreover, U.S. investors are reported to account for 22% of these new investment. In addition, Tiglao (1991) reports that the New York-based First Philippine Fund was the biggest single market investor in the Philippine stock market in 1991. Therefore, we speculate that the inward direct foreign investment figures mirror as well the ranking of portfolio equity investments by nationality of foreigner investors. On the other hand, evidence on growing interest of Philippine residents to invest abroad are reflected on the growth of outward investments. Tiglao (1995) reports that during the first half of the 1990s Philippine residents have become much larger investors in overseas markets than before. In particular, overseas investments by Filipinos and other residents grew from $115 million in 1992 to $1.1 billion in 1993 and further to $1.3 billion in 1994. A large portion of these outward flows involve investments of Manila's biggest major corporations in overseas equity markets. A reason cited for this growth in outward portfolio investment is the liberalization of foreign exchange regulations. As mentioned in Chapter 1, strict limits on the amount of foreign exchange that Filipinos could bring outside of the country have been imposed by the Philippine government up until the end of 1991. However, the limits were eventually relaxed in 1992 when Philippine residents were allowed to purchase from the banking system up to US$1 million annually for investments overseas, without prior Central Bank approval. This limit was further increased to $6 million in 1993. Therefore, given the relatively small size of the Philippine stock market, a reduction in investment activity by these investors is expected to reduce overall market trading activity and therefore domestic market return volatility.

On the other hand, a reason for the positive impact of a shock in the returns on the stock markets of Singapore and Taiwan on future Philippine conditional possibly is because their percentage share of total foreign portfolio equity investment is relatively small. Consequently, withdrawal of trading in Philippine equities by investors from these countries have little or no effect on overall level of trading activity in the domestic market. As such, the positive linkages of Philippine stock market return volatility with those of Taiwan and Singapore more than offset the withdrawal of trading effect. Moreover, as mentioned in Chapter 2, access to Taiwan's stock market for foreign investors remain heavily restricted during the 1987 to 1995 period. For example, Taiwan regulations bar direct sales to individual foreign investors. Nonresidents are allowed to invest only in qualified foreign institutional investors (Euromoney, 1994). On the other hand, even Singapore, which is generally rated as a freely open market (International Finance Corporation, 1996) maintains restrictions on foreign ownership in strategic companies, such as local banks, Singapore International Airline, Singapore Petroleum Company, and listed firms in the state defense complexes, Singapore Technologies. Foreign share holdings in these entities are limited to 20 to 49 percent of issued capital (Euromoney, 1994). Moreover, although it is considered as a mature market, the size of the stock market of Singapore is a lot smaller than that of the developing market of Taiwan and the developed and mature market of Hong Kong.[16] Therefore, it is unlikely that foreign investors, as well as Filipino investors, will concentrate their portfolio equity investments in this market.

In contrast, the results of the pre-liberalization subperiod analysis indicate a positive dynamic response of Philippine conditional volatility to innovations originating from the U.S., Taiwan and Japan. This finding is consistent with our preceding hypotheses. During this subperiod, significant barriers governed capital inflows into and out of the Philippines. For example, withdrawal of investments from the local stock market is much more difficult given the more restrictive foreign exchange regulations that governed outward flows of capital. Although the law prevailing during the pre-liberalization subperiod guaranteed full repatriation of cash investments in securities certified by the Central Bank and traded on the Philippine stock market, foreign investors were required to hold the securities for a minimum of 90 days before the proceeds become eligible for repatriation (International Monetary Fund, 1987), subject to prior Central Bank approval. The minimum holding period was removed only in 1989 (International Monetary Fund, 1990). Furthermore, it was not until 1992 when the Philippine government simplified the procedures for capital repatriation and dividend remittance of investments made by foreigners. Since January 1992, the law merely required foreign investors to register all investments in securities listed in the Philippine Stock Exchange with the Central Bank or with a duly designated custodian bank. Authorized agent banks were allowed to sell and remit the equivalent foreign exchange, without prior approval by the Central Bank. Lamberte and Llanto (1994) report that under previous regulations, brokers have pointed out that settlement of transactions related to foreign investment in Central Bank approved securities took about 4 to 6 months. However, under the new rules and regulation such transactions can be settled in 3 to 4 days. Given this regime of restrictions to outward flows of capital, it would have been difficult for foreign investors, as well as Philippine residents, to adjust their portfolio of Philippine equities in a desire to redirect investment activity towards the foreign equity markets.[17]

Model Misspecification Tests

We also perform an assessment of the general validity of the estimated multivariate GARCH parameterization in each subperiod using alternative misspecification tests. Li and McLeod (1983) propose residual-based diagnostic type tests using the Ljung-Box (LB) portmanteau statistics. These tests are conducted on the first and second conditional moments of the estimated GARCH specification for each national stock market index in the sample. In particular, the LB tests for up to 6[th] order serial correlation, LB(6), are performed on the standardized residuals $\hat{\varepsilon}_{it}/\sqrt{h_{iit}}$, squared standardized residuals $\hat{\varepsilon}_{it}^2/h_{iit}$, and cross-products of the standardized residuals, $\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}/\sqrt{h_{iit}h_{jjt}}$. If the GARCH parameterization adequately describes the heteroscedasticity, the standardized residuals, squared standardized residuals and the cross-products of the standardized residuals of the estimated model should be uncorrelated.[18]

The results of the LB tests for the pre- and post- liberalization subperiods are reported in Table 4.12. For the pre-liberalization subperiod, the LB(6) statistics for the standardized residuals are all statistically insignificant. Likewise, the LB(6) statistics as applied to the squared standardized are all statistically insignificant. For the cross-products of standardized residuals, the LB(6) statistics are all insignificant, except for the case between Hong Kong and the Philippines.

For the post-liberalization subperiod, the LB(6) statistics for the standardized residuals are all below their 5 percent critical values, except for the Philippines. On the other hand, the LB(6) statistics as applied to the squared standardized residuals are all insignificant. For the cross-products of standardized residuals, the LB(6) statistics are all insignificant except for two cases, both involving the Philippines (with Hong Kong and Singapore, respectively). Although not reported, these statistics become insignificant at higher order lags for the LB tests.

Bollerslev (1990) suggests a more direct test of the conditional variance and covariance parameterizations. An assumption of the multivariate GARCH specification is that the estimates of the conditional variance and conditional covariance reflect all relevant past information I_{t-1}; i.e., if the model is correctly specified, then $E[\varepsilon_{it}\varepsilon_{jt}|I_{t-1}]=h_{ijt}$ for i,j=US, PHL, TWN, JPN, HK, SIN. This test involves the inclusion of past residuals in the information set I_{t-1}. For $i=j$, the test is performed by regressing $\left(\hat{\varepsilon}_{i,t-1}^2-1\right)$ on $\hat{h}_{iit}^{-1}$ and $\hat{\varepsilon}_{i,t-1}^2\hat{h}_{iit}^{-1},\ldots,\hat{\varepsilon}_{i,t-5}^2\hat{h}_{iit}^{-1}$ and testing whether all of the estimated coefficients are significantly different from zero via a conventional F-test. For $i\neq j$, $\left(\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}-1\right)$ is regressed on $\hat{h}_{ijt}^{-1}$, $\hat{\varepsilon}_{i,t-1}^{2}\hat{h}_{ijt}^{-1}$, $\hat{\varepsilon}_{j,t-1}^{2}\hat{h}_{ijt}^{-1}$, and $\hat{\varepsilon}_{i,t-1}\hat{\varepsilon}_{j,t-1}\hat{h}_{iit}^{-1},....,\hat{\varepsilon}_{i,t-5}\hat{\varepsilon}_{j,t-5}\hat{h}_{iit}^{-1}$. The null hypothesis that the estimated coefficients are all zero in the previous regressions should not be rejected under the assumption that the GARCH specification adequately describes the heteroscedasticity.

Table 4.13 summarizes the results of the *F*-tests for both the pre- and post-liberalization subperiods. For the pre-liberalization subperiod, the *F*-test results indicate that only 1 out of 21 statistics is significant at the 0.05 level, involving the cross-product of the residuals of Taiwan and the Philippines. On the other hand, the results of the *F*-tests for the post-liberalization subperiod indicate that only 2 out of 21 *F*-test statistics are significant at the 0.05 level, both cases involving Singapore.

Overall, the results of the misspecification tests discussed above do not indicate any serious evidence against the simple and parsimonious multivariate GARCH(1,1)-in Mean model with constant conditional correlation. This is true for both the pre- and post- liberalization subperiods.

4.5. CONCLUSION

In this study, we investigate the transmission of stock returns and volatility of returns among the markets of the Philippines and its major trading partners and investing countries, using weekly data before and after the liberalization of barriers to international investments in the Philippine capital market. In particular, we examine whether spillovers of returns and returns volatility occur from the foreign markets to the Philippine market using the multivariate GARCH-in Mean model assuming constant conditional correlation. More importantly, we try to determine whether or not the opening up of the Philippine capital market to greater foreign investor participation has an impact on the responsiveness of this market's stock returns to the national stock market movements of its major trading partners and investors.

Overall, our evidence for the six national stock markets in the study indicates that (1) weekly returns on each national stock market index exhibit time-varying volatility and (2) lagged cross-market mean return spillovers occur among some of these countries. For the post-liberalization subperiod, there is also some evidence of a time-varying expected market return-market risk relationship in the stock markets of the Philippine, U.S. and Hong Kong markets, with risk measured by the conditional standard deviation of returns. This possibly implies that country-specific risks are priced. Moreover, the post-liberalization subperiod results indicate that weekly returns of the stock market indexes of the Philippines and Singapore are significantly affected by the cointegrating relationship governing the six national stock markets. The overall results of the model misspecification tests do not indicate any serious evidence against the simple and parsimonious multivariate GARCH(1,1)-in Mean with constant conditional correlation parameterization employed in this study.

The results of our analysis for the Philippine market suggest that there are no lagged mean return spillovers from the other markets to the Philippine market in both the pre- and post-liberalization subperiods. However, we find significant lagged volatility spillovers from the foreign markets to the Philippine stock market and that the evidence of such volatility transmission appears to be stronger in the post-liberalization subperiod. Specifically, while significant volatility spillovers occur only from the markets of the U.S., Taiwan and Japan to the Philippine market during the pre-liberalization subperiod. the post-liberalization subperiod results indicate that past innovations in the stock markets returns of all the other five markets significantly influence the future or predicted conditional variance of Philippine stock market returns. Results of the impulse response analysis indicate that the impact of an initial return shock originating from the foreign stock market on Philippine conditional volatility generally persists from 1 up to 7 weeks into the future. An innovation in the stock market return of Taiwan seems to have the most persistent effect on the conditional volatility of Philippine stock market returns, with the impact lasting up to 7 weeks after the initial shock.

Moreover, we find that during the post-liberalization subperiod, the conditional volatility of Philippine stock market returns seems to have become more responsive to information contained in past innovations in the foreign stock market returns relative to information contained in its own past innovations. During this subperiod, past innovations in the Singapore market have the greatest impact on the volatility of Philippine stock market returns, with past innovations originating from the U.S. market having the second largest influence. In contrast, while some cross-market volatility spillovers are observed during the pre-liberalization subperiod, own-market return innovations exhibit the largest impact on Philippine conditional volatility.

The preceding findings are supportive of the view that the presence of barriers to international investments effectively segment the domestic market from the relatively open foreign capital markets, thereby insulating it from international developments that can possibly affect the short-run dynamics of this market's assets returns. By liberalizing such restrictions, new information contained in international stock market movements become an important influence on the behavior of domestic stock market returns relative to local information. The stronger evidence of volatility spillovers during the post-liberalization subperiod is consistent with the finding of an increase in the degree of integration of the Philippine equity market with international equity markets in Chapter 2. However, our finding of lagged volatility spillover from some of the foreign markets to the Philippine market during the pre-liberalization subperiod also supports the view that cross-market transmission of stock market movements can occur in the absence of cross-country investing provided that a strong economic linkage exists between these countries. This is because such relationship also links the economic fundamentals of these countries' asset prices. Moreover, our finding of cross-market volatility spillovers despite the absence of mean return spillovers to the Philippine stock market is consistent with the view that information is most likely to be revealed on the volatility of asset prices than on its simple price changes.

Table 4.1: National Stock Markets Operating Hours

Country	Operating Hours (Local Time)	Operating Hours (New York time)	Market Closing Time Differences (Hours ahead of New York closing, in New York time)
Japan (Tokyo)[a]	Mon-Fri: 0900-1100;	1900-2100[c]	+15
	1230-1500	2330-0200	
Singapore	Mon-Fri: 0900-1230;	2000-2330[c]	+13
	1400-1700	0100-0400	
Taiwan[b]	Mon-Fri: 0900-1200	2000-2300[c]	+17
Philippines	Mon-Fri: 0930-1200	2030-2300[c]	+17
Hong Kong	Mon-Fri: 1000-1230;	2100-2330[c]	+13.5
	1430-1530	0130-0230	
United States (New York)	Mon-Fri: 0930-1600	0930-1600	

[a] Japan: The Tokyo Stock Exchange was open for half day sessions other than the third Saturday of the month until July 1983, other than the second Saturday of the month from August 1983 to July 1986, and other than the second and third Saturday of each month from August 1986 until the end of January 1989. The Exchange is now closed on all Saturdays.
[b] Taiwan: Saturday: 0900-1100
[c] Previous day in New York time

Sources: Emerging Stock Markets Factbook 1995, International Finance Corporation Emerging Markets Data Base, Capital Markets Department: Stock Exchanges of the World, International Securities Regulation, Oceana Publications, 1995; Doing Business in the USA (1995), Philippines (1994), Taiwan (1994), Singapore (1995), Hong Kong (1993), Singapore (1995), Japan (1991), Ernst & Young

Table 4.2: Summary Statistics for Weekly Returns on the National Stock Market Indexes

	Pre-Liberalization[a] January 1980-September (508 observations)						Post-Liberalization October 1989-December 1995 (325 observations)					
Statistics[b]	Philippines	Taiwan	Japan	Hong Kong	Singapore	United States	Philippines	Taiwan	Japan	Hong Kong	Singapore	United States
Mean	0.0031	0.0069*	0.0048*	0.0022	0.0032**	0.0030*	0.0018	-0.0022	-0.0006	0.0039**	0.0020	0.0017
Variance	0.0014	0.0017	0.0008	0.0021	0.0009	0.0005	0.0022	0.0032	0.0012	0.0010	0.0006	0.0003
Skewness	-0.201	0.007	0.052	-0.630*	-0.125	0.005	0.225	-0.337**	-0.110	-0.785*	-0.830*	-0.319**
Kurtosis	9.437*	3.036*	1.611*	2.932*	0.847*	0.995*	1.470*	3.243*	1.984*	1.705*	4.282*	1.149*
Autocorrelations:												
Returns												
ρ_1	0.061	0.176*	0.045	0.087**	0.073	-0.095**	0.144*	0.020	-0.008	-0.033	0.079	-0.114**
LB(6)	11.810	26.659*	5.134	16.912**	13.344**	6.246	9.818	7.328	11.185	6.361	5.859	16.997*
Squared Returns												
ρ_1	0.187*	0.358*	0.219*	0.208*	0.165*	0.120*	0.186*	0.201*	0.155*	0.068	0.041	0.079
LB(6)	26.788*	347.991*	25.959*	60.037*	38.047*	17.949*	26.353*	131.593*	49.831*	25.816*	44.536*	36.805*

[a] Statistics are based on the return series adjusted for the effect of the October 1987 stock market crash.

[b] LB(6) denotes the Ljung-Box test statistic to test the significance of the autocorrelation of the first 6 lags. ρ_1 denotes the autocorrelation coefficient at lag 1. Different lag lengths have no qualitative effect on the test results.

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.

Table 4.3: ARCH Tests[a-c]

Country	Pre-Liberalization January 1980-September			Post-Liberalization October 1989-December 1995		
	ARCH(4)	MARCH-1	MARCH-2	ARCH(4)	MARCH-1	MARCH-2
Philippines	**10.077****	**33.558***	**45.472***	**31.263***	**22.797***	**46.371***
Taiwan	**22.612***	**23.504***	**26.242***	**19.999***	**22.427***	**61.045***
Japan	**131.706***	**66.822***	**100.360***	**53.269***	**29.177***	**54.390***
Hong Kong	**25.344***	**33.906***	**40.369***	**30.060***	**10.705*****	**34.141***
Singapore	**39.731***	**26.002***	**54.503***	**19.849***	8.680	**26.467***
United States	**22.714***	**21.087***	**25.466****	**43.270***	**14.618****	**66.630***

[a] ARCH(4) is the ARCH test statistic with a univariate information set. The regressors are four lags of own-squared returns. This test statistic is distributed as $\chi^2(4)$. The critical values at the 0.01, 0.05 and 0.10 levels of significance are 13.3, 9.49, and 7.78, respectively.

[b] MARCH-1 is the ARCH test statistic with a multivariate information set. The regressors are lagged one own squared returns and lagged one squared returns on the stock market indexes of each of the other markets. This test statistic is distributed as $\chi^2(6)$. The critical values at the 0.01, 0.05 and 0.10 levels of significance are 16.8, 12.6, and 10.6, respectively.

[c] MARCH-2 is the same as MARCH-1 albeit with two lags. This test statistic is distributed as $\chi^2(12)$. The critical values at the 0.01, 0.05 and 0.10 levels of significance are 26.2, 21.0, and 18.5, respectively.

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.
The superscript *** denotes significance at the 0.10 level.

Table 4.4: Cross-Correlations of Philippine Stock Market Index Returns and Squared Returns

with National Stock Market Index Returns of[b]	Pre-Liberalization[a] January 1980-September 1989		Post-Liberalization October 1989-December 1995	
	Returns	Squared Returns	Returns	Squared Returns
Taiwan:				
ρ_{-1}	-0.022	0.003	0.086	**0.157***
ρ_0	0.038	-0.023	**0.239***	**0.254***
ρ_1	0.033	0.067	**0.174***	**0.171***
Japan:				
ρ_{-1}	-0.026	0.051	0.038	0.012
ρ_0	-0.028	0.028	0.086	0.073
ρ_1	0.029	0.069	-0.039	-0.027
Hong Kong:				
ρ_{-1}	-0.039	-0.022	0.094	0.064
ρ_0	**0.092****	0.006	**0.270***	**0.209***
ρ_1	0.061	-0.041	**0.129****	-0.032
Singapore:				
ρ_{-1}	0.043	-0.058	0.089	**0.117****
ρ_0	**0.097****	-0.030	**0.349***	**0.335***
ρ_1	**0.092****	-0.002	**0.129****	0.104
United States:				
ρ_{-1}	-0.088**	0.015	0.016	**0.210***
ρ_0	0.051	-0.011	**0.262***	**0.260***
ρ_1	**0.102****	0.013	0.074	0.056

[a] Statistics are based on the return series adjusted for the effect of the October 1987 stock market crash.

[b] ρ_j denotes cross correlation coefficient at lag j. ρ_1 indicates cross-correlation between past period's returns (squared returns) on the foreign stock market index and current period's returns (squared returns) on the Philippine stock market index. ρ_0 indicates contemporaneous cross-correlation between the foreign stock market index returns (squared returns) and the Philippine stock market index returns (squared returns). ρ_{-1} indicates cross-correlation between future foreign stock market index returns (squared returns) and current Philippine stock market index returns (squared returns).

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.

Table 4.5: Contemporaneous Cross-Correlations of Stock Market Returns and Squared Returns

	Pre-Liberalization January 1980-September 1989					Post-Liberalization October 1989-December 1995				
Returns:	Taiwan	Japan	Hong Kong	Singapore	U.S.	Taiwan	Japan	Hong Kong	Singapore	U.S.
Taiwan	1.000	0.123**	0.118*	0.115*	0.092**	1.000	0.097*	0.228*	0.303*	0.175*
Japan		1.000	0.152*	0.199*	0.295*		1.000	0.126*	0.378*	0.203*
Hong Kong			1.000	0.375*	0.274*			1.000	0.468*	0.335*
Singapore				1.000	0.386*				1.000	0.414*
U.S.					1.000					1.000
Squared Returns:	Taiwan	Japan	Hong Kong	Singapore	U.S.	Taiwan	Japan	Hong Kong	Singapore	U.S.
Taiwan	1.000	0.004	0.002	0.026	0.008	1.000	0.200*	0.160*	0.594*	0.469*
Japan		1.000	-0.038	0.023	0.242*		1.000	0.033	0.240*	0.198*
Hong Kong			1.000	0.100**	0.069			1.000	0.415*	0.198*
Singapore				1.000	0.198*				1.000	0.609*
U. S.					1.000					1.000

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.

Table 4.6: Estimates of the VAR Model in Returns: Pre-Liberalization - January 1980 To September 1989[a]

$$r_{i,t} = \mu_i + \phi_{US,i} r_{US,t-1} + \phi_{PHL,i} r_{PHL,t-1} + \phi_{TWN,i} r_{TWN,t-1} + \phi_{JPN,i} r_{JPN,t-1} + \phi_{HK,i} r_{HK,t-1} + \phi_{SIN,i} r_{SIN,t-1} + \varepsilon_{i,t}$$

	Country (i)					
Parameter	United States (US) (1)	Philippines (PHL) (2)	Taiwan (TWN) (3)	Japan (JPN) (4)	Hong Kong (HK) (5)	Singapore (SIN) (6)
μ_i	**0.0034**	0.0023	**0.0059**	**0.0046**	0.0028	**0.0028**
	(3.53)*	(1.39)	**(3.08)***	**(3.61)***	(1.32)	**(2.04)****
$\phi_{US,i}$	-0.0821	0.1319	-0.0126	0.0185	-0.0711	0.0210
	(-1.50)	(1.46)	(-0.13)	(0.28)	(-0.72)	(0.28)
$\phi_{PHL,i}$	**-0.0445**	0.0496	-0.0330	-0.0167	-0.0454	0.0271
	(-1.67)***	(0.65)	(-0.70)	(-0.45)	(-0.99)	(0.93)
$\phi_{TWN,i}$	-0.0198	0.0158	**0.1814**	0.0027	-0.0649	-0.0256
	(-0.83)	(0.32)	**(2.44)****	(0.09)	(-1.50)	(-0.79)
$\phi_{JPN,i}$	0.0235	-0.0096	-0.0478	0.0446	0.0744	0.0182
	(0.65)	(-0.13)	(-0.69)	(0.70)	(1.11)	(0.38)
$\phi_{HK,i}$	0.0022	0.0129	-0.0182	0.0053	**0.1288**	0.0400
	(0.07)	(0.33)	(-0.34)	(0.15)	**(1.82)*****	(1.05)
$\phi_{SIN,i}$	-0.0303	0.0651	0.0386	-0.0281	**-0.1151**	0.0419
	(-0.76)	(1.00)	(0.60)	(-0.55)	**(-1.65)*****	(0.70)
χ^2 Tests of Exclusion Restrictions[b]	4.8525	8.9870	1.5956	1.1402	4.6058	4.6062
	(0.43)	(0.17)	(0.90)	(0.98)	(0.33)	(0.60)

[a] Figures in parentheses are t-ratios based on OLS regressions with standard errors computed using the Newey-West (1987) correction for heteroscedasticity and/or autocorrelation.

[b] χ^2 statistics (p-values in parentheses) denote tests of the null hypothesis that the coefficients of the lagged stock market returns regressors found to be insignificant in each market's equation are all zero.

The superscript * denotes significance at 0.01 level.
The superscript ** denotes significance at 0.05 level.
The superscript *** denotes significance at 0.10 level.

Table 4.7: Estimates of the VAR Model in Returns: Post-Liberalization - October 1989 To December 1995[a]

$$r_{i,t} = \mu_i + \phi_{US,i} r_{US,t-1} + \phi_{PHL,i} r_{PHL,t-1} + \phi_{TWN,i} r_{TWN,t-1} + \phi_{JPN,i} r_{JPN,t-1} + \phi_{HK,i} r_{HK,t-1} + \phi_{SIN,i} r_{SIN,t-1} + \alpha_i z_{t-1} + \varepsilon_{i,t}$$

$$\text{where } z_{t-1} = 2.282 S_{US,t-1} + 7.792 S_{PHL,t-1} - 3.780 S_{TWN,t-1} + 5.975 S_{JPN,t-1} - 4.634 S_{HK,t-1} - 9.681 S_{SIN,t-1}$$

Parameter	Country (i)					
	United States (US) (1)	Philippines (PHL) (2)	Taiwan (TWN) (3)	Japan (JPN) (4)	Hong Kong (HK) (5)	Singapore (SIN) (6)
μ_i	-0.0490	**-0.3061**	0.0253	-0.0014	-0.0064	0.0530
	(-1.48)	**(-3.26)***	(0.22)	(-0.03)	(-0.11)	(1.06)
α_i	-0.0013	**-0.0076**	0.0007	-0.00003	-0.0003	0.0013
	(-1.55)	**(-3.26)***	(0.25)	(-0.02)	(-0.18)	(1.03)
$\phi_{US,i}$	**-0.1457**	-0.0178	-0.1264	-0.0674	-0.1133	0.0214
	(-2.23)**	(-0.10)	(-0.47)	(-0.55)	(-0.98)	(0.23)
$\phi_{PHL,i}$	0.0207	0.0872	0.0752	0.0221	**0.0761**	0.0355
	(0.80)	(1.25)	(0.79)	(0.46)	**(1.76)*****	(1.00)
$\phi_{TWN,i}$	-0.0274	0.0876	-0.0216	0.0292	-0.0110	-0.0083
	(-1.40)	(1.60)	(-0.25)	(0.83)	(-0.33)	(-0.26)
$\phi_{JPN,i}$	**0.0498**	-0.0961	0.14208	-0.0244	0.0390	0.0320
	(1.89)***	(-1.33)	(1.19)	(-0.32)	(0.70)	(0.78)
$\phi_{HK,i}$	-0.0316	0.0490	0.05.82	-0.0569	-0.0671	0.0292
	(-1.11)	(0.64)	(0.61)	(-0.85)	(-0.97)	(0.64)
$\phi_{SIN,i}$	0.0430	0.1387	0.1570	0.0852	0.0595	0.0222
	(0.96)	(0.91)	(0.91)	(0.85)	(0.62)	(0.31)
χ^2 Tests of Exclusion Restrictions[b]	4.2898	10.1540	5.4881	2.6196	3.1206	4.6057
	(0.37)	(0.12)	(0.48)	(0.86)	(0.68)	(0.60)

[a] Figures in parentheses are t-ratios based on OLS regressions with standard errors computed using the Newey-West (1987) correction for heteroscedasticity and/or autocorrelation.

[b] χ^2 statistics (p-values in parentheses) denote tests of the null hypothesis that the coefficients of the lagged stock market returns regressors found to be insignificant in each market's equation are all zero.

The superscript * denotes significance at 0.01 level.
The superscript ** denotes significance at 0.05 level.
The superscript *** denotes significance at 0.10 level.

Table 4.8: Maximum Likelihood Estimates of the Multivariate GARCH-in Mean Model with Constant Conditional Correlation. MGARCH(1,1)-M2-CCTL: Pre-Liberalization - January 1980 to September 1989[a]

$$r_{US,t} = \mu_{US} + \phi_{PHL,US} r_{PHL,t-1} + \delta_{US,US} h_{US,US,t} + \varepsilon_{US,t}$$
$$r_{PHL,t} = \mu_{PHL} + \delta_{PHL,PHL} h_{PHL,PHL,t} + \varepsilon_{PHL,t}$$
$$r_{TWN,t} = \mu_{TWN} + \phi_{TWN,TWN} r_{TWN,t-1} + \delta_{TWN,TWN} h_{TWN,TWN,t} + \varepsilon_{TWN,t}$$
$$r_{JPN,t} = \mu_{JPN} + \delta_{JPN,JPN} h_{JPN,JPN,t} + \varepsilon_{JPN,t}$$
$$r_{HK,t} = \mu_{HK} + \phi_{HK,HK} r_{HK,t-1} + \phi_{SIN,HK} r_{SIN,t-1} + \delta_{HK,HK} h_{HK,HK,t} + \varepsilon_{HK,t}$$
$$r_{SIN,t} = \mu_{SIN} + \delta_{SIN,SIN} h_{SIN,SIN,t} + \varepsilon_{SIN,t}$$
$$h_{ii,t} = c_i + a_{US,i}\varepsilon^2_{US,t-1} + a_{PHL,i}\varepsilon^2_{PHL,t-1} + a_{TWN,i}\varepsilon^2_{TWN,t-1} + a_{JPN,i}\varepsilon^2_{JPN,t-1} + a_{HK,i}\varepsilon^2_{HK,t-1} + a_{SIN,i}\varepsilon^2_{SIN,t-1} + b_{ii}h_{ii,t-1} \text{ and}$$
$$h_{ij,t} = \rho_{ij}\left[h_{ii,t}h_{jj,t}\right]^{1/2}, \; -1 \le \rho_{ij} \le 1 \text{ and } i \ne j, \text{ for } i,j = \text{US, PHL, TWN, JPN, HK, SIN}$$

where US = United States, PHL = Philippines, TWN = Taiwan, JPN = Japan, HK = Hong Kong, and SIN = Singapore

Parameters	Country (i)					
Conditional Mean Returns	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)
μ_i	0.0014	-0.0014	-0.0002	-0.0004	0.0018	0.0041
	(0.57)	(-0.88)	(-0.10)	(-0.10)	(0.44)	(1.03)
$\phi_{US,i}$	-	-	-	-	-	-
$\phi_{PHL,i}$	**-0.0600**	-	-	-	-	-
	(-2.20)**					
$\phi_{TWN,i}$	-	-	**0.0999**	-	-	-
			(2.11)**			
$\phi_{JPN,i}$	-	-	-	-	-	-
$\phi_{HK,i}$	-	-	-	-	0.1100	-
					(1.66)	
$\phi_{SIN,i}$	-	-	-	-	-0.0952	-
					(-1.50)	
δ_{ii}	3.4235	0.6659	2.3622	6.6274	1.8036	-0.6223
	(0.60)	(0.49)	(1.50)	(1.07)	(0.78)	(-0.13)
Conditional Variance						
c_i	0.00006	0.00006	0.00005	**0.00038**	**0.00039**	**0.00026**
	(1.47)	(1.60)	(1.38)	**(3.57)***	**(2.94)***	**(2.68)***
b_{ii}	**0.5953**	**0.2834**	**0.8141**	0.1859	**0.5808**	**0.4821**
	(4.30)*	**(5.02)***	**(17.97)***	(1.00)	**(7.02)***	**(3.63)***
$a_{US,i}$	0.0527	**0.2627**	0.0303	-0.0091	0.2160	0.0397
	(1.19)	**(4.36)***	(0.70)	(-0.14)	(1.64)	(0.54)
$a_{PHL,i}$	0.0114	**0.6500**	0.0028	0.0279	-0.0059	-0.0021
	(1.64)	**(5.03)***	(0.58)	(1.40)	(-0.48)	(-0.19)
$a_{TWN,i}$	0.0116	**0.1221**	**0.1552**	0.0027	-0.0143	-0.0008
	(1.29)	**(7.20)***	**(3.54)***	(0.19)	(-1.02)	(-0.10)
$a_{JPN,i}$	-0.0045	**0.0996**	-0.0058	**0.1702**	-0.0163	-0.0135
	(-0.23)	**(2.44)****	(-0.30)	**(2.67)***	(-0.55)	(-0.37)
$a_{HK,i}$	0.0139	-0.0068	-0.0025	0.0129	**0.2203**	0.0023
	(1.86)	(-1.88)	(-0.56)	(0.76)	**(4.77)***	(0.21)
$a_{SIN,i}$	0.0463	-0.0176	-0.0139	0.0453	-0.0615	**0.2079**
	(1.80)	(-1.54)	(-0.87)	(1.23)	(-1.50)	**(3.63)***
Conditional Correlation (ρ_{ij})						
(j)						
PHL	-	-	-	-	-	-
TWN	-	0.0274	-	-	-	-
		(0.45)				
JPN	-	-0.0087	**0.1431**	-	-	-
		(-0.13)	**(2.80)***			
HK	-	0.0706	**0.1402**	**0.1545**	-	-
		(1.05)	**(2.69)***	**(2.57)****		
SIN	-	0.1041	**0.1531**	**0.1900**	**0.3574**	-
		(1.77)	**(3.11)***	**(3.48)***	**(7.85)***	
US	-	0.0561	**0.1268**	**0.2740**	**0.2865**	**0.3933**
		(0.94)	**(2.46)****	**(6.15)***	**(5.90)***	**(8.73)***

[a] Figures in parentheses are asymptotic t-values: * denotes significance at 0.01 level; ** denotes significance at 0.05 level

Table 4.9: Maximum Likelihood Estimates of the Multivariate GARCH-in Mean Model with Constant Conditional Correlation. MGARCH(1,1)-MI-CCTL: Post-Liberalization - October 1989 to December 1995*

$$r_{US,t} = \mu_{US} + \phi_{US,US} r_{US,t-1} + \phi_{JPN,US} r_{JPN,t-1} + \alpha_{US} z_{t-1} + \delta_{US,US}\sqrt{h_{US,US,t}} + \varepsilon_{US,t}$$

$$r_{PHL,t} = \mu_{PHL} + \alpha_{PHL} z_{t-1} + \delta_{PHL,PHL}\sqrt{h_{PHL,PHL,t}} + \varepsilon_{PHL,t}$$

$$r_{TWN,t} = \mu_{TWN} + \alpha_{TWN} z_{t-1} + \delta_{TWN,TWN}\sqrt{h_{TWN,TWN,t}} + \varepsilon_{TWN,t}$$

$$r_{JPN,t} = \mu_{JPN} + \alpha_{JPN} z_{t-1} + \delta_{JPN,JPN}\sqrt{h_{JPN,JPN,t}} + \varepsilon_{JPN,t}$$

$$r_{HK,t} = \mu_{HK} + \phi_{PHL,HK} r_{PHL,t-1} + \alpha_{HK} z_{t-1} + \delta_{HK,HK}\sqrt{h_{HK,HK,t}} + \varepsilon_{HK,t}$$

$$r_{SIN,t} = \mu_{SIN} + \alpha_{SIN} z_{t-1} + \delta_{SIN,SIN}\sqrt{h_{SIN,SIN,t}} + \varepsilon_{SIN,t}$$

$$h_{ii,t} = c_i + a_{US,i}\varepsilon^2_{US,t-1} + a_{PHL,i}\varepsilon^2_{PHL,t-1} + a_{TWN,i}\varepsilon^2_{TWN,t-1} + a_{JPN,i}\varepsilon^2_{JPN,t-1} + a_{HK,i}\varepsilon^2_{HK,t-1} + a_{SIN,i}\varepsilon^2_{SIN,t-1} + b_{ii} h_{ii,t-1} \text{ and}$$

$$h_{ij,t} = \rho_{ij}\left[h_{ii,t} h_{jj,t}\right]^{1/2}, \quad -1 \le \rho_{ij} \le 1 \text{ and } i \ne j, \text{ for } i,j = \text{US, PHL, TWN, JPN, HK, SIN}$$

where US = United States, PHL = Philippines, TWN = Taiwan, JPN = Japan, HK = Hong Kong, and SIN = Singapore

Parameters	Country (i)					
Conditional Mean Returns	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)
μ_i	-0.0155	-0.5221	0.1881	0.0442	0.0544	0.0983
	(-0.55)	(-6.52)*	(1.75)	(0.56)	(0.91)	(2.09)**
α_i	-0.0006	-0.0123	0.0047	0.0013	0.0009	0.0024
	(-0.86)	(-6.34)*	(1.81)	(0.68)	(0.63)	(2.14)**
$\phi_{US,i}$	-0.1401	-	-	-	-	-
	(-2.23)**					
$\phi_{PHL,i}$	-	-	-	-	0.0044	-
					(0.16)	
$\phi_{TWN,i}$	-	-	-	-	-	-
$\phi_{JPN,i}$	0.0464	-	-	-	-	-
	(1.80)					
$\phi_{HK,i}$	-	-	-	-	-	-
$\phi_{SIN,i}$	-	-	-	-	-	-
δ_{ii}	-0.4658	0.5976	0.0336	0.3041	-0.4543	0.0378
	(-2.21)**	(3.67)*	(0.20)	(1.43)	(-2.72)*	(0.13)
Conditional Variance						
c_i	0.000005	0.0007	0.00007	0.00004	0.0002	0.00027
	(0.19)	(4.49)*	(0.83)	(0.63)	(2.98)*	(2.83)*
b_{ii}	0.9964	0.5296	0.7554	0.7057	0.7805	0.5121
	(79.75)*	(5.61)*	(8.58)*	(9.46)*	(10.74)*	(2.95)*
$a_{US,i}$	-0.0330	-0.3284	0.0558	0.0988	-0.0737	0.0195
	(-2.34)**	(-3.98)*	(0.12)	(0.77)	(0.54)	(0.17)
$a_{PHL,i}$	0.0034	0.0249	0.0299	0.0167	-0.0189	-0.0185
	(1.73)	(0.71)	(0.71)	(0.70)	(-1.88)	(-1.58)
$a_{TWN,i}$	0.0018	0.0694	0.1891	0.0057	0.0024	0.0357
	(1.69)	(1.81)	(2.68)*	(0.54)	(0.44)	(2.09)**
$a_{JPN,i}$	0.0007	-0.0761	0.0077	0.2616	-0.0194	-0.0056
	(0.59)	(-3.64)*	(0.18)	(3.70)*	(-1.45)	(-0.41)
$a_{HK,i}$	-0.000013	-0.1641	0.0067	0.0271	0.1057	0.0353
	(-0.01)	(-4.85)*	(0.13)	(0.93)	(2.17)**	(1.17)
$a_{SIN,i}$	-0.0094	0.5231	-0.0176	-0.1320	-0.0011	0.0414
	(-1.12)	(2.61)*	(-0.11)	(-1.97)**	(-0.03)	(0.48)
Conditional Correlation (ρ_{ij})						
(j)						
PHL	-	-	-	-	-	-
TWN	-	0.1789	-	-	-	-
		(2.20)**				
JPN	-	0.0867	0.1621	-	-	-
		(1.16)	(1.99)**			
HK	-	0.2406	0.2152	0.1570	-	-
		(3.68)*	(3.14)*	(2.23)**		
SIN	-	0.3015	0.2102	0.3934	0.4622	-
		(4.07)*	(3.39)*	(6.58)*	(10.04)*	
US	-	0.2035	0.0115	0.1906	0.3458	0.3356
		(2.78)*	(0.16)	(3.12)*	(5.67)*	(5.35)*

[a] Figures in parentheses are asymptotic t-values: * denotes significance at 0.01 level; ** denotes significance at 0.05 level

Table 4.10: Impulse Response Coefficients for Conditional Volatility of Philippine Stock Market Returns
Pre-Liberalization: January 1980 to September 1989[a]

s-weeks ahead	one-unit returns shock in originating from					
	US	PHL	TWN	JPN	HK	SIN
1	0.2627	0.6500	0.1221	0.0996	-0.0068	-0.0176
	(4.36)*	(5.03)*	(7.20)*	(2.44)**	(-1.88)	(-1.54)
2	0.2597	0.6130	0.1363	0.1084	-0.0033	-0.0047
	(3.88)*	(3.50)*	(5.32)*	(2.38)**	(-0.75)	(-0.31)
3	0.2564	0.5794	0.1490	0.1061	-0.0008	0.0040
	(3.23)*	(2.67)*	(4.02)*	(2.24)**	(-0.15)	(0.20)
4	0.2521	0.5486	0.1602	0.1084	0.0011	0.0097
	(2.69)*	(2.16)**	(3.22)*	(2.04)**	(0.17)	(0.42)
5	0.2469	0.5201	0.1703	0.0941	0.0024	0.0132
	(2.28)**	(1.81)	(2.72)*	(1.83)	(0.34)	(0.51)
6	0.2412	0.4937	0.1793	0.0880	0.0034	0.0151
	(1.96)**	(1.56)	(2.36)**	(1.63)	(0.44)	(0.53)
7	0.2350	0.4689	0.1873	0.0823	0.0042	0.0158
	(1.72)	(1.37)	(2.10)**	(1.45)	(0.49)	(0.52)
8	0.2285	0.4458	0.1944	0.0770	0.0046	0.0156
	(1.53)	(1.22)	(1.89)	(1.30)	(0.51)	(0.49)
9	0.2220	0.4242	0.2007	0.0722	0.0049	0.0148
	(1.38)	(1.11)	(1.73)	(1.16)	(0.51)	(0.45)
10	0.2155	0.4039	0.2063	0.0678	0.0051	0.0136
	(1.25)	(1.01)	(1.60)	(1.05)	(0.50)	(0.40)
11	0.2090	0.3848	0.2112	0.0636	0.0051	0.0122
	(1.15)	(0.93)	(1.49)	(0.96)	(0.48)	(0.35)
12	0.2027	0.3669	0.2154	0.0598	0.0050	0.0107
	(1.06)	(0.86)	(1.39)	(0.88)	(0.45)	(0.30)
13	0.1966	0.3500	0.2191	0.0563	0.0048	0.0091
	(0.99)	(0.80)	(1.31)	(0.81)	(0.43)	(0.25)
14	0.1906	0.3341	0.2222	0.0530	0.0046	0.0075
	(0.92)	(0.75)	(1.24)	(0.74)	(0.40)	(0.20)
15	0.1848	0.3192	0.2248	0.0500	0.0044	0.0059
	(0.87)	(0.71)	(1.18)	(0.69)	(0.37)	(0.16)
16	0.1792	0.3052	0.2270	0.0471	0.0041	0.0044
	(0.82)	(0.67)	(1.12)	(0.64)	(0.34)	(0.12)
17	0.1738	0.2919	0.2288	0.0445	0.0038	0.0029
	(0.77)	(0.63)	(1.07)	(0.60)	(0.31)	(0.08)
18	0.1686	0.2794	0.2301	0.0420	0.0035	0.0015
	(0.74)	(0.60)	(1.02)	(0.57)	(0.28)	(0.04)
19	0.1637	0.2677	0.2311	0.0397	0.0032	0.0003
	(0.70)	(0.57)	(0.98)	(0.53)	(0.25)	(0.01)
20	0.1589	0.2566	0.2318	0.0375	0.0029	-0.0009
	(0.67)	(0.55)	(0.94)	(0.50)	(0.23)	(-0.02)
21	0.1543	0.2461	0.2321	0.0355	0.0026	-0.0020
	(0.65)	(0.53)	(0.91)	(0.48)	(0.20)	(-0.05)
22	0.1499	0.2362	0.2322	0.0336	0.0023	-0.0031
	(0.62)	(0.51)	(0.88)	(0.45)	(0.18)	(-0.08)
23	0.1457	0.2268	0.2320	0.0318	0.0020	-0.0040
	(0.60)	(0.49)	(0.85)	(0.43)	(0.16)	(-0.11)
24	0.1416	0.2180	0.2316	0.0301	0.0017	-0.0049
	(0.58)	(0.47)	(0.82)	(0.41)	(0.13)	(-0.13)
25	0.1378	0.2096	0.2310	0.0285	0.0015	-0.0057
	(0.56)	(0.45)	(0.80)	(0.39)	(0.11)	(-0.15)
26	0.1341	0.2017	0.2301	0.0271	0.0012	-0.0064
	(0.54)	(0.44)	(0.77)	(0.37)	(0.10)	(-0.17)

Table 4.10 continued

s-weeks ahead	one-unit returns shock in originating from					
	US	PHL	TWN	JPN	HK	SIN
27	0.1305	0.1942	0.2291	0.0257	0.0010	-0.0070
	(0.53)	(0.43)	(0.75)	(0.36)	(0.08)	(-.0.19)
28	0.1271	0.1871	0.2279	0.0244	0.0008	-0.0076
	(0.51)	(0.41)	(0.73)	(0.34)	(0.06)	(-0.21)
29	0.1238	0.1804	0.2266	0.0232	0.0006	-0.0082
	(0.50)	(0.40)	(0.71)	(0.33)	(0.05)	(-0.22)
30	0.1206	0.1740	0.2251	0.0220	0.0004	-0.0087
	(0.49)	(0.39)	(0.69)	(0.31)	(0.03)	(-0.24)
31	0.1176	0.1680	0.2235	0.0210	0.0002	-0.0091
	(0.47)	(0.38)	(0.67)	(0.30)	(0.02)	(-0.25)
32	0.1146	0.1622	0.2217	0.0199	0.0000	-0.0095
	(0.46)	(0.37)	(0.66)	(0.29)	(0.00)	(-0.26)
33	0.1118	0.1568	0.2199	0.0190	-0.0001	-0.0099
	(0.45)	(0.36)	(0.64)	(0.28)	(-0.01)	(-0.27)
34	0.1091	0.1516	0.2180	0.0181	-0.0003	-0.0102
	(0.44)	(0.35)	(0.63)	(0.27)	(-0.02)	(-0.28)
35	0.1065	0.1467	0.2160	0.0173	-0.0004	-0.0104
	(0.43)	(0.35)	(0.61)	(0.26)	(-0.03)	(-0.29)
36	0.1040	0.1420	0.2139	0.0165	-0.0005	-0.0107
	(0.43)	(0.34)	(0.60)	(0.25)	(-0.04)	(-0.30)
37	0.1016	0.1375	0.2118	0.0157	-0.0006	-0.0109
	(0.42)	(0.33)	(0.59)	(0.25)	(-0.05)	(-0.31)
38	0.0992	0.1333	0.2096	0.0150	-0.0007	-0.0111
	(0.41)	(0.33)	(0.58)	(0.24)	(-0.06)	(-0.32)
39	0.0970	0.1292	0.2074	0.0144	-0.0008	-0.0112
	(0.40)	(0.32)	(0.56)	(0.23)	(-0.07)	(-0.32)
40	0.0948	0.1254	0.2051	0.0138	-0.0009	-0.0114
	(0.40)	(0.32)	(0.55)	(0.23)	(-0.08)	(-0.33)
41	0.0927	0.1217	0.2027	0.0132	-0.0010	-0.0115
	(0.39)	(0.31)	(0.54)	(0.22)	(-0.09)	(-0.33)
42	0.0906	0.1182	0.2004	0.0126	-0.0010	-0.0116
	(0.38)	(0.30)	(0.54)	(0.21)	(-0.09)	(-0.34)
43	0.0887	0.1148	0.1980	0.0121	-0.0011	-0.0116
	(0.37)	(0.29)	(0.53)	(0.20)	(-0.10)	(-0.34)
44	0.0867	0.1116	0.1956	0.0116	-0.0012	-0.0117
	(0.37)	(0.29)	(0.52)	(0.20)	(-0.10)	(-0.34)
45	0.0849	0.1085	0.1931	0.0111	-0.0012	-0.0117
	(0.36)	(0.28)	(0.51)	(0.19)	(-0.11)	(-0.34)
46	0.0831	0.1056	0.1907	0.0107	-0.0013	-0.0117
	(0.35)	(0.28)	(0.50)	(0.18)	(-0.11)	(-0.34)
47	0.0814	0.1027	0.1883	0.0103	-0.0013	-0.0117
	(0.35)	(0.27)	(0.50)	(0.18)	(-0.12)	(-0.34)
48	0.0797	0.1000	0.1858	0.0099	-0.0013	-0.0117
	(0.34)	(0.26)	(0.49)	(0.17)	(-0.12)	(-0.35)
49	0.0780	0.0974	0.1833	0.0095	-0.0014	-0.0117
	(0.34)	(0.26)	(0.48)	(0.17)	(-0.13)	(-0.35)
50	0.0765	0.0949	0.1809	0.0092	-0.0014	-0.0116
	(0.33)	(0.25)	(0.48)	(0.16)	(-0.13)	(-0.35)
51	0.0749	0.0926	0.1784	0.0088	-0.0014	-0.0117
	(0.33)	(0.25)	(0.47)	(0.16)	(-0.13)	(-0.35)
52	0.0734	0.0902	0.1760	0.0085	-0.0014	-0.0116
	(0.32)	(0.25)	(0.46)	(0.15)	(-0.14)	(-0.35)

[a] Figures in parentheses are asymptotic t-values.

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.

Table 4.11: Impulse Response Coefficients for Conditional Volatility of Philippine Stock Market Returns
Post-Liberalization: October 1989 to December 1995[a]

	one-unit returns shock in originating from					
s-weeks ahead	US	PHL	TWN	JPN	HK	SIN
1	**-0.3284**	0.0249	0.0694	**-0.0761**	**-0.1641**	**0.5231**
	(-3.98)*	(0.71)	(1.81)	**(-3.64)***	**(-4.85)***	**(2.61)***
2	-0.1526	0.0069	**0.0689**	**-0.0616**	**-0.0915**	**0.3238**
	(-1.92)	(0.33)	**(2.48)***	**(-3.88)***	**(-3.02)***	**(2.47)****
3	-0.0598	0.0008	**0.0629**	**-0.0515**	-0.0539	**0.1996**
	(-0.65)	(0.05)	**(2.62)***	**(-2.42)***	(-1.74)	**(2.02)****
4	-0.0129	-0.0005	**0.0560**	**-0.0446**	-0.0349	0.1246
	(-0.14)	(-0.04)	**(2.49)***	**(-1.98)****	(-1.22)	(1.60)
5	0.0094	0.0000	**0.0499**	-0.0398	-0.0252	0.0805
	(0.10)	(0.00)	**(2.28)***	(-1.69)	(-0.99)	(1.28)
6	0.0189	0.0009	**0.0449**	-0.0363	-0.0201	0.0550
	(0.22)	(0.09)	**(2.10)***	(-1.47)	(-0.88)	(1.05)
7	0.0222	0.0016	0.0409	-0.0336	-0.0172	0.0404
	(0.27)	(0.17)	(1.95)	(-1.30)	(-0.81)	(0.89)
8	0.0225	0.0021	0.0377	-0.0314	-0.0154	0.0320
	(0.29)	(0.24)	(1.82)	(-1.17)	(-0.77)	(0.78)
9	0.0215	0.0023	0.0351	-0.0296	-0.0139	0.0270
	(0.30)	(0.28)	(1.72)	(-1.06)	(-0.73)	(0.71)
10	0.0202	0.0024	0.0328	-0.0280	-0.0127	0.0239
	(0.30)	(0.31)	(1.62)	(-0.96)	(-0.69)	(0.66)
11	0.0188	0.0024	0.0309	-0.0266	-0.0116	0.0218
	(0.31)	(0.32)	(1.54)	(-0.89)	(-0.65)	(0.63)
12	0.0174	0.0022	0.0292	-0.0253	-0.0106	0.0202
	(0.31)	(0.32)	(1.46)	(-0.82)	(-0.61)	(0.61)
13	0.0162	0.0021	0.0276	-0.0240	-0.0096	0.0190
	(0.2)	(0.31)	(1.39)	(-0.76)	(-0.57)	(0.60)
14	0.0151	0.0019	0.0261	-0.0229	-0.0087	0.0179
	(0.34)	(0.30)	(1.32)	(-0.71)	(-0.53)	(0.58)
15	0.0141	0.0018	0.0247	-0.0218	-0.0079	0.0169
	(0.35)	(0.28)	(1.25)	(-0.66)	(-0.49)	(0.57)
16	0.0132	0.0016	0.0234	-0.0208	-0.0072	0.0160
	(0.37)	(0.26)	(1.20)	(-0.62)	(-0.46)	(0.55)
17	0.0124	0.0015	0.0221	-0.0199	-0.0065	0.0151
	(0.39)	(0.24)	(1.14)	(-0.59)	(-0.43)	(0.53)
18	0.0117	0.0013	0.0210	-0.0190	-0.0059	0.0144
	(0.42)	(0.22)	(1.09)	(-0.56)	(-0.40)	(0.52)
19	0.0110	0.0012	0.0198	-0.0181	-0.0053	0.0136
	(0.45)	(0.20)	(1.04)	(-0.53)	(-0.37)	(0.51)
20	0.0104	0.0011	0.0188	-0.0173	-0.0048	0.0129
	(0.49)	(0.18)	(0.99)	(-0.50)	(-0.35)	(0.49)
21	0.0098	0.0010	0.0178	-0.0166	-0.0044	0.0123
	(0.53)	(0.16)	(0.95)	(-0.48)	(-0.33)	(0.48)
22	0.0093	0.0009	0.0168	-0.0158	-0.0040	0.0116
	(0.58)	(0.15)	(0.91)	(-0.46)	(-0.31)	(0.46)
23	0.0088	0.0008	0.0159	-0.0152	-0.0036	0.0111
	(0.64)	(0.13)	(0.87)	(-0.44)	(-0.29)	(0.45)
24	0.0084	0.0007	0.0151	-0.0145	-0.0033	0.0105
	(0.72)	(0.12)	(0.84)	(-0.42)	(-0.28)	(0.44)
25	0.0079	0.0006	0.0142	-0.0139	-0.0030	0.0100
	(0.79)	(0.10)	(0.80)	(-0.40)	(-0.26)	(0.43)
26	0.0075	0.0005	0.0135	-0.0133	-0.0027	0.0095
	(0.87)	(0.09)	(0.78)	(-0.39)	(-0.24)	(0.42)

Table 4.11 continued

s-weeks ahead	one-unit returns shock in originating from US	PHL	TWN	JPN	HK	SIN
27	0.0072	0.0004	0.0127	-0.0127	-0.0025	0.0091
	(0.93)	(0.08)	(0.74)	(-0.37)	(-0.23)	(0.41)
28	0.0068	0.0004	0.0120	-0.0122	-0.0023	0.0087
	(0.96)	(0.07)	(0.71)	(-0.36)	(-0.22)	(0.40)
29	0.0065	0.0003	0.0114	-0.0117	-0.0021	0.0083
	(0.94)	(0.06)	(0.69)	(-0.35)	(-0.21)	(0.39)
30	0.0062	0.0003	0.0108	-0.0112	-0.0019	0.0079
	(0.88)	(0.05)	(0.67)	(-0.34)	(-0.20)	(0.37)
31	0.0059	0.0002	0.0102	-0.0108	-0.0017	0.0075
	(0.80)	(0.04)	(0.64)	(-0.33)	(-0.19)	(0.37)
32	0.0056	0.0002	0.0096	-0.0103	-0.0016	0.0072
	(0.72)	(0.03)	(0.62)	(-0.32)	(-0.18)	(0.36)
33	0.0054	0.0001	0.0091	-0.0099	-0.0014	0.0069
	(0.65)	(0.02)	(0.60)	(-0.31)	(-0.17)	(0.35)
34	0.0051	0.0001	0.0086	-0.0095	-0.0013	0.0065
	(0.58)	(0.02)	(0.57)	(-0.30)	(-0.16)	(0.34)
35	0.0049	0.0001	0.0081	-0.0091	-0.0012	0.0063
	(0.52)	(0.01)	(0.55)	(-0.29)	(-0.15)	(0.33)
36	0.0047	0.0000	0.0076	-0.0088	-0.0011	0.0060
	(0.47)	(0.00)	(0.53)	(-0.29)	(-0.15)	(0.32)
37	0.0045	0.0000	0.0072	-0.0084	-0.0010	0.0057
	(0.43)	(0.00)	(0.52)	(-0.28)	(-0.14)	(0.32)
38	0.0043	0.0000	0.0068	-0.0081	-0.0009	0.0055
	(0.40)	(0.00)	(0.50)	(-0.27)	(-0.13)	(0.31)
39	0.0041	-0.0001	0.0064	-0.0078	-0.0009	0.0052
	(0.37)	(-0.01)	(0.48)	(-0.27)	(-0.13)	(0.30)
40	0.0040	-0.0001	0.0060	-0.0075	-0.0008	0.0050
	(0.34)	(-0.02)	(0.46)	(-0.26)	(-0.12)	(0.30)
41	0.0038	-0.0001	0.0057	-0.0072	-0.0007	0.0048
	(0.32)	(-0.02)	(0.44)	((-0.25)	(-0.11)	(0.29)
42	0.0037	-0.0001	0.0054	-0.0069	-0.0007	0.0046
	(0.31)	(-0.02)	(0.42)	(-0.24)	(-0.11)	(0.28)
43	0.0035	-0.0001	0.0051	-0.0067	-0.0006	0.0044
	(0.29)	(-0.03)	(0.40)	(-0.24)	(-0.10)	(0.27)
44	0.0034	-0.0002	0.0048	-0.0064	-0.0006	0.0042
	(0.28)	(-0.03)	(0.39)	(-0.23)	(-0.09)	(0.26)
45	0.0032	-0.0002	0.0045	-0.0062	-0.0005	0.0040
	(0.27)	(-0.03)	(0.37)	(-0.22)	(-0.09)	(0.25)
46	0.0031	-0.0002	0.0042	-0.0059	-0.0005	0.0039
	(0.26)	(-0.04)	(0.35)	(-0.22)	(-0.08)	(0.25)
47	0.0030	-0.0002	0.0040	-0.0057	-0.0004	0.0037
	(0.25)	(-0.04)	(0.33)	(-0.21)	(-0.08)	(0.24)
48	0.0029	-0.0002	0.0037	-0.0055	-0.0004	0.0036
	(0.24)	(-0.04)	(0.32)	(-0.21)	(-0.07)	(0.23)
49	0.0028	-0.0002	0.0035	-0.0053	-0.0004	0.0034
	(0.23)	(-0.04)	(0.31)	(-0.20)	(-0.07)	(0.22)
50	0.0027	-0.0002	0.0033	-0.0051	-0.0003	0.0033
	(0.22)	(-0.05)	(0.29)	(-0.19)	(-0.07)	(0.22)
51	0.0026	-0.0002	0.0031	-0.0049	-0.0003	0.0032
	(0.21)	(-0.05)	(0.28)	(-0.19)	(-0.06)	(0.21)
52	0.0025	-0.0002	0.0029	-0.0047	-0.0003	0.0030
	(0.21)	(-0.05)	(0.26)	(-0.18)	(-0.06)	(0.21)

[a] Figures in parentheses are asymptotic t-values.

The superscript * denotes significance at the 0.01 level..
The superscript ** denotes significance at the 0.05 level.

Table 4.12: Normality Tests and Misspecification Tests Based on Ljung-Box Portmanteau Statistics for Serial Correlation in the Standardized Residuals, Squared Standardized Residuals and Cross-Products of Standardized Residuals of the MGARCH(1,1)-M2-CCTL and MGARCH(1,1)-M1 Models for the Pre- and Post-Liberalization Subperiods, Respectively

	Pre-Liberalization: January 1980 to September 1989						Post-Liberalization: October 1989 to December 1995					
	Country						Country					
Statistic	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)
Standardized Residuals:												
Skewness	0.005	**-0.487***	-0.096	-0.126	**-0.610***	0.020	-0.080	0.103	-0.262	**-0.281****	**-0.642***	**-0.346****
Kurtosis	0.118	**9.233***	0.419	**1.622***	**1.565***	0.215	-0.027	0.512	0.298	**0.702****	**1.440***	**1.504***
Ljung-Box Tests:												
Standardized Residuals:												
LB(6)	6.537	5.998	11.895	7.328	11.427	12.687	8.579	**13.444****	10.771	7.055	6.037	8.252
Squared Standardized Residuals:												
LB(6)	1.535	7.527	2.684	1.338	1.541	5.337	4.391	1.634	5.976	5.267	5.164	8.281
Cross Products of Standardized Residuals:												
LB(6)												
US	-	-	-	-	-	-	-	-	-	-	-	-
PHL	4.516	-	-	-	-	-	10.168	-	-	-	-	-
TWN	11.114	11.644	-	-	-	-	0.856	7.024	-	-	-	-
JPN	8.013	6.048	3.543	-	-	-	5.532	9.336	2.631	-	-	-
HK	0.849	**27.912***	9.618	7.681	-	-	9.813	**13.493****	4.685	10.516	-	-
SIN	2.286	4.272	5.112	9.157	5.800	-	10.914	**12.626****	10.898	6.746	6.952	-

The superscript * denotes significance at the 0.01 level.
The superscript ** denotes significance at the 0.05 level.

Table 4.13: Conditional Heteroscedasticity Specification Tests[a]

	Pre-Liberalization: January 1980 to September 1989						Post-Liberalization: October 1989 to December 1995					
	Country						Country					
	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)	United States (US)	Philippines (PHL)	Taiwan (TWN)	Japan (JPN)	Hong Kong (HK)	Singapore (SIN)
Conditional Variances[b]	0.295	0.571	0.225	0.122	0.401	0.391	1.053	0.265	0.883	0.562	0.914	2.333**
Conditional Covariances[c]												
US	-	-	-	-	-	-	-	-	-	-	-	-
PHL	0.855	-	-	-	-	-	0.933	-	-	-	-	-
TWN	1.583	2.000**	-	-	-	-	0.371	1.723	-	-	-	-
JPN	1.083	1.504	0.629	-	-	-	1.004	1.026	0.428	-	-	-
HK	0.337	1.618	1.067	1.075	-	-	0.984	1.226	0.901	0.913	-	-
SIN	0.898	0.861	0.320	1.335	0.835	-	1.548	2.466**	1.816	0.788	1.460	-

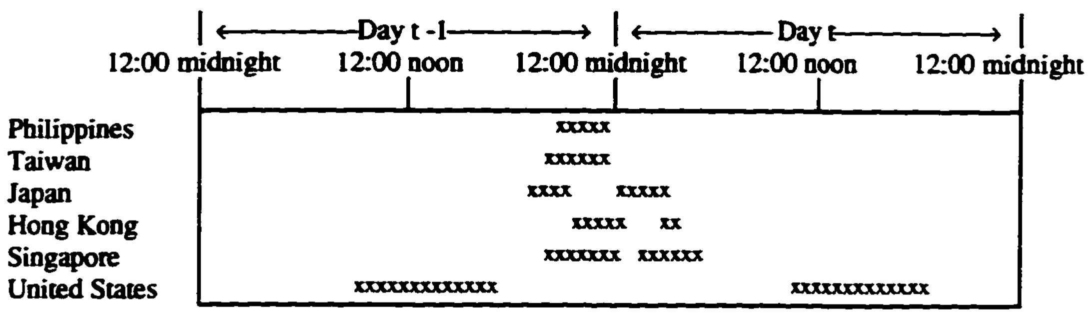
a This table summarizes the results of the conditional heteroscedasticity specification tests as suggested in Bollerslev (1990). The test involves regressing squared standardized residuals and cross-products of residuals on lagged variables, where the residuals are obtained from the MGARCH(1,1)-M-CCTI. model.

[b] Pre-liberalization subperiod figures are $F_{6,493}$ values. The critical values at the 0.05 and 0.01 levels of significance are 2.12 and 2.85, respectively. Post-liberalization subperiod figures are $F_{6,312}$ values. The critical values at the 0.05 and 0.01 levels of significance are 2.13 and 2.87, respectively.

[c] Pre-liberalization subperiod figures are $F_{8,491}$ values. The critical values are 1.96 and 2.55 at the 0.05 and 0.01 levels of significance, respectively. Post-liberalization subperiod figures are $F_{8,310}$ values. The critical values are 1.97 and 2.58 at the 0.05 and 0.01 levels of significance, respectively.

The superscript ** denotes significance at the 0.05 level.

Figure 4.1: Market trading hours of the stock exchanges on the same calendar day, in New York time (EST)



Each x represents 30 minutes of trading.

Figure 4.2: Impulse Response Function of Philippine Stock Market Return Conditional Volatility Pre Liberalization

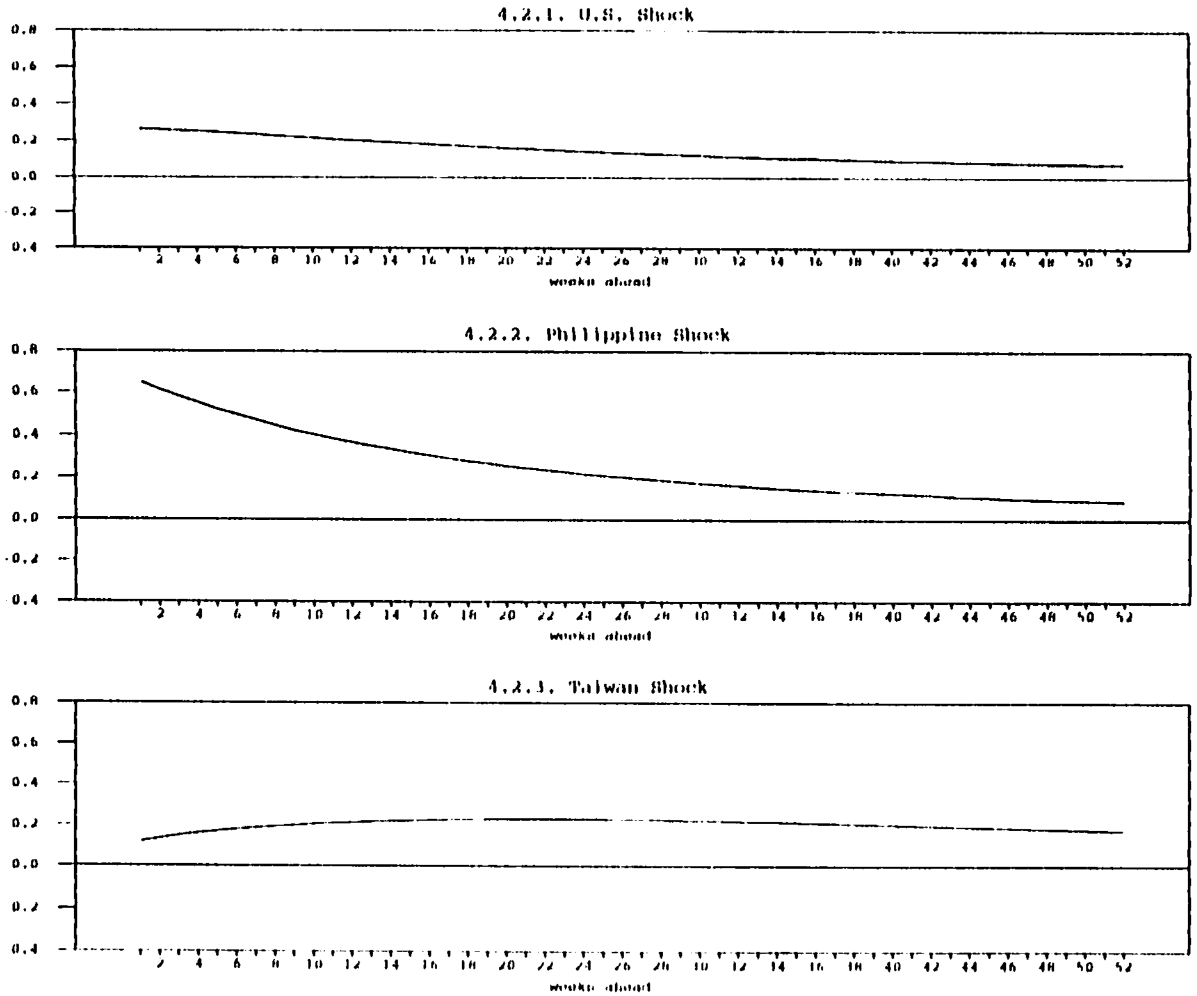


Figure 4.2 continued

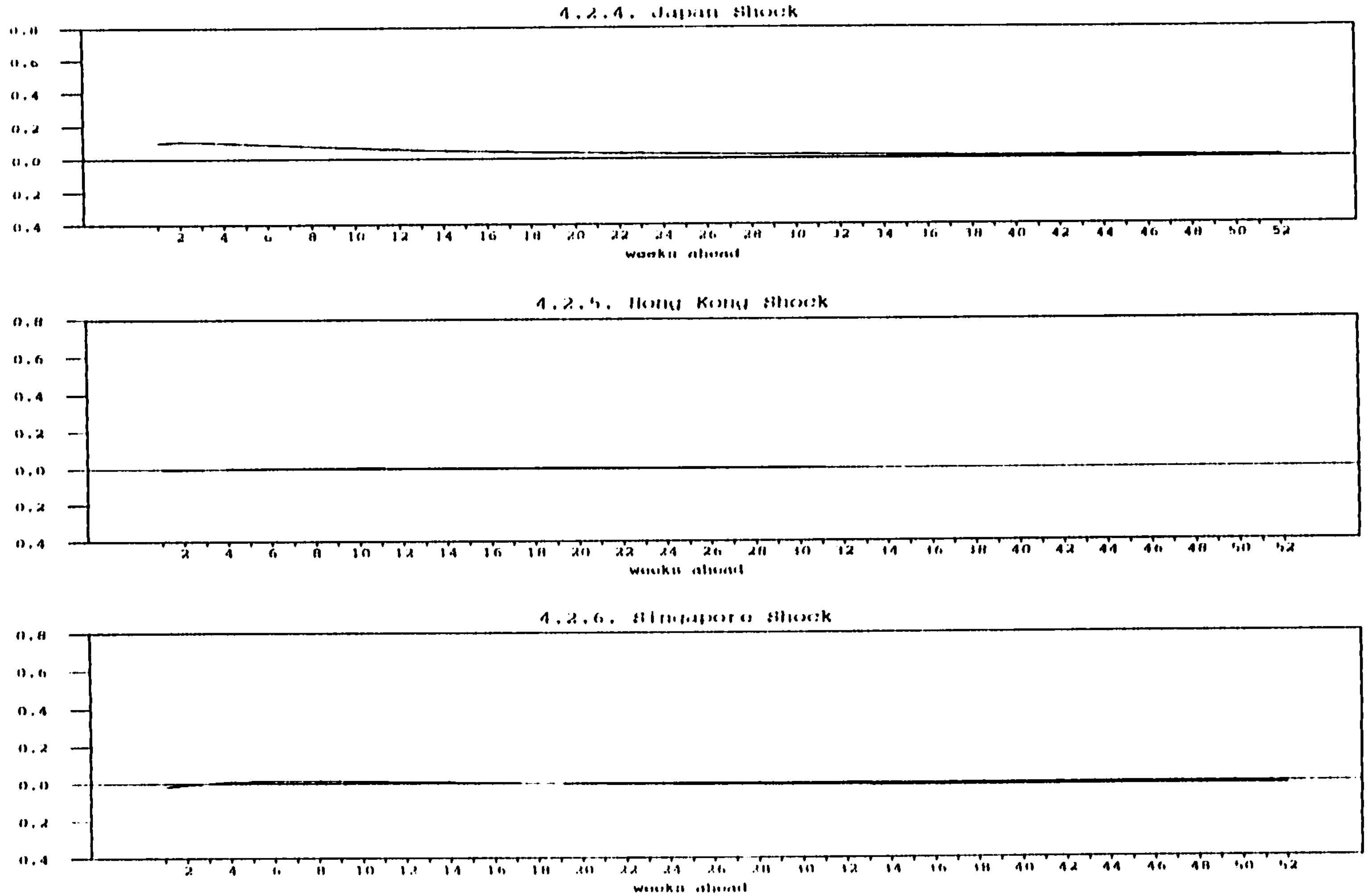


Figure 4.3: Impulse Response Function of Philippine Stock Market Return Conditional Volatility Post Liberalization

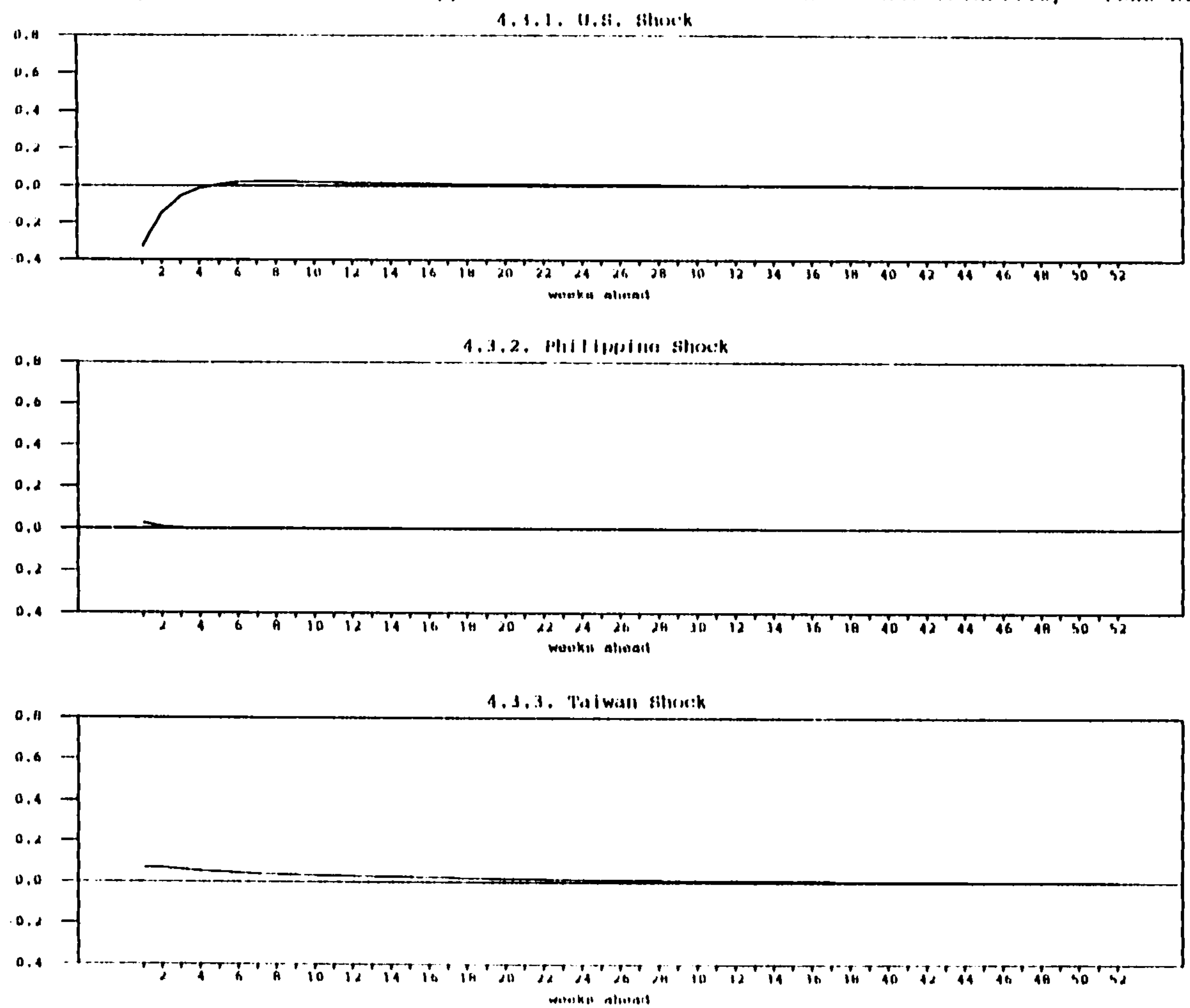
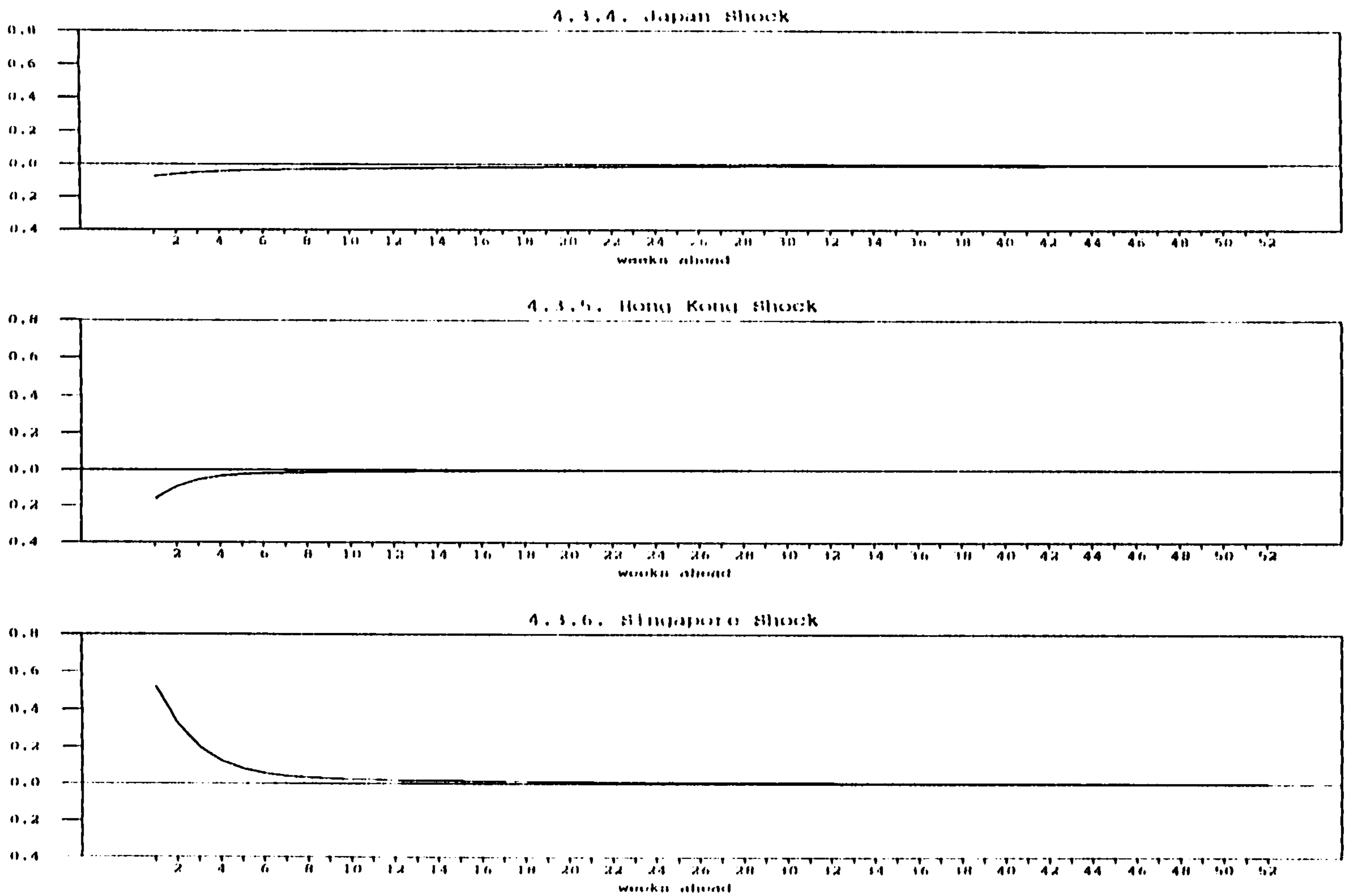


Figure 4.4 continued



Notes

1. The rationale for the potential international transmission of stock returns and volatility follows Lin and Ito (1994) and Lin, Engle and Ito (1994).

2. In addition, the five other countries have strong trade and investment linkages as well (see, e.g., Ahmad, Rao and Barnes, 1996).

3. For instance, Mills (1993) notes that ignoring the presence of autoregressive conditional heteroscedasticity can lead to serious model misspecification and, as with all forms of heteroscedasticity, results in inappropriate standard errors for the estimated parameters.

4. Initially, we tried to estimate the Multivariate GARCH models using the original series and controlling for the effects of the crash of October 1987 using dummy variables for the crash week and the following week. The models converge but the standard errors of the dummy variables are blowing up. Therefore, we decided to use the series obtained using this procedure.

5. The results of the tests for heteroscedasticity in the following section indicate the presence of heteroscedasticity in each national stock market returns series. Therefore, we employ a heteroscedasticity consistent estimate of the variance-covariance matrix of the OLS estimates based on the procedure proposed by Newey and West (1987). Furthermore, we assume that the "crash" of 1987 is a pulse variable. That is, we treat this event as a unique and totally unexpected event that results to a temporary drop in each national stock market index returns series without creating a permanent change in each stock market index returns series nor causing a change in the relationship of stock market returns through time, as captured by the AR coefficients ϕ_{ij}. Consequently, we ignore slope shifters, which take into account the interaction between the dummy variables associated with the stock market crash and the AR coefficients, in the adjustment procedure. This 'outlier adjustment' procedure is done in line with our ultimate objective of building a multivariate model which seeks to explain the interdependencies in international stock market movements during a typical week.

6. In general, if a process x_t is independent white noise, then any function of x_t, e.g. x_t^2, is also temporally independent and will display intertemporal statistical independence.

7. See, for example, Divecha, Drach and Stefek (1992), Solnik (1991), Errunza (1983), and Agtmael and Errunza (1982).

8. Most of the studies which have employed a variation of the MGARCH models in examining relationships among asset returns find the P=Q=1 parameterization to provide a reasonable fit. See, for example, Malliaropulos (1995), Theodossiou and Lee (1993), Kroner and Lastrapes (1993), and Chan et al (1991).

9. Glosten et al. (1993) state that, initially, it may be reasonable to expect rational risk-averse investors to require a relatively larger risk premium during times when the payoff from the security is riskier. However, they argue that investors may not require a larger risk premium since time periods which are relatively riskier could correspond to time periods when the investors are better able to tolerate particular risk types. Moreover, investors may not require a larger risk premium since they may want to save relatively more during periods when the future is riskier. This is because if all the productive assets available for transferring income to the future are risky assets and there are no risk-free investment opportunities available, then the price of the risky asset may be bid up substantially therefore reducing the risk premium.

10. The previous studies which investigated multivariate return and/or volatility spillovers among various national stock markets did not address the possibility that the stock market indexes in their sample are cointegrated. Consequently, if these stock market indexes are cointegrated and the cointegrating relationship is ignored, then, the models used to capture the transmission of stock market movements in these studies are suboptimal.

11. Although not reported here, the estimates of the conditional variances, obtained under the chosen MGARCH(1,1)-M-CCTL specification, for each market in each of the weeks covered in the pre- and post- liberalization subperiods are all positive. This is also true in the case of the five other MGARCH models considered in this study. Furthermore, except for the estimated MGARCH(1,1)-M1-CCTL model for the pre-liberalization subperiod, all of the estimated models satisfy their respective covariance stationarity conditions.

12. It should be noted that the estimated multivariate GARCH models display some deviations from the conditional normality assumption. In particular, the sample excess kurtosis for the standardized residuals is significant, at least at the 0.05 level, for the univariate GARCH(1,1)-in Mean models of the Philippines, Hong Kong and Japan for the pre-liberalization subperiod and for Japan, Hong Kong and Singapore for the post-liberalization subperiod. In contrast, the excess kurtosis of the corresponding original raw returns series are all statistically significant in both subperiods. However, this violation of conditional normality is not confined to our sample, but is quite apparent with most financial time series. A large number of studies that employ GARCH models which assume conditional normality of returns provide evidence that such class of models cannot fully account for all the leptokurtosis in the data; see, for example, Bollerslev (1987). One implication of deviations to normality is that the standard errors of the coefficient estimates may be understated. However, most of the coefficient estimates are significant at the 0.01 level. This is especially true for the coeficients of the conditional variance-covariance equations.

13. The likelihood ratio test statistic is given by LR = $2*[L(\Theta_U)-L(\Theta_R)]$, where $L(\Theta_U)$ and $L(\Theta_R)$ are the maximum log likelihood function values obtained from the MGARCH(1,1)-M1 model with the error-correction term z_{t-1} and the MGARCH(1,1)-M1

model without the error-correction term, respectively. This test statistic is asymptotically distributed as χ^2 with degrees of freedom equal to the number of restrictions implied by MGARCH(1,1)-M1 model without the error-correction term (6 in our case). The computed value of the likelihood ratio test statistic is 181.65 thus rejecting the MGARCH(1,1)-M1 model without the error-correction term at the conventional levels of significance.

14. Although it appears that the impact of an initial return shock in the stock market of Taiwan on Philippine conditional volatility increases over time, these coefficients start to decline after the 13-th week and are only statistically significant at the 0.05 level up to 7 weeks after the initial shock.

15. See Ahmad, Rao and Barnes (1996). The figures for 1993 are similar. According to the Portable Encyclopedia of Doing Business in the Philippines, at the end of 1993, the U.S. represented the largest foreign investor in the Philippines, with about 44 percent of cumulative foreign direct investment, followed by Japan with 20 percent, and then Hong Kong with 6.5 percent. The share of Singapore and Taiwan are less than 1 percent.

16. As of December 1995, total market capitalization of Singapore, Taiwan and Hong Kong stood at US$148.004 billion, US$187.206 billion and US$303.705 billion, respectively. (International Finance Corporation, 1996)

17. Another potential explanation for the post-liberalization subperiod results is that all of the national stock market returns considered in this study are denominated in U.S. dollars. It is quite apparent that these returns series include foreign exchange rate movements. As mentioned earlier, previous studies find an inverse foreign exchange volatility relationship between some markets. For example, Lin (1997) finds negative impulse responses of the conditional volatilities of Japanese Yen/U.S. dollar and German Deutschemark/U.S. dollar exchange rates. Therefore, it is possible that the observed inverse relationship between the Philippine stock market return volatility and those of the U.S., Japan and Hong Kong arises from the foreign exchange rate market and this effect maybe overwhelming the positive cross-market stock return volatility relationships. However, it is difficult to verify this hypothesis since we do not test for international transmission of foreign exchange market movements as this is beyond the scope of our study. This issue opens a subject for future research.

18. Bollerslev (1990) notes that the constant conditional correlation model predicts that the product of the standardized cross-market residuals are uncorrelated and not the product of the raw residuals $\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}$, as would be implied by a model which assumes constant conditional covariances.

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Chapter 5

General Discussion and Conclusions

The Philippines has implemented a cornucopia of economic reforms, especially in recent years, in its quest to develop further and eventually join the ranks of the Asian Newly Industrializing Economies (NIEs). These include, among others, policy changes aimed at capital market liberalization. This set of reforms involve the relaxation or removal of barriers to international investments and of the easing of barriers to international capital flows in general. To the extent that barriers to international investments effectively limit cross-border capital movements, the liberalization of these restrictions are expected to increase the inflow of foreign capital into the domestic market. In fact, stylized facts point out to a surge in flows of foreign portfolio capital into the Philippines in recent years.

In this thesis, we concentrated on investigating the impact of capital market liberalization on the Philippine equity market. It was not until recently that academic researchers have shown interest in studying the emerging stock markets of developing countries such as the Philippine stock market. The recent developments related to the liberalization of the Philippine capital market provide an opportunity to examine their short- and long-term implications on the domestic equity market and on its relationship with other national equity markets. We draw on the principles, concepts and theories in the areas of investment and international finance for the theoretical framework and economic intuition underlying these issues.

In Chapter 2, we examined the impact of capital market liberalization on the degree of integration of the Philippine equity market with the stock markets of its major economic partners. Using cointegration as a measure of the degree of equity market integration, we found evidence that the Philippine stock market has become integrated with the international stock markets during the post-liberalization subperiod but not during the pre-liberalization subperiod. This finding can be partially attributed to the significant reforms implemented over the post-liberalization subperiod. This is because liberalization encourages international capital flows which in turn promotes capital market integration. However, the degree of Philippine equity market integration with the international markets is found to be weak, owing to barriers to international capital flows that remain in the Philippine market. In addition, the weak degree of integration can also be interpreted as an indication that the impact of capital market liberalization is protracted and therefore its effect on the degree of equity market integration is not immediately substantial. We also find that, during the post-liberalization subperiod, the information contained in the cointegrating relationship between the equity market of the Philippines and those of its major economic partners is helpful in explaining the short-run movements of the Philippine stock market index. Given that cointegration suggests long-run co-movement of national stock markets, one implication of our results is that the long-run horizon return correlations between the Philippine stock market price indexes are expected to be higher than those reflected in short-run stock market returns. In turn, this implies limited long-run diversification benefits from investing in the stocks of the Philippine market. However, the finding of a weak degree of integration suggests that the potential long-run diversification benefits offered by Philippine equities to overseas investors is still significant.

In Chapter 3, we investigated the response of American investors to announcements of specific reforms that relaxed the restrictions on international investments in the Philippines, using data on the First Philippine closed-end country Fund. Theoretical international asset pricing models imply that the imposition of significant and effective international investment barriers can cause the expected returns on assets of equal risk to differ across countries. An implication of these models is that effective barriers to international investment raise the premium or reduce the discount on the country fund investing in that country. An event study methodology was employed to determine whether announcements of relaxations in the foreign investment restrictions in the Philippines are associated with an increase in the fund's discounts. Our results indicate that announced relaxation of foreign equity ownership limits are associated with a widening of the First Philippine Fund's discounts. One implication of this result is that the imposition of foreign equity ownership restrictions raised the required return on Philippine equities. Consequently, this has the effect of segmenting the Philippine equity market. Therefore, the finding of a significant increase in the country fund's premium as a result of the loosening of such restrictions implies a reduction in the cost of raising capital in the Philippine stock market.

Finally, in Chapter 4, we examined the impact of capital market liberalization on the short-run dynamic relationships of the Philippine equity market with the equity markets of its major economic partners. Using a multivariate GARCH methodology, we find that while there are no lagged mean return spillovers from the other markets to the Philippine equity market, significant lagged volatility spillovers occur from the foreign markets to the Philippine market. This is consistent with theoretical arguments that information (e.g., as reflected in stock market return innovations) is most likely to be revealed on the volatility of asset prices than on its simple price changes. The results of our analysis indicate that past innovations in the stock returns of the markets of the Philippines' major economic partners significantly influence the future conditional variance of Philippine stock market returns. Moreover, the evidence of such cross-market volatility transmission appears to be stronger in the post-liberalization subperiod. At the same time, the post-liberalization results suggest that the conditional volatility of Philippine stock market returns has become more responsive to information contained in the past squared innovations of the foreign stock market returns relative to that contained in its own market return innovations. In addition, results of the analysis of the impulse response of conditional volatility of Philippine stock market returns indicate that the impact of cross-market past innovations on current conditional volatility of Philippine stock market returns is quite persistent. That is, the impact of an initial foreign stock market return innovation remains significant from 1 up to 7 weeks into the future. The preceding findings are supportive of the view that the presence of barriers to international investments effectively segment the domestic market from the relatively open foreign capital markets, thereby insulating it from international developments that can possibly affect the short-run dynamics of this market's assets returns. By liberalizing such restrictions, new information contained in international stock market movements become an important influence on the behavior of domestic stock market returns relative to local information. The stronger evidence of volatility spillovers during the post-liberalization subperiod is consistent with the finding of an increase in the degree of integration of the Philippine equity market with international equity markets in Chapter 2. However, our finding of lagged volatility spillover from some of the foreign markets to the Philippine market during the pre-liberalization subperiod also supports the view that cross-market transmission of stock market movements can occur in the absence of cross-country investing provided that a strong economic linkage exists between these countries. This is because such relationship also links the economic fundamentals of these countries' asset prices.

Overall, our results suggest that recent capital market liberalization reforms in the Philippines may have been partly responsible for increasing the price linkages of the domestic equity market with those of international equity markets. We expect the linkages to strengthen further as the Philippine government and its allied agencies pursue additional reforms that encourage greater domestic equity market participation by both domestic and foreign investors and which induce domestic firms to use the equity market as a venue for fund raising. Some of the benefits of liberalizing the domestic equity market to greater foreign participation are that it (1) provides an impetus for improving both operational and informational efficiency of the market and (2) reduces the cost of capital. For example, Kim and Singal (1993) assert that the opening up of the domestic equity market results in an increase in competition from foreign institutions. In turn, competition requires the importation and adaptation of more sophisticated financial technology by the domestic market as well as substantial investments in improving information processing and upgrading the quality of financial services. These leads to enhanced efficiencies in capital allocation, risk sharing and monitoring of the use of capital. In addition, market liberalization is said to result in greater access to foreign capital at lower cost. Kim and Singal (1993) argue that liberalization leads to lower cost of foreign capital since the resultant ease of cross-border investing promotes international diversification of foreign portfolios. Consequently, this reduces, if not eliminates, country-specific risk, thereby resulting in a lower risk premium. Moreover, the enhanced efficiency of the domestic market that accompanies liberalization increases domestic market liquidity, which in turn also leads to lower cost of capital.

In this thesis, we have generally concentrated on examining the impact of capital market liberalization on the short-run and long-run behavior of the Philippine stock market index. It would have been ideal to investigate the implications of liberalization on individual stocks as well. For example, it is interesting to examine which types of stock are more integrated with the global capital markets and which are less integrated. In addition, it is equally interesting to examine how effective Philippine ownership restrictions, via the issuance of restricted shares ("A" shares) and unrestricted shares

("B" shares) create market segmentation and how capital market liberalization has affected the relationship between the stock prices of these two classes of shares. In fact, Lamberte and Llanto (1994) report that in 1989, prices of class "B" shares are about five times as much as those of class "A" shares. The theoretical models of Eun and Janakiramanan (1986), Hietala (1989), and Stulz and Wasserfallen (1995) predict that the unrestricted shares will sell at a premium over the restricted shares. This premium reflects market segmentation induced by domestic versus foreign ownership restrictions. For example, Domowitz, Glen and Madhavan (1995) find significant stock price premia for unrestricted shares in the Mexican stock market. They also find that the premia varies over time and across individual firms, partly as a result of the opening of the domestic market to international investors. However, data limitations on the individual stocks prevented us from exploring these issues. Therefore, we leave the investigation of these issues to future research.

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Appendix A: Data Sources for Chapters 2 and 4

Country/Stock Market Index	Sources (Period Covered) Stock Market Price Index	Exchange Rate
Philippines/Philippine Stock Exchange Commercial and Industrial Index	PACAP Research Center at the University of Rhode Island (1980-1995)	PACAP Research Center at the University of Rhode Island (1980-1994) Financial Times (London) (1995)
Japan/Tokyo Stock Exchange Price Index	Financial Times (London) and Wall Street Journal (1980-1995)	IMF International Financial Statistics Monthly (1980-1995)
Hong Kong/Hang Seng Index	PACAP (1980-1994) Financial Times (London) (1995)	PACAP Research Center at the University of Rhode Island (1980-1994) Financial Times (London) (1995)
Singapore/Stock Exchange of Singapore All-Shares Index	PACAP (1980-1994) Financial Times (London) (1995)	PACAP Research Center at the University of Rhode Island (1980-1994) Financial Times (London) (1995)
Taiwan/Taiwan Stock Exchange Weighted Price Index	PACAP (1980-1994) Financial Times (London) (1995)	PACAP Research Center at the University of Rhode Island (1980-1994) Financial Times (London) (1995)
United States/Standard & Poors' 500 Index	Center for Research In Security Prices (CRSP) Database, University of Chicago (1980-1994) S&P NYSE Daily Stock Price Record (1995)	

Appendix B: Johansen's Cointegration Tests, Procedure for Estimating the Cointegrating Relationships and Likelihood Ratio Tests on the Long-Run Parameters of the Vector Error Correction Model for Chapter 2

B1. Johansen's Likelihood Ratio Tests of Cointegration

The trace test statistic is constructed from the residuals of two auxiliary regressions aimed at concentrating out the short-run dynamics of the data. The first set of residuals, $\hat{\mathbf{u}}_{0t}$, an (nx1) vector of residuals, are based on the least squares residuals from the vector regression of $\Delta\mathbf{S}_t$ on a constant and all elements of the vectors $\Delta\mathbf{S}_{t-1}$, $\Delta\mathbf{S}_{t-2}$,....,$\Delta\mathbf{S}_{t-j+1}$.

That is, a $(j\text{-}1)^{th}$-order VAR is estimated for $\Delta\mathbf{S}_t$ by regressing the scalar ΔS_{it} on a constant and all elements of the vectors $\Delta\mathbf{S}_{t-1}$, $\Delta\mathbf{S}_{t-2}$,....,$\Delta\mathbf{S}_{t-j+1}$ using *OLS*, for i=1,....,n. The n OLS regression results are then summarized in vector form

$$\Delta\mathbf{S}_t = \hat{\mathbf{c}}_0 + \hat{\aleph}_1\Delta\mathbf{S}_{t-1} + \hat{\aleph}_2\Delta\mathbf{S}_{t-2} + \cdots + \hat{\aleph}_{j-1}\Delta\mathbf{S}_{t-j-1} + \hat{\mathbf{u}}_{0t} \tag{B1.1}$$

where $\hat{\aleph}_i$, i=1,..., j-1, denotes an (nxn) matrix of *OLS* coefficient estimates and $\hat{\mathbf{u}}_{0t}$ denotes an (nx1) vector of *OLS* residuals.

The second set, $\hat{\mathbf{u}}_{1t}$, an (nx1) vector of residuals, are based on the least squares residuals from the vector regression of $\mathbf{S}_{t-1}$ on the same set of regressors as the first set. The n OLS regressions are then collected in vector form

$$\mathbf{S}_{t-1} = \hat{\mathbf{c}}_1 + \hat{\mathbf{\Theta}}_1\Delta\mathbf{S}_{t-1} + \hat{\mathbf{\Theta}}_2\Delta\mathbf{S}_{t-2} + \cdots + \hat{\mathbf{\Theta}}_{j-1}\Delta\mathbf{S}_{t-j-1} + \hat{\mathbf{u}}_{1t} \tag{B1.2}$$

with the $\hat{\mathbf{u}}_{1t}$ the (nx1) vector of *OLS* residuals from this second battery of regressions.

The estimate of the variance-covariance matrices of these two sets of residuals are then calculated as $\hat{\mathbf{\Sigma}}_{ij} = T^{-1}\sum_{t=1}^{T}\hat{\mathbf{u}}_{it}\hat{\mathbf{u}}_{jt}$, i,j=0,1, to give $\hat{\mathbf{\Sigma}}_{11}$, $\hat{\mathbf{\Sigma}}_{00}$, $\hat{\mathbf{\Sigma}}_{01}$, and $\hat{\mathbf{\Sigma}}_{10}$. From these, the eigenvalues of the matrix $\hat{\mathbf{\Sigma}}_{11}^{-1}\hat{\mathbf{\Sigma}}_{10}\hat{\mathbf{\Sigma}}_{00}^{-1}\hat{\mathbf{\Sigma}}_{01}$ is obtained via canonical correlation analysis, with the eigenvalues ordered $\hat{\lambda}_1 > \hat{\lambda}_2 > \cdots > \hat{\lambda}_n$. Johansen (1988,1991) shows that the eigenvalues of the matrix $\hat{\mathbf{\Sigma}}_{11}^{-1}\hat{\mathbf{\Sigma}}_{10}\hat{\mathbf{\Sigma}}_{00}^{-1}\hat{\mathbf{\Sigma}}_{01}$ are simply the squares of the canonical correlations between the disturbances of the two auxiliary regressions.

Johansen (1988, 1991) shows that the *trace statistic*, is given by

$$\lambda_{tr} = -T\sum_{i=r+1}^{n} ln\left(1-\hat{\lambda}_i\right) \tag{B1.3}$$

where $\hat{\lambda}_{r+1} > \hat{\lambda}_{r+2} > \cdots > \hat{\lambda}_n$ are the n-r smallest eigenvalues of the matrix $\hat{\mathbf{\Sigma}}_{11}^{-1}\hat{\mathbf{\Sigma}}_{10}\hat{\mathbf{\Sigma}}_{00}^{-1}\hat{\mathbf{\Sigma}}_{01}$.

On the other hand, Johansen and Juselius (1990) demonstrate that for each value of r ($0 \leq r \leq n$), there is a corresponding hypothesis of r or fewer cointegrating vectors. Thus, they proposed an alternative likelihood ratio test statistic, called the *maximum eigenvalue test* , which tests the null hypothesis of r cointegrating relations against the alternative of at most $r+1$ cointegrating relations. This is given by

$$\lambda_{max} = -T\, ln\left(1 - \hat{\lambda}_{r+1}\right) \qquad \text{(B1.4)}$$

The two cointegration test statistics do not have the standard distributions. Instead the critical values of both test statistics follow a (n-r)-dimensional standard Brownian motion. Johansen and Juselius (1990) provide the simulated asymptotic critical values for both statistics for at most five variables while Osterwald-Lenum (1992) extended the tabulations for both test statistics for at most eleven variables.

B2. Maximum Likelihood Estimation of the Vector Error-Correction Model

A detailed description of the maximum likelihood estimation of the parameters the error correction equations is provided in Hamilton (1994). A summary of the procedure is given below.

Let $\tilde{\mathbf{b}}_1, \tilde{\mathbf{b}}_2, \cdots, \tilde{\mathbf{b}}_r$ denote the (Nx1) eigenvectors of the matrix $\hat{\mathbf{\Sigma}}_{11}^{-1}\hat{\mathbf{\Sigma}}_{10}\hat{\mathbf{\Sigma}}_{00}^{-1}\hat{\mathbf{\Sigma}}_{01}$ associated with the r largest eigenvalues. Johansen then showed that the maximum likelihood estimator (MLE) is that any cointegrating vector can be written in the form

$$\mathbf{b} = a_1\tilde{\mathbf{b}}_1 + a_2\tilde{\mathbf{b}}_2 + \cdots a_r\tilde{\mathbf{b}}_r \qquad \text{(B2.1)}$$

for some choice of scalars (a_1, a_2,..., a_r); i.e. any linear combination of the cointegrating vectors $\tilde{\mathbf{b}}_1, \tilde{\mathbf{b}}_2, \cdots, \tilde{\mathbf{b}}_r$ can also be described as a cointegrating vector. Since their values are not uniquely defined, Johansen suggested normalizing the coefficients of the vectors $\tilde{\mathbf{b}}_i$ so that $\tilde{\mathbf{b}}_i = \tilde{\mathbf{b}}_i'\hat{\Sigma}_{11}\tilde{\mathbf{b}}_i = 1$ before any inferences about them can be made. Suppose the vectors $\hat{\mathbf{b}}_i$ are the normalized vectors. The first r normalized eigenvectors are then collected in an (nxr) matrix $\hat{\boldsymbol{\beta}} \equiv \left[\hat{\mathbf{b}}_1 \quad \hat{\mathbf{b}}_2 \cdots \hat{\mathbf{b}}_r\right]$ where the columns are the cointegrating vectors. An advantage of the Johansen procedure is that the results and implications are invariant to the chosen normalizing variable.

Johansen then shows that the MLE of the long-run impact matrix $\mathbf{\Pi}$ is given by $\hat{\mathbf{\Pi}} = \hat{\mathbf{\Sigma}}_{11}\hat{\boldsymbol{\beta}}\hat{\boldsymbol{\beta}}'$. The MLE for $\boldsymbol{\alpha}$, the matrix summarizing the average speeds of adjustment to the long-run equilibrium relationships or cointegrating vectors given by $\hat{\boldsymbol{\alpha}} = \hat{\mathbf{\Sigma}}_{01}\hat{\boldsymbol{\beta}}$.

The MLE for the short-run dynamics $\hat{\Gamma}_i$ for i=1,..,j-1 is $\hat{\Gamma}_i = \hat{\aleph}_i - \hat{\Pi}\hat{\Theta}_i$ using the results of the first auxiliary regression in Equation (B1.1) and the MLE for the constant μ is $\hat{\mu} = \hat{c}_0 - \hat{\Pi}\hat{c}_1$ using the results of the second auxiliary regression in Equation (B1.2).

The MLE of Ω is $\hat{\Omega} = T^{-1}\sum_{t=1}^{T}\left[\left(\hat{u}_{0t} - \hat{\Pi}\hat{u}_{1t}\right)\left(\hat{u}_{0t} - \hat{\Pi}\hat{u}_{1t}\right)'\right]$.

B3. Likelihood Ratio Test Statistics for Testing Hypotheses on the Long-Run Parameters of the Vector Error Correction Model

Long-Run Exclusion Test Statistic. Johansen (1988, 1991) and Johansen and Juselius (1990) showed that the likelihood ratio test statistic under the null hypothesis that b_{ij}=0 for some i, i=1,..,6 and for all j, j=1,..,r, where b_{ij} is the ij^{th} element of the matrix β, is given by

$$LR_\beta = -T\sum_{i=1}^{r} ln\left(1-\hat{\lambda}_i\right) + T\sum_{i=1}^{r} ln\left(1-\tilde{\lambda}_i\right) \tag{B3.1}$$

where $\tilde{\lambda}_i$ is the i^{th} largest eigenvalue of the matrix $\tilde{\Sigma}_{11}^{-1}\tilde{\Sigma}_{10}\tilde{\Sigma}_{00}^{-1}\tilde{\Sigma}_{01}$ obtained by applying the Johansen's maximum likelihood estimation procedure with the restrictions on the matrix β implied by the null imposed and $\hat{\lambda}_i$ is the i^{th} largest eigenvalue $\hat{\Sigma}_{11}^{-1}\hat{\Sigma}_{10}\hat{\Sigma}_{00}^{-1}\hat{\Sigma}_{01}$ when no restrictions are imposed. This test statistic is asymptotically distributed as χ^2 with $r(n-m)$ degrees of freedom, where $(n-m)$ is the number of variables for which the cointegration coefficients are hypothesized to be zero.

Weak Exogeneity Test Statistic. Johansen (1988, 1991) and Johansen and Juselius (1990) showed that the likelihood ratio test statistic under the null hypothesis that a_{ij}=0 for some i, i=1,..,6 and for all j, j=1,..,r, where a_{ij} is the ij^{th} element of the matrix α, is given by

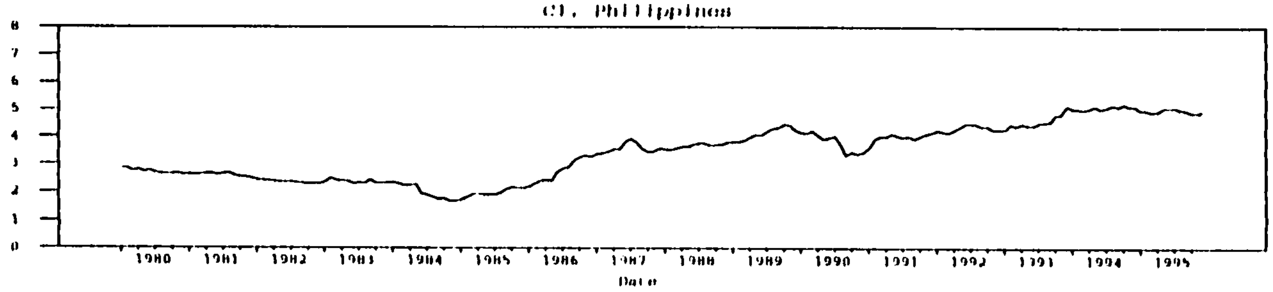
$$LR_\alpha = -T\sum_{i=1}^{r} ln\left(1-\hat{\lambda}_i\right) + T\sum_{i=1}^{r} ln\left(1-\tilde{\lambda}_i\right) \tag{B3.2}$$

where $\tilde{\lambda}_i$ is the i^{th} largest eigenvalue of the matrix $\tilde{\Sigma}_{11}^{-1}\tilde{\Sigma}_{10}\tilde{\Sigma}_{00}^{-1}\tilde{\Sigma}_{01}$ obtained by applying the Johansen's maximum likelihood estimation procedure with the restrictions on the matrix α implied by the null imposed and $\hat{\lambda}_i$ is the i^{th} largest eigenvalue $\hat{\Sigma}_{11}^{-1}\hat{\Sigma}_{10}\hat{\Sigma}_{00}^{-1}\hat{\Sigma}_{01}$ when no restrictions are imposed. This test statistic is asymptotically distributed as χ^2 with $r(n-m)$ degrees of freedom, where $(n-m)$ is the number of stock market indexes for which the speed of adjustment coefficients are hypothesized to be all zero.

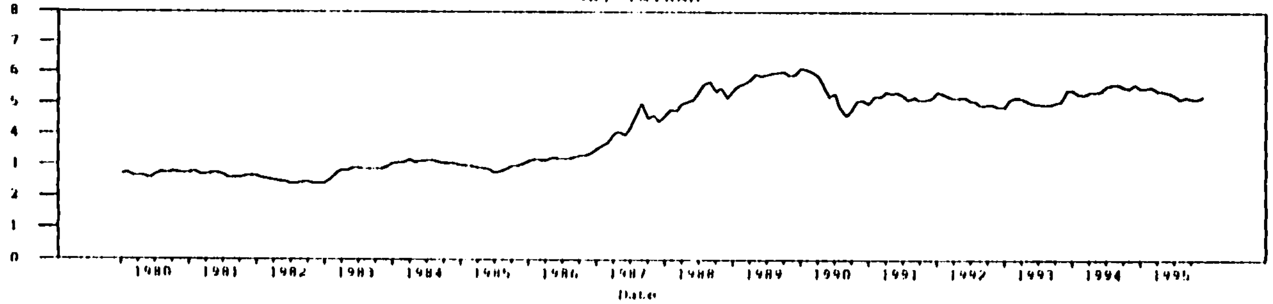
Joint Long-Run Exclusion and Weak Exogeneity Test Statistic. The likelihood ratio test statistic for testing the joint hypotheses of zero cointegration coefficients and adjustment speed coefficients is computed in the same manner as preceding test statistic except that $\tilde{\lambda}_i$ is taken to be the i^{th} largest eigenvalue of the matrix $\tilde{\mathbf{\Sigma}}_{11}^{-1}\tilde{\mathbf{\Sigma}}_{10}\tilde{\mathbf{\Sigma}}_{00}^{-1}\tilde{\mathbf{\Sigma}}_{01}$ obtained by applying the Johansen's maximum likelihood estimation procedure with the restrictions on both $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ implied by the null imposed. This test statistic is asymptotically distributed as χ^2 with $r(n\text{-}m)$ degrees of freedom, where $(n\text{-}m)$ is the total number of stock market indexes for which the speed of adjustment coefficients and/or cointegration coefficients are hypothesized to be all zero.

Appendix C: Plots of National Stock Market Price Indexes (U.S. dollars/logs)   January 1980 to December 1995

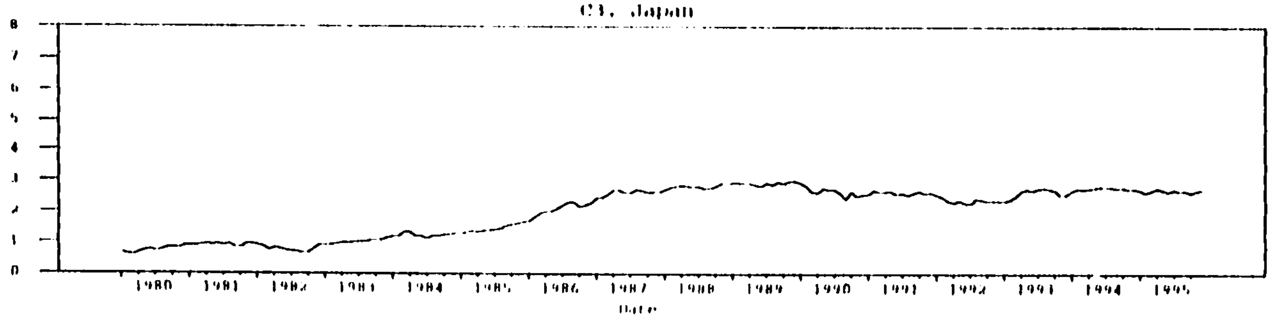
C1. Philippines



C2. Taiwan

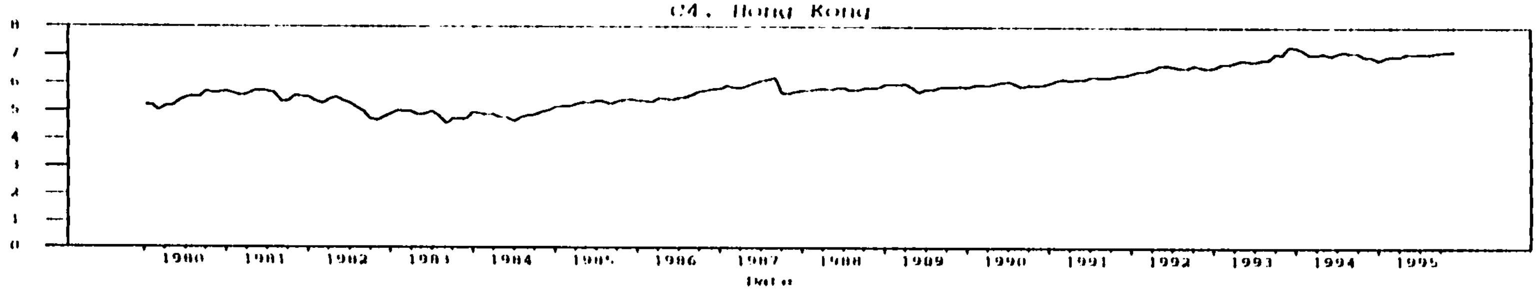


C3. Japan

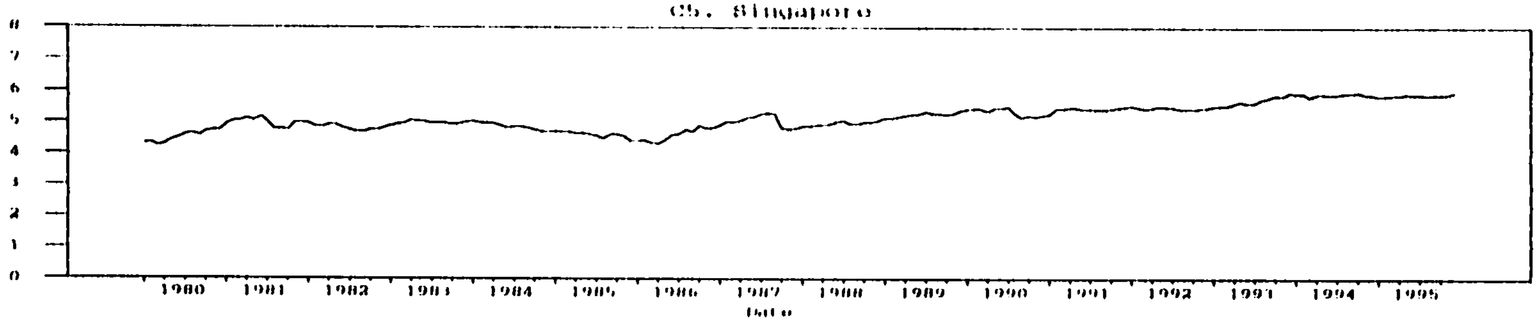


APPENDIX C continued

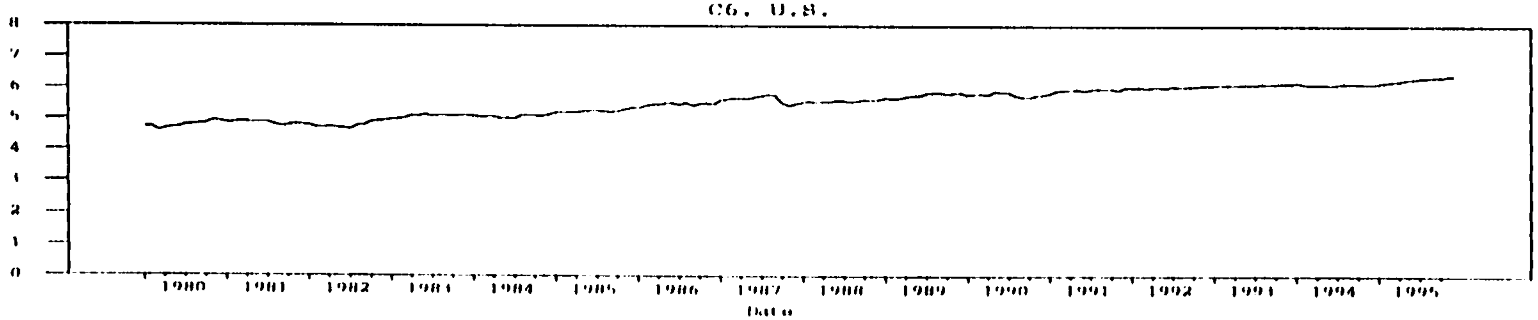
C4. Hong Kong



C5. Singapore



C6. U.S.



Appendix D: Chronological Listing of Announcements of Changes in Philippine International Investment Restrictions for Chapter 3

10/14/94. The entry of foreign banks to operate in the Philippines was liberalized (Circular No. 51). Such entry can be effected through a purchase of 60 percent of the voting stock of an existing domestic bank or of a new banking subsidiary incorporated in the Philippines or through the establishment of branches with full banking authority, subject to the licensing requirements of the Central Bank. For a foreign bank branch (new or already established), permanently assigned capital of the dollar equivalent of P210 million (converted at the exchange rate of P26.979 per US$1-the rate prevailing on June 5, 1994) must be remitted and converted into pesos, which will allow for the establishment of three branches. For each three additional branches to be opened, the US dollar equivalent of P35 million must be remitted. (IMF, 1995): Direct investment, loosening, capital inflows.

6/22/94. President Fidel Ramos opened the Philippine economy wider to overseas businesses. The executive order is part of a foreign-investment liberalization that takes effect Oct. 24. Non-Filipinos will be able to own businesses in many sectors that now are restricted to 40% foreign ownership. Foreigners will be allowed to operate in areas such as insurance, travel agencies, wholesale trading, convention organizing, manufacturing under foreign licenses and cockfighting. The easing isn't expected to affect the economy much initially, but it underscores Mr. Ramos's determination to increase competition in protected areas, despite small companies' claims of hardship. The National Economic and Development Authority said that 'adequate capacity' is not a sound basis for excluding foreign investments in a particular sector. It said restricting competition benefits high-cost producers at consumers' expense. (WSJ 6/23/94): Direct investment, loosening, capital inflows.

8/10/92. The Philippines will scrap most remaining foreign-exchange restrictions. Businesses and analysts welcomed the move but urged further deregulation of trade and foreign-investment policies. President Fidel Ramos said the measures, the second stage of an overhaul launched late last year, will remove requirements that exporters sell their foreign-exchange earnings to banks. Under the package expected to take effect this month, Philippine residents may borrow as much as $1 million from banks for investment abroad without central bank approval and may hold overseas deposits. Gold imports won't require central bank authorization, and most gold exports will be allowed. The first stage, widely considered incomplete, required 15 types of enterprises, ranging from airlines to oil companies and including most foreign-exchange earners, to sell almost all these earnings to banks for resale to the central bank. The latest move encouraged businesses, which said it removed psychological blocks to investment and could encourage Filipinos abroad to repatriate more earnings. (WSJ 8/11/92): Foreign exchange accounts, loosening, capital outflows.

1/3/92. Central Bank of the Philippines issued rules/regulations liberalizing non-trade foreign exchange transactions, including investment related transactions. With respect to foreign investments, the major policy changes entailed the broader coverage of foreign investments, the liberalization of repatriation and remittance privileges and the reduction as well as simplification of reportorial and documentary requirements. Under CB Circular No. 1318, foreign investments are defined to include investments by a resident in foreign exchange or its equivalent in assets actually brought into the country, as contrasted to the definition under the Foreign Investments Act of 1991, which considers the nationality or citizenship of the investor. Full and immediate repatriation and remittance privileges for all types of duly registered investments, whether as direct equity or in listed shares/securities and regardless of the type of industry or sector where investment were made are now allowed to be directly serviced by AABs [Authorized Agent Banks which include all categories of banks (except offshore banking units) duly licensed by the Central Bank] without prior CB approval. This is in contrast to previous guidelines where full and immediate repatriation is allowed only for registered investments in CB-certified export-oriented industries and in CB approved securities, but is otherwise staggered for investments in other industries from three to nine years, depending on the type of industry and sectoral priority where investments were made. However, under Section 40 of Circular No. 1318, repatriation of investment financed through the debt-to-equity program under Circular No. 1111 dated August 26, 1986, Revised Circular No. 1111 dated October 20, 1982 and Circular No. 1267 dated December 20, 1990, shall be governed by said Circulars or any subsequent amendments thereto. (IMF 1993, WSJ 1/7/92): Foreign exchange accounts, loosening, capital outflows.

6/6/91. The Philippine Congress approved a bill allowing foreigners to own as much as 100% of most businesses in the country, now limited to 40%. The measure, to be signed into law in November, also is aimed at generating jobs for Filipinos. Separately, Manila will seek to borrow $100 million from the Asian Development Bank for relending to small and medium industries. Meanwhile, the government will probably shed 80% of its holding in Philippine Airlines in a single phase this year instead of gradually. (WSJ 6/7/91): Direct investment, loosening, capital inflows.