

Preliminary and incomplete
First draft: January, 25, 2000
Comments welcome

The Center and the Periphery: Tales of Financial Turmoil

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Abstract

The literature on the international transmission of shocks has not discriminated where the shocks originate. One might expect, that the global or regional consequences of a disturbance depend importantly whether the shock originates in the periphery--to borrow a term from Arthur Lewis--or in the center. We provide some preliminary answers to this question. Our approach is in the "event study" tradition, as we analyze the daily behavior of financial indicators for thirty-five countries in and around a collection of events. The analysis of the Russian-LTCM crisis revealed that there were a variety of withdrawals from risk-taking, which drastically reduced the liquidity of markets and increased their volatility. Most explanations of these events have emphasized the behavior of investors, but an equally plausible explanation can be found in the role of market making. A simple model that stresses this mechanism is presented.

* This paper was prepared for the joint Asian Development Bank, International Monetary Fund, and World Bank Conference on International Financial Contagion: How it spreads and how it can be stopped?, February 3-4, Washington DC. The authors wish to thank Vincent Reinhart for insightful comments and suggestions and Sergio Kurlat, Amine Mati, and Rafael Romeu for excellent research

assistance.

“The first springs of great events, like those of great rivers, are often mean and little.”
Jonathan Swift, 1667-1745

I. Introduction

The crisis-prone 1990s gave rise to a blossoming debate in academic and policy circles about the international transmission of shocks. Much of this discussion, including the one on the “redesign of the international financial architecture,” has come under broad umbrella of the term contagion.¹ Indeed, if the aftermaths of the Mexican peso crisis of late 1994 and the Asian crisis of 1997 were not sufficiently hair-raising, the events that followed the Russian devaluation and default in August 1998 certainly caught the attention of policy makers and financial market participants all over the world.² At least then, in terms of its relevance, the subject is worthy of the scrutiny it receives.

The literature on contagion, spillovers, or international propagation of shocks has developed along two complementary strands in recent years: the earlier studies attempted to document the incidence of contagion or establish whether there is such a beast; the second group of papers has primarily sought to discriminate among the possible channels of transmission of disturbances (i.e. trade links, common foreign bank lenders, etc.)^{3, 4}

¹ See Dornbusch, Park, and Claessens (2000), for a comprehensive survey of this literature.

² As will be discussed extensively in this paper, the Russian crisis does not occur in a vacuum, as the Long-Term Capital Management (LTCM) debacle is unfolding during this period.

³ Different authors have used the term contagion to mean different things (see Masson (1999) and Dornbusch, Park, and Claessens (2000), for a fuller discussion of this issue.

⁴ Examples of the first strand of the “contagion” literature include Doukas (1989), Eichengreen, Rose, and Wyplosz (1996), and Forbes and Rigobon (1998). Other authors focussed on particular regions; Calvo and Reinhart (1996) on Latin America, Baig and Goldfajn (1998) on Asia, and Gelos

In our view, this literature has not been too particular about discriminating where the shocks originate. One might expect, a priori, that the global or regional consequences of a disturbance may depend importantly whether the shock originates in the periphery--to borrow a term from Arthur Lewis--or in the center. Were the regional consequences of the Thai crisis so severe owing to Thailand's direct links with other countries in the region or because that shock affected the region's largest economy-- Japan? Was the paralysis of the bond markets in many parts of the globe and the persistent equity market volatility due to the Russian default or to concerns that there might be more LTCMs in the making in the financial centers of the world? Why did the Brazilian devaluation of January 1999 and Ecuador's default later that year not have greater international consequences?⁵

In this paper, we attempt to provide some preliminary and tentative answers to these questions. Our approach is in the "event study" tradition. We analyze the daily behavior of a variety of financial indicators for thirty-five emerging-to-mature market countries in and around a collection of events, ranging from highly publicized events, such as the devaluation of the Russian ruble in August 1998, to less familiar ones, such as the disbandment of Salomon Brothers bond arbitrage desk on July 6 of that year.

Secondly, the analysis of the summer and fall of 1998 revealed that there were a variety of withdrawals from risk-taking, which drastically reduced the liquidity of many asset markets and

and Sahay (1999) on the transition economies. As to the channels of transmission, see Glick and Rose (1998), Kaminsky and Reinhart (1998).

⁵ A very plausible explanation of the former is that the event was largely discounted by financial markets and it did not have the "surprise" element of a Russian default.

increased their volatility.⁶ Most explanations of the events of the fall of 1998 have emphasized the behavior of investors, but an equally plausible explanation can be found in the role of market making.⁷ The argument runs much like a prisoners' dilemma (or the more complicated interactions of individual choice and aggregate outcomes discussed by Schelling, 1978, and now central to the literature on market externalities). Market participants commit to trade because they expect others to do so. If they think others will not, they will not, creating a self-fulfilling prophesy. We present the simplest of models to illustrate how even the smallest increases in risk aversion or in the cost of participating in market trading can give rise to drastic declines in market liquidity.

As to the empirical part of the paper, some of our findings can be summarized as follows: It is hardly surprising that, in terms of the severity of spillovers, when the shock originates in the United States, its international propagation is the most far-reaching, hitting the largest number of countries. An example of this, was the brief but very volatile period in international equity markets on October 27-28, 1997. This was also the case for the more persistent period of instability in bond and equity markets in the summer and fall of 1998. Thus, from this "systemic" perspective, the Russian/LTCM episode was far more severe than the Asian crisis. Shocks to Japan, which has the least comovement in asset returns and other financial variables among the mature markets, do not have nearly comparable international consequences.

As to the severity of these "events" for particular regions, the results are more hybrid. The Thai devaluation had more severe consequences for Asia than elsewhere, and the Russian devaluation had

⁶ See Bank of International Settlements (1999) for a lucid discussion of these issues.

⁷ See Calvo (1998), Calvo and Mendoza (1999), and Caballero and Krihnamurthy (1999).

its greatest impact on other former Soviet Republics. It is less obvious, whether the Russian default or the problems at LTCM had a greater effect on Latin America and Europe. One another, our conclusion is that Russia had a greater effect than LTCM on Latin America and some of the other emerging markets, such as Turkey;⁸ the effect of Russia's default on most of the recovering emerging Asian economies was milder; and the effect of LTCM even milder.⁹ Indeed, in the September 2-October 14, 1998 period, (prior to the Federal Reserves interest-rate cut) emerging equity markets were recovering and bond spreads had begun to come down. The developed markets were a different story, with LTCM playing a far more significant role. While developed markets were hit very hard almost across the board in the immediate aftermath of the Russian default, in many cases the volatility persisted well into October and November, even after U.S. monetary policy had eased, suggesting the importance of lingering concerns about the health of financial institutions at the center countries.

While an analysis of more episodes is necessary, one of the preliminary conclusions we draw from this exercise is that for understanding "systemic" problems--be these defined at the global or regional level-- we have to understand how a shock to the periphery spreads to the periphery (or to other financial centers), via its impact on financial centers.¹⁰ In the case of the Asian crisis, Japanese

⁸ A likely interpretation is that the Russian default is the most obviously connected to the pricing of sovereign risk in emerging markets.

⁹ By the time Russia defaults, emerging equity markets had already taken a substantial beating, and bond yield spreads had widened markedly, particularly for Latin America. This was a period in which portfolio flows to emerging markets fell drastically. By contrast, during this period mature equity markets, with the exception of Japan were enjoying a lasting rally.

¹⁰ We find some evidence that bond spreads widened somewhat following headlines in the Wall Street Journal (on July 22) regarding the woes befalling LTCM, but spreads and market volatility only pick up markedly after the Russian default.

bank exposure to Thailand--and their subsequent retrenchment from lending to other Asian countries--played a prominent role in the spread of the crisis. The role played by the center (i.e. Japan) in this episode was much the same that played by U.S. banks in the 1980s. In the case of Russia, its default triggered a pervasive widening of spreads that hobbled the weakened LTCM and led to a generalized withdrawal of risk taking. If the shock never reaches the center, it is doubtful, though, it can become systemic.

In the next section, we present a brief discussion of some of the analytical issues that are relevant to our analysis of events. In Section III, we describe the various episodes, while in Section IV we focus on comovement across markets and the profile of daily volatility. Section V presents a model that offers an explanation of the events of the fall 1998; concluding remarks, sprinkled with some policy implications, are presented in Section VI.

II. Analytical Issues

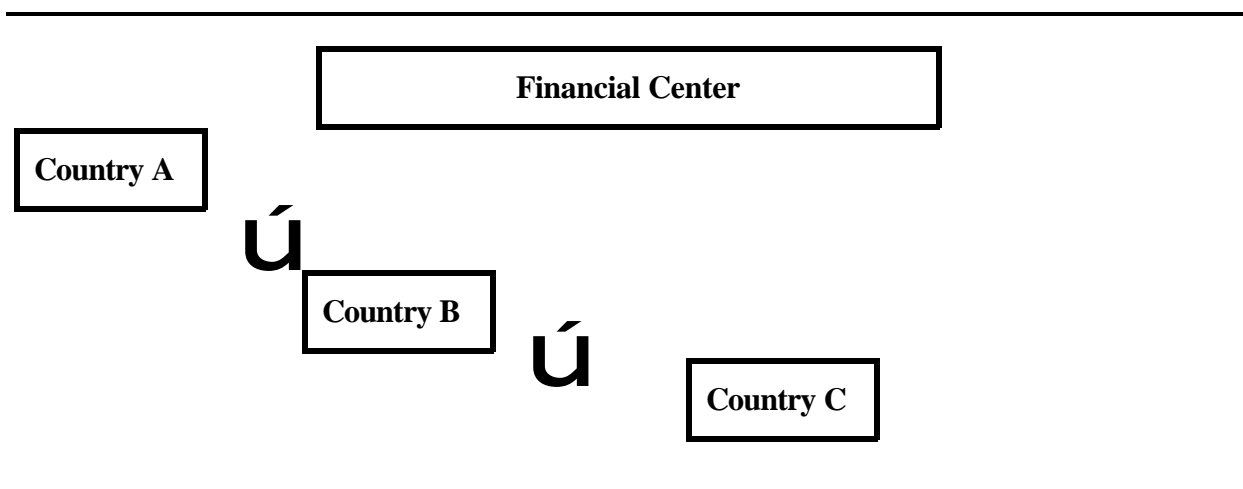
In this section, we discuss some of the analytical issues that may clarify the comparison of the various “events” or “episodes” described in the following section. First, we make some distinctions about where the shocks originate and how they propagate internationally; we then discuss whether the disturbances during a particular episode are confined to a single market (i.e., equities, high-risk bonds, foreign exchange, etc.), or a spread across a broader family of assets.

1. The center and the periphery

We distinguish three patterns in the propagation of shocks. First, there is *the transmission of*

shocks from one periphery country to another periphery country, which can take place if the two countries are directly linked through bilateral trade or finance (Figure 1). Recent examples of this type of transmission mechanism include the adverse impact of the 1997-98 Asian crisis on Chilean exports and the recessionary consequences for Argentina of the Brazilian devaluation in early 1999.¹¹ This transmission channel may also be operative if there are bilateral finance links. For instance, Costa Rican banks were borrowing from Mexican banks on the eve of the Mexican crisis (see Calvo and Reinhart, 1996), but when Mexican banks ran into trouble this source of funds disappeared.

Figure 1. The Transmission of Shocks from One Periphery Country to Another

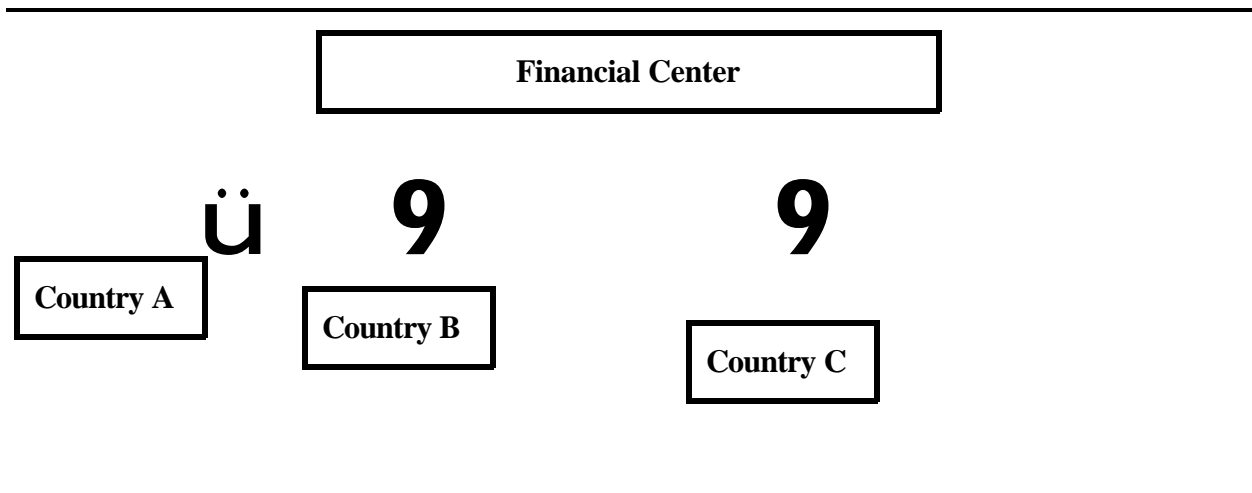


The transmission of shocks from one periphery country to another through a center country, shown in Figure 2, has received much attention in the recent literature on contagion. There are several prominent examples of this type of transmission mechanism. Corsetti, Pesenti, and Roubini (1998) model trade competition among the periphery countries in a common third “center” market.

¹¹ Unlike most countries in Latin America, Chile diversified its trade to include a larger share of trading partners outside the region. Brazil is Argentina’s largest trading partner. For a model that stresses the role bilateral trade, see Gerlach and Smets (1996).

For instance, Malaysia exports many of same goods as does Thailand to Japan, Hong Kong, and Singapore.¹² Hence, when Thailand devalued in mid-1997, Malaysia lost its competitive edge in the common third markets. Calvo (1998)--who suggests that Wall Street may have been the carrier of the “Russian virus”--focusses on asymmetric information and illiquidity problems. When Russia defaulted on its bonds, leveraged (and informed) investors in the center country faced margin calls and the need to raise liquidity. This, in turn, causes them to sell their asset holdings (the bonds and stock of other countries in their portfolio) to an uninformed counterpart. Because of the information asymmetries, a “lemons problem” arised and the asset could only be sold at a firesale price.

Figure 2. The Transmission of Shocks from One Periphery Country to Another Through a Center Country



A variant of this story can be told about an open-end fund portfolio manager who needed to raise liquidity in anticipation of future redemptions. In either case, the strategy would not to sell the asset whose price has already collapsed but other assets in the portfolio. In doing so, however, other

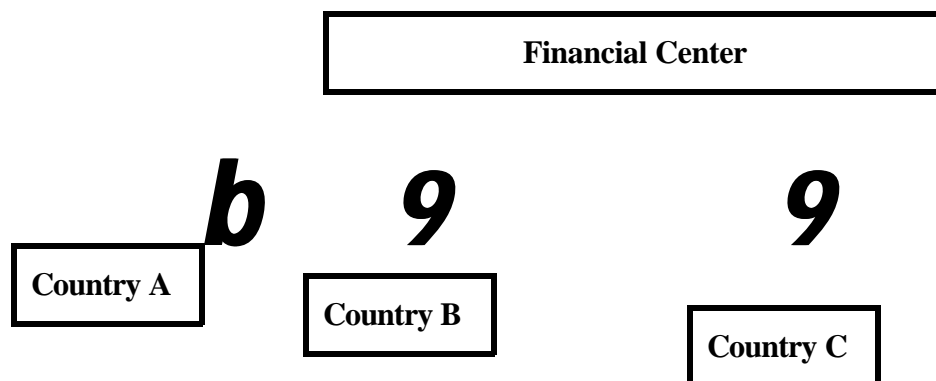
¹² See Kaminsky and Reinhart (1998).

asset prices are depressed and the original disturbance spreads across markets. Frankel and Schmukler (1996) find evidence to suggest that the crisis in Mexico in late 1994 spread to other equity markets in the Latin America through New York rather than directly. Another example of this channel of transmission is analyzed in Kaminsky and Reinhart (1998), who focus on the role of commercial banks lenders in the center country. U.S. banks had an extensive exposure to Mexico in the early 1980s, much in the way that Japanese banks did to Thailand in 1997. The behavior of the foreign banks can both exacerbate the original crisis, by calling loans and drying up credit lines, and propagate crises by calling loans elsewhere. The need to rebalance the overall risk of the bank's asset portfolio and to recapitalize following the initial losses can lead to a marked reversal in commercial bank credit across markets where the bank has exposure.

Lastly, we discuss the case of *symmetric shocks from the center country to the periphery* (Figure 3). This is the type of shock stressed in several papers by Calvo, Leiderman, and Reinhart (1994, 1996), who analyze how changes in U.S. interest rates influenced capital flows to Latin America in the early part of the 1990s. While an obvious example of this type of shock is changes in interest rates in a center country, more subtle ones may include the kinds of regulatory changes in the center country discussed in El-Erian (1992). The closure of Salomon Brothers' bond arbitrage desk on July 6, 1998, for example, is thought to have been a factor contributing to the loss of liquidity in the market for emerging market bonds.¹³

¹³ See Bank for International Settlements (1999).

Figure 3. Symmetric Shocks from the Center to the Periphery



2. The markets

Shocks may be confined to a single market, such as equities, or may have more far-reaching consequences, affecting foreign exchange, domestic money, and the international bond markets. Most often, when a country is mired in a deep financial crisis, all markets are affected; the currency weakens, domestic interest rates rise as expectations are unsettled, the terms of borrowing in international capital markets (assuming access is not lost altogether) deteriorates, and other asset prices (i.e., equity and real estate) slide. Milder periods of turbulence, owing to external developments, may not have such widespread impacts. For instance, the period of global turbulence around October 27-28, 1997, was largely confined to equity markets--despite the fact that it reached into a vary large number of mature and emerging markets across the globe. In the analysis that follows, we will also pay particular attention to the spread of disturbances across markets, within a particualr country during a specific events. The larger the number of markets impacted by the shock, the more severe the disturbance is

thought to be.

III. The Episodes

In this section, we turn our attention to some of the events that have impacted financial markets in recent years and have received considerable attention from the financial press. Our approach is in the “event study” tradition, focusing on two aspects of the events. The first of these, *severity*, is assumed to have two manifestations--severity can be gauged by how much “the event” affected financial markets (either on impact or immediately after its occurrence) or by how many markets were affected globally. The second dimension of these shocks has to do with the *persistence* of the consequences of the initial event; while market disruptions may not be dramatically acute on a given day or week, if the disturbance is sufficiently persistent, these can prove to be equally (if not more) debilitating than more drastic, but less persistent, shocks.

1. The events

Table 1 presents the briefest of chronologies of significant events during the January 1, 1997-August 31, 1999 period. The list is not meant to be exhaustive, rather it highlights some of the key episodes we analyze.¹⁴ In the remainder of this paper, our focus is on four events. In chronological order, these are: the devaluation of the Thai baht on July 2, 1997; the Russian devaluation and default on August 17, 1998; the September 1-2, 1998 stint, during which Malaysia introduced fairly drastic

¹⁴ For a more comprehensive chronology of the events surrounding the Asian crisis the reader is referred to Nouriel Roubini’s home page; for a more detailed listing of significant events in the fall of 1998, see Bank of International Settlements (1999); and for a more extensive chronology of capital controls see Edison and Reinhart (1999).

capital control measures (on September 1st) and LTCM issued a letter to its shareholders revealing its precarious condition (on September 2nd); and the recapitalization of LTCM that began on September 23rd, 1998.

While these events are a focal point of our study, there are other episodes that are encompassed in our analysis. These landmarks include: the crash of the U.S. equity market and the speculative attack on Hong Kong on October 28, 1997; the evolution of the Korean crisis following the devaluation of the won on November 17, 1997; the closure of Solomon Brothers' bond arbitrage desk on July 6, 1998; the first Wall Street Journal article on the demise of LTCM on July 20, 1998; the inter-FOMC meeting reduction in U.S. interest rates on October 15, 1998; and the Brazilian devaluation on January 13, 1999, which also coincided with rumors about a possible debt crisis in China.

2. Data and sample

Our data is daily and spans the period beginning on January 1st, 1997 through August 31st, 1999. Because of the daily frequency of the data, the variables we analyze are confined to financial markets. These variables are: the domestic "policy" interest rate--whenever possible, overnight interbank interest rates are used; the daily return on equities in the local currency and based on the available local bourse indices;¹⁵ the percent change in the daily exchange rate versus the dollar or versus the deutschemark (DM);¹⁶ and, the interest rate spreads on bonds that capture the "pricing of

¹⁵ More precisely, the percent change in equity prices, as dividend data is not available on a daily frequency.

¹⁶ For all the countries the exchange rate is bilateral against the U.S. dollar. The exceptions are Estonia and the European countries, for which bilateral exchange rates versus the DM are used. The

risk”. For the industrial countries, the interest rate spread is between corporate and sovereign bonds, while for emerging markets the spread is between a sovereign bond and a United States Treasury security. Additional data on the volume of daily transactions in equity markets and bid-ask spreads in selected markets also form part of the analysis. The particulars for all the data used for the thirty-five countries in our sample are provided, along with the sources, in the Data Appendix.

The countries in our sample cover more of the mature-to-emerging market range of experiences. Countries with less developed capital markets and a significant extent of financial repression are not a part of this study, as the focus rests on high-frequency capital market developments. We can classify the sample into five, somewhat arbitrary, seven-country groupings: The G7 countries, which are comprised of Canada, France, Germany, Italy, Japan, United Kingdom, and the United States; and the transition economies, which include Bulgaria, Czech Republic, Estonia, Hungary, Poland, Russia, and the Ukraine. The remaining three groups are primarily by region. There is the Asian cluster, which includes Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, South Korea, and Thailand. The other European group, which excludes those countries that are part of the G7, and includes, Finland, Greece, Holland, Norway, Spain, Sweden, and the non-European Turkey. Finally, the Latin American sample consists of the larger economies in the region, Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.

3. The international setting

Before turning to a “before” and “after” review of the main episodes, Tables 2 and 3 present a

exchange rate is expressed as number of local currency units per dollar or DM; hence, an increase denotes a depreciation. After January 1, 1999, DM quotes are based on a strict translation from euros.

broad brush view of the key variables during three sub-periods in our sample: the period in between the devaluation of the Thai baht and that of the Russian ruble; the couple of weeks in between the Russian devaluation and the introduction of capital controls in Malaysia, which occurs a day before LTCM issued a letter to its shareholders; and the stretch between that day and the relatively rare interim easing of monetary policy in the United States. Table 2 presents the cumulative change, which simply compares the end point to the first observation of the sample. Hence, for example, interest rates were roughly the same on August 17, 1998 as they were on July 1, 1997 for the G7 and the Latin American economies, although, rates were higher for the Asian and transition economies (7.09 and 13.14 percent, respectively.) Since the first sub-sample covers a much longer period, Table 3 presents the same data for daily changes at a monthly rate.¹⁷ So, for instance, during the first sub-sample, interest rates rose (on average) by 0.69 percent per month for the transition economies, but the increase was close to zero for the G7.

The three subsamples are quite distinct from one another. Prior to the Russian crisis, Asian exchange rates had depreciated markedly against the US dollar--largely owing to the collapse of the Indonesian rupiah. Asian equity prices fell 56 percent, while the terms at which they could borrow in international capital markets deteriorated, as reflected in the widening of bond spreads of 354 basis points. Over this period, other emerging markets also experienced declining asset prices, despite relatively stable exchange rates and interest rates. For the Latin American group, equity prices fell 32

¹⁷ Specifically, the change reported in Table 3 divided by the number of days in the subsample raised to 30 to present it as a monthly rate. The simple reason for not presenting the daily change, is that when cumulative changes were small over the longer sample (as was the case for domestic interest rates), we would have to report many decimal numbers.

percent, as equity markets in the region fell across the board.¹⁸ More surprisingly, bond yield spreads widened 522 basis points--even more than for the Asian crisis countries.¹⁹ The widening in bond spreads is even more pronounced for the transition economies. However, this is largely owing to Russia. Equity markets were falling nearly everywhere for the transition group, with the exception of Hungary. By contrast, most European and G-7 equity markets had substantial rallies during this period, with notable exceptions being Japan (down 25 percent) and Norway (down 11 percent).

Following the Russian devaluation and before the LTCM story became vox populi, the picture changes markedly.²⁰ Equity markets take a tumble everywhere, with the exceptions of South Korea and Russia, which begins to recover from its massive slide. Latin American markets are particularly hard hit. Bond spreads widen dramatically, especially for Latin American sovereign borrowers. For Russia the spread widens more than 6,300 basis points. Bid-ask spreads on debt instruments also widen dramatically, reflecting the loss of market liquidity. As the next section will illustrate in the context a simple model, this reflected several withdrawals from risk-taking. Domestic interest rates in Latin America rise during this period, with Mexico and Peru posting the largest increases. The higher interest rates during this period owed both to the loss of credibility many emerging markets suffered following the Russian default, to the failure of the International Monetary Fund to bail them out (as was

¹⁸ The decline in equity prices was largest for Venezuela (56 percent) and smallest for Colombia (11 percent).

¹⁹ Again, the largest deterioration was for Venezuelan bonds, as the spread widened by 1,793 basis points.

²⁰ , It is important to note that stories of LTCM's financial difficulties were circulating as early as July 20.

widely expected), and to the use of tight-money policies to defend exchange rates.

What is striking about the last subsample, which are the six weeks preceding the Fed's interest rate cut, is that emerging markets appeared to be recovering already from the Russian shock. Interest rates had started to decline, particularly in Asia, while equity markets were recovering, especially in Malaysia and Thailand. Bond spreads for Latin America had begun to narrow (by about 289 basis points), although yields spreads remained well above pre-crisis levels. For industrial countries the picture is very different from the emerging markets, as equity markets continued to tumble and bond spreads widened further.

This strikingly divergent performance between emerging and mature capital markets in this last period may owe to the fact that, during these weeks, there was much speculation in financial circles, as to whether there would be more LTCMs. Hence, there was concern about the health of the financial centers, rather than the periphery. By then, the periphery had already been hard hit and portfolio inflows of capital (bond and equity) had dramatically dried up. This stands in contrast to the equity market booms most of the industrial countries were enjoying prior to the Russian/LTCM shock.

4. The aftermath of shocks: severity

To begin our enquiry as to the severity of the various bouts of financial turbulence, we examine the descriptive statistics. In particular, we compare the dates of maximum and minimum values during the full sample to those of the episodes we are interested in analyzing. Many of the countries in our sample do not allow their currencies to float freely--even when they say they do.²¹ As a consequence,

²¹ See Reinhart (2000) and Calvo and Reinhart (2000) on the pervasiveness of the "fear of floating" across both industrial and emerging market countries.

we focus in the overnight domestic interest rate, as the highest rates may be associated with speculative attacks on the foreign exchange market. Table 4, which provides the dates of the maximum values, reveals that, for most of the Asian countries in our sample, interest rate peaks occur in the second half of 1997 and into early 1998, a period of much turbulence in the region.²² August and September 1998 also shows numerous entries, coinciding with the Russia/LTCM crises. However, with only a couple of exceptions, peaks in domestic interest rates are not highly coordinated across countries. The global coordination of disturbances is far more evident in Tables 5 and 6, which provide the dates of the largest daily equity market declines and the largest increase in the bond yield spread. These equity market crashes are overwhelmingly clustered on October 27-28, 1997 and in the interval between the Russian devaluation and the Federal Reserve's intermeeting interest rate cut. The bunching of disturbances across countries is even more evident in the bond spread data presented in Table 6. With a few exceptions, the largest daily increases occur in the late summer and fall of 1998.

On the basis of these simple observations, it would appear that the October 1997 disturbance, while far-reaching was, confined to equity markets, while the August-October 1998 disturbances extended to bond markets as well. Given the relative synchronicity of equity price declines in the two episodes, it is also evident that in the latter of these two episodes turmoil was more persistent.

In the spirit of an event study, we trace out in Tables 7-10, the profile of the selected financial indicators on the eve of the shock, (i.e., the day before to the date of the shock, $t-1$ to t) and the days following the particular event, the day after (t to $t+1$), the first week after ($t+7$), and the second week

²² This will be discussed in more detail in the next section.

following the shock (t+7 to t+14). Tables 7-10 include four episodes, while Appendix Tables 1-4 present comparable data for the stock market crash of October 1997, the closing of Salomon Brothers bond desk, the early headlines about LTCM losses, and the Brazilian devaluation.

As regards domestic interest rates following the Thai devaluation, interest first rose in Asia owing to Thailand and Malaysia, but by the second week, Malaysia had abandoned its “interest-rate defense” policy. Not much can be said about other countries during this episode. The Russian crisis (second panel in Table 7) paints a different picture. Interest rates gyrated widely for the transition economies owing to the volatility in Russia. Of more interest is the hike in Latin American interest rates by the second week, this hike was particularly noticeable in Mexico—during a few weeks interest rates would double to reach 40 percent. The higher interest rates, however, were not confined to Mexico in Latin America. No such pressures are evident for the Asian Group, except for Hong Kong. In the aftermath of the two LTCM-related episodes, the volatility in interest rates in the transition economies persisted, as the Ukraine has a crisis of its own. In Latin America, Brazilian interest rates, in particular, rise some more. However much of the volatility in the bottom two panels for the region owes to Colombia, which was undergoing a crisis of its own at this time.

Turning to a comparable exercise for exchange rate changes (Table 8), there are few surprises, in that exchange rates are volatile and depreciate in Asia following the Thai devaluation and oscillate widely in the remaining three episodes for the transition economies, as Russia and later the Ukraine are engulfed in turmoil. The analysis of stock and bond markets, however, yield more interesting dynamics across countries.

Initially, the Asian equity markets rose, as the Thai market showed signs of recovering from the

protracted and severe crash that receded the crisis; by the second week after the crisis, other equity markets in Asia (most noticeably Malaysia and the Philippines) were down. As shown under the last column, other emerging equity markets, particularly in Latin America were falling 4 percent on the week. The rally in the industrial countries continued unabated. The Russian devaluation was quite distinct in this regard. As the last column shows (Table 9, second panel), there were an across-the-board decline in equity markets; Latin America was particularly hard hit, as in the two weeks after the crisis equity prices were down more than twenty percent.

The two LTCM-related episodes are somewhat different as well, in that the largest losses are sustained in the more mature markets, particularly in Europe. Asian markets recovered--particularly the Malay market-- and Latin American showed some signs of reviving, although as evident from the last two column volatility remained very high. During these two episodes, Brazil and Mexico, which have the two most liquid markets in the region (in that order), were especially vulnerable.

Finally, turning to bond yield spreads, there is little to be said about developments following the Thai crisis. As shown in the last two columns of Table 10, the Russian default, not the two LTCM episodes, produced the most dramatic increases in spreads for all the regions. The fact that these episodes fell so closely on the heels of the first emerging market default in a while just added fuel to the fire, and even if the increases in spreads were more modest, they were coming on top of very hefty hikes on the price attached to risk.

5. The aftermath of shocks: persistence

We next examine the persistence of these shocks by extending our horizons to the three-month mark following the event. Tables 11-14, present the profile of the cumulative changes in selected

financial indicators following the particular event, the two weeks after (t to $t+14$), the month after ($t+30$), sixty days following the shock ($t+1$ to $t+60$), and three months after ($t+1$ to $t+90$).

The most evident cases, shown in Table 11, when interest rates remained persistently high after the event are: the Asian countries sixty days after the Thai crisis and the transition economies and the Latin American countries a month following the devaluation of the ruble. The two LTCM related episodes do not appear to have longer-lived consequences for domestic overnight interest rates. Turning to exchange rates (Table 12), not surprisingly, the two episodes where the shock has lasting consequences for exchange rates are the Asian countries after July, 1997 and the transition economies after August, 1998. The evident cumulative appreciation of the Asian currencies in the aftermath of the remaining three episodes reflects the return of capital to those economies and early emergence from the crash.

Table 13 presents the comparable exercise for equity prices. In the aftermath of the devaluation of the baht, equity prices are off by seventeen percent sixty days after the crisis began, but appear to recover by the end of the third month. The sharpest and most persistent declines in equity prices are shown in the next panel, which reviews the aftermath of the Russian default. Prices are down sharply across the board, with Latin American markets showing the greatest losses fourteen and thirty days after the crisis. Of course, by the thirty-day mark and beyond markets are also reacting to LTCM. It is noteworthy, that following both LTCM episodes emerging markets were coming back sharply, while Europe and the G-7 remained off.

As shown in Table 14, the only episode in which spreads on debt instruments show a marked and persistent widening for all country groups (most noticeably for Latin America) is following the Russian default. Two weeks following the September 2 LTCM shareholder letter, spreads had begun

to narrow.

Taken together, these observations suggest that the most widespread and persistent changes in equity and bond markets occurred following Russia's default. Clearly, the timing of LTCM re-enforced those effects, but emerging markets were on the mend before mature economies in the aftermath of LTCM--particularly by the time of the recapitalization.

IV. Comovement and Volatility

In this section, we move beyond the analysis of events to examine the patterns of comovement among financial variables across countries and over different time periods. By examining which countries appear to be more interconnected, we can begin to understand how an initially "idiosyncratic shock" can become a "systemic" one. We also provide a more detailed profile of the volatility in financial markets across our sample.

1. Principal component analysis

To assess how the degree of comovement across countries in several financial variables evolves over time and across regions, we applied principal component analysis to the financial time series data over the full sample, as well as several subsamples.

We focus on four daily time series, the domestic policy interest rate, the return on equity, the change in the exchange rate (in percent), and the bond spreads, for thirty-four of the thirty-five countries in our.²³ From these series, we constructed a smaller set of series, the principal components,

²³ Owing to limited data availability, Bulgaria is excluded from the sample.

that explain as much of the variance of the original series as possible. The higher the degree of comovement in the original series, the fewer the number of principal components needed to explain a large portion of the variance of the original series. In case where the original series are identical (perfectly collinear), the first principal component would explain 100 percent of the variation in the original series. Alternatively, if the series are orthogonal to one another, it would take as many principal components as there are series to explain all the variance in the original series. In that case, no advantage would be gained by looking at common factors, as none exist.

The procedure begins by standardizing the variables so that each series has a zero mean and a unit standard deviation. This standardization ensures that all series receive equal treatment and the construction of the principal component indices is not influenced disproportionately by the series exhibiting the largest variation. The correlation matrix of the standardized series, E , is decomposed into its Eigen-vectors (P) and the diagonal matrix of Eigen-values (Λ).

$$E = P\Lambda P' \quad (1)$$

The Eigen-vectors are the loading factors, or weights, attached to each of the original series. For a particular time-series, the higher the degree of comovement with other series the higher (in absolute value) its loading factor. If a particular time series is uncorrelated with the remaining series included in the analysis, then its loading factor in the first principal component should be close to zero. A priori, this is what we should expect to see for the time series of, say, a small country with a “perfectly

idiosyncratic” shock, or for a country which has binding capital controls.²⁴

The results are presented in Tables 15-16 for the four regional groupings and for the G-7 countries. The share of the variance of the original series (in this case equity returns) explained by the first principal component ranges from a low of 0.36 for the transition economies to a high of 0.57 percent for the European group--with the other groups falling in between. These results are hardly surprising, in light of the lack of homogeneity in the Transition economies group relative to the higher degree of integration in Europe.

Examining the factor loadings by region or group, the outcomes are equally intuitive. Among the Asian countries in our sample (Japan excluded), South Korea has the lowest factor loading (0.24); this result is not surprising, given that that its own financial crisis began months after the onset of turmoil in Thailand, Indonesia, Malaysia, and the Philippines.²⁵ Malaysia shows the next-to-least extent of comovement (the loading factor is 0.32)--then again, Malaysia had capital controls throughout the latter part of the sample. Among the European grouping, the extent of comovement is the least for Turkey, which has unresolved chronic inflation problems, and Greece. Among the G7 countries, the patterns of comovement are also largely defined along regions. The four European countries move in unison, the United States and Canada move in another block;²⁶ and Japan shows the least comovement

²⁴ As the controls insulate the country from external disturbances (see Edison and Reinhart, 1999).

²⁵ See Kaminsky and Reinhart (1999) for an analysis of the interdependence of the Asian economies before and after the 1997 crisis.

²⁶ This is evident in the factor loadings of the second principal component, shown in the next column.

with the other G7 countries.

Turning to Latin America, comovement is strongest among the larger three--Argentina, Brazil and Mexico, and least for Colombia and Venezuela. These patterns of covariation are not unique to the 1997-1999 sample. In the immediate aftermath of the Mexican crisis, when most Latin American equity markets posted substantial declines, Colombia's equity market posted moderate gains.²⁷ Lastly, comovement is strongest among the earlier reformers--Poland, the Czech Republic, and Hungary--and weakest the Republics of the the former Soviet Union.

Tables 15 and 16 also report, for comparison purposes, the results for interest rate changes and exchange rates. As is evident for all the country groups, the extent of covariation is noticeably lower reaching reaching 0.4 for any group's excxchange rates and interest rates.

2. *Conditional variances*

In this section, we work with the simplest of the generalized autoregressive conditional heteroskedasticity (GARCH) models to examine whether there was a marked change in volatility during and around the various episodes analyzed in the preceding section.²⁸ We consider the following models:

$$r_t = \sum_{i=1}^k \beta_i r_{t-i} + \epsilon_t \quad (3)$$

$$F_{rt}^2 = \omega + \alpha_1 F_{t-1}^2 + \beta_1 \epsilon_{t-1}^2$$

²⁷ See Calvo and Reinhart (1996) for an analysis of this episode.

²⁸ In all cases a GARCH (1, 1) model was estimated.

where stock returns are denoted by r_t , in equation (3), and the random shock is denoted by ϵ_t .²⁹ In the variance equation, σ^2 is the mean of the variance; the lag of the mean squared residual from the mean equation (i.e., ϵ_{t-1}^2) is the ARCH term and last period's forecast variance (i.e., F_{t-1}^2) is the GARCH term. The number of autoregressive lags, k , was selected on a country-by-country basis using both the Akaike and Schwartz criteria; if these yielded different results as regards the optimal lag length, both models were estimated. We also estimated a comparable model for the domestic interest rate and the change (in percent) of the exchange rate. Periods of turbulence that are part of our sample of daily observations render the assumption of identically and independently distributed conditionally normal disturbances in the most basic GARCH model inadequate.³⁰ Given the presence of heteroskedastic disturbances in our sample (i.e., the ϵ_t s), we use the methods described in Bollerslev and Woolridge (1992) to compute the Quasi-Maximum Likelihood covariances and standard errors.

The conditional variance of daily equity returns is plotted for each country in Appendix Figures 1-18, while some of the most salient features of this exercise are summarized in Tables 17-21. Before turning to a discussion of specific countries, however, there are some general patterns that emerge from the analysis of the conditional variance of equity returns for these thirty three countries that merit mention. Even without knowing what events transpired during the three years covered in our sample, the equity returns data reveal four periods of general market stress, as reflected in large-to-moderate

²⁹ More precisely, the variable in question is capital gains or losses, as there is no dividend data at a daily frequency.

³⁰ For a discussion of some of the implications of changes in the variance of economic fundamentals during crises periods in the analysis of the international transmission of shocks, see Forbes and Rigobon (1998).

spikes in the variance of equity returns. Two periods stand out most clearly from a review of the figures: a marked period of turbulence at end-October-early November of 1997 in most of the equity markets in our sample--this episode was, for the most part, relatively short-lived; and a more severe and far more protracted bout of volatility that, for most countries, begins in August of 1998 and lasts through October of that year.³¹ Indeed, a tally of the information presented in Tables 17-21 reveals that in more than half of the countries in the sample the largest spikes in volatility were recorded in the late summer and fall of 1998 and, that in nineteen of the thirty three countries, this period was associated with the most persistent bout of volatility in the sample.

In addition to the two more obvious episodes of market volatility on a global scale, there are two periods of market stress which merit discussion. The first of these occurs in early 1998, at the height of the Asian crisis and it engulfs all the Asian countries in our sample, including Japan.³² Indeed, for seven of the countries in our sample (all in Asia), this episode shows the most marked and persistent rise in equity market volatility. The high volatility during this period, however, is largely confined to Asia, as both mature and emerging markets elsewhere are relatively tranquil. The other market turbulence episode revealed by this data occurs in January 1999, and it is most evident in Latin America. The equity markets of four countries in our sample (all in Latin America) record their largest

³¹ The first of these episodes lines up with the equity market crash in New York and, particularly Hong Kong on October 28, 1997, while the second spans the Russian crisis-LTCM debacle.

³² Korea's devaluation of the won occurs on November 17 and their negotiations with the International Monetary Fund last into late December 1997-early January 1998. Furthermore, during this period there are recurring rumors that China will devalue and set the stage for a new round of financial instability in the region.

spike in volatility in that month; the shock, however, seems to be relatively short-lived. Several European and Transition economies' equity markets also show more moderate increases in volatility. This spike corresponds to both the Brazilian devaluation of the real and several market disruptions after the Chinese government refused to help foreign creditors of GITIC. Fears of debt crisis in China also swept through Hong Kong at this time.

As regards individual countries, it is worth noting that in some cases overlap with “global events” may be more of a coincidence that the conditional variances reveal. For example, as discussed earlier in the context of the principal component analysis, Colombia is a country whose equity markets show little comovement with the rest of Latin America or other equity markets. Its deep financial crisis, which occurs shortly after the devaluation of the ruble, had little to do with Russia or LTCM--as it had been brewing for fundamental reasons for some time. Similarly, the spike in interest rates in Greece following the equity market turbulence in end-October 1997, was owing to an attack on the drachma motivated by predominantly domestic considerations. Another feature of the conditional variances, which applies to several “crisis” countries, is that the conditional volatility of equity returns remains consistently higher in the post-crisis period. This is most evident of Indonesia and South Korea, but it also applies to Colombia, the Philippines, and Thailand.

In sum, the analysis of the variance of equity prices provides additional support that disturbances have an important global dimension in the period under scrutiny. Not surprisingly, it also appears that the global consequences of shocks to the financial center countries are far larger than

shocks which originate (and largely stay) in the periphery.³³

V. Varieties of Withdrawal from Risk Taking

As discussed in the preceding sections, the period from mid-August 1998, when Russia defaulted to mid-October, when the Federal Reserve eased was, by far, the most turbulent period for financial markets during 1997-99--Asian crisis, Brazilian crisis, and October 1997 equity market crash, notwithstanding. During this period, there were two mutually reinforcing withdrawals from risk taking. Investors apparently reassessed their tolerance for and estimate of the volatility of longer-term asset prices, and market makers reduced the amount of resources devoted to pricing and trading.³⁴ They were reinforcing because investors saw the value of their option to liquidate their position decline with the erosion of liquidity, and market makers were less committed to satisfying customers demands once they saw those customers begin to withdraw. The joint outcome of these withdrawals from risk taking widened bid-ask spreads, reduced trading volume, elevated risk spreads, and equity market volatility.³⁵

Most explanations of the events of the fall of 1998 have emphasized the behavior of investors, but an equally plausible explanation can be found in the role of market making. The argument runs much like a prisoners' dilemma (or the more complicated interactions of individual choice and aggregate

³³ This statement reflects the fact that it is difficult to cleanly separate the effects of the Russian default and LTCM as these two disturbances are unfolding over a similar time frame.

³⁴ See Bank of International Settlements (1999) for a fuller discussion.

³⁵ Appendix Figures 1-18 illustrate clearly this last point.

outcomes discussed by Thomas Schelling, 1978, and now central to the literature on market externalities that is reviewed by Economides, 1994).³⁶ Market participants commit to trade because they expect others to do so. If they think others will not, they will not, creating a self-fulfilling prophesy.

In the presence of such nonlinearities, even a modest reappraisal of risk-taking appetites, the imposition of a small cost, or even public statements warning about certain behaviors could have large consequences for market activity. In the remainder of this section, we will provide a simple example of the tenuousness of market activity when participants' behavior are self reinforcing and, thus, suggests that market strains should be interpreted (in part) as evidence of a coordination failure. As is familiar in models of debt repudiation (Calvo, 1988), speculative foreign exchange attacks (Obstfeld, 1994), and network externalities (Katz and Shapiro, 1985), there can be multiple equilibria. In this case, not because of the interaction between government and investors as in Calvo and Obstfeld; rather it is the joint outcome of private decisions, as in Katz and Shapiro. This simple model will have implications for understanding the events of the fall of 1998 and making policy statements at times of stress.

1. The process at work

Trading is an activity that needs equal aggregate effort on both the buy and sell side of transactions by more than one person. To make it simple, suppose there are two agents deciding individually on the extent to participate in some activity in a single period of time. For instance, the activity might be thought of as the intensity of an agent's search to find a willing counterparty for his or

³⁶ See Calvo (1998), Calvo and Mendoza (1999), and Caballero and Krihnamurthy (1999).

her own principal. The benefit that the first agent accrues (B^1) from this activity is increasing in own participation (p^1) and that of the other person, Agent 2 (p^2), who has a similar benefit calculus. The logic applied to financial trading is that intensifying activity yields more profit to the trader, but at a diminishing rate. Moreover, those profits rise if the counterparty increases effort because own search time will decline.

Similarly, the cost to participation for agent one, C_1 , can be written as a function of own participation. Unless there was an organized exchange, a trade group, or common suppliers supporting trading services for both agents that were exploiting some economies of scale, there is no reason to expect that the cost of participation for Agent 1 depends on the participation of Agent 2.

The profit maximizing trader will equate marginal cost and marginal benefit for possible levels of participation of the other person. This individual choice problem simplifies to choosing a level of individual participation as a function of participation of the other person. As an example, we can assume that the benefit Agent 1 accrues from participation can be expressed as,

$$B_1 = Ap_1^{\alpha} p_2^{\beta}, \quad (3)$$

a specification that reflects both diminishing marginal returns to personal activity and a positive externality conveyed by the other's effort. Cost is assumed to be proportional to scale,

$$C_1 = cp_1. \quad (4)$$

We assume that the externalities are limited so that each agent benefits more directly from own

participation than indirectly from the participation of the other agent ($\alpha > \beta$). Also, marginal benefit is diminishing in aggregate participation, $\alpha + \beta < 1$.

Under these assumptions, equating marginal benefit with the constant marginal cost of participation implies that the optimal degree of effort by Agent 1 is:

$$p_1 = \left(\frac{\alpha A p_2^\beta}{c} \right)^{\frac{1}{1-\alpha}} \quad (5)$$

Participation is increasing at first because the marginal benefits of own effort is high, as is the contribution of the participation of the other to that marginal benefit. Ultimately, though, diminishing returns set in.

Agent 2 performs the exact same calculation, which produces a participation function mirroring that of Agent 1. Because of the assumed similarity of preferences, That is,

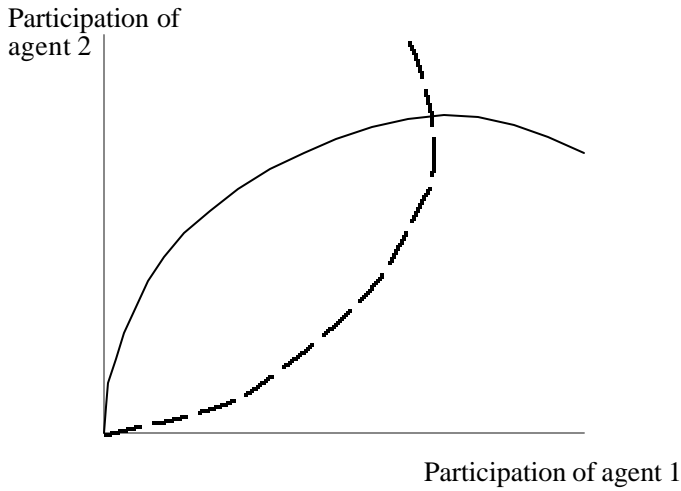
$$B_2 = \alpha A p_1^\beta p_2^\alpha, \quad (6)$$

we know that effort by Agent 2 takes the form:

$$p_2 = \left(\frac{\alpha A p_1^\beta}{c} \right)^{\frac{1}{1-\alpha}} \quad (7)$$

Because the participation schedules are mirror images, this market clears when the effort of both participants is equal, as in Figure 4. Taken together, this can be thought of as a simplification of the models of network externalities in which each participant employs equal effort and the question

Figure 4. The determination of equilibrium



becomes determining how many agents will participate in equilibrium (as in Katz and Shapiro, 1985).

In terms of our specification of behavior, this requires solving equation (3) or (4) for equal effort, $p_1 = p_2 = p^*$. There are two fixed points.

$$p^* = \left(\frac{A}{c} \right)^{\frac{1}{1+\beta}} \quad (8)$$

And trivially, $p^* = 0$.

This exercise establishes two simple points. First, there are two possible outcomes, one with high participation by both parties and one with low participation (actually zero). While the high-effort outcome makes both parties better off, there is no guarantee that they get there if they are not allowed to communicate. And such communication is difficult given the mistrust between entities that provide similar services to the same client base and the problems of antitrust enforcement.

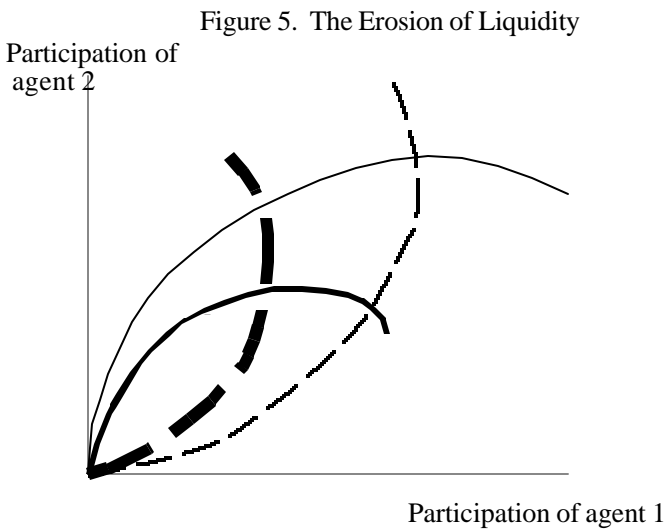
Perhaps market participants will recognize their self interest and voluntarily and independently choose the high-trade outcome, but there is no guarantee--that is the prisoner's dilemma. Market convention, an industry group that sets standards, or government leadership are among the means to cooperate in finding the high-trade outcome without trusting to luck or to private communication between rivals.

Second, participation depends on market participants' assessment of the costs of participation and the benefits accruing from the participation of others. An increase in c or reduction in $\$$ will cause a withdrawal from participation.

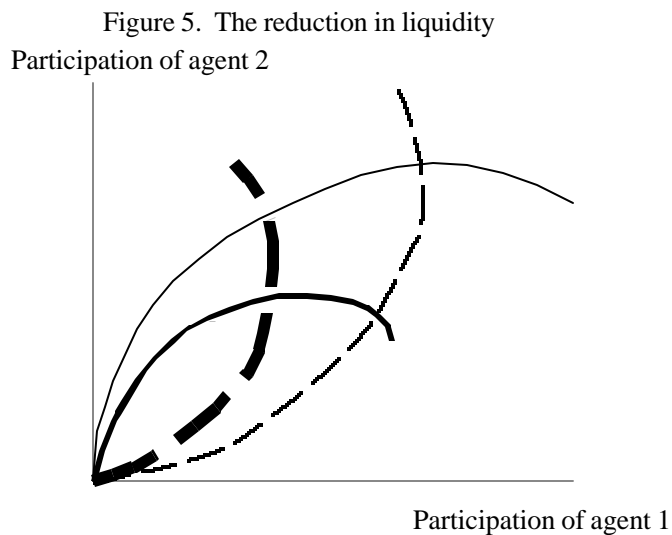
2. The events of the fall 1998

The Russian default, as opposed to the earlier crises, was associated with the virtual liquidation of principal. This both raised each trader's assessment of the odds of default of their potential

counterparties and the cost of hedging, because volatility was elevated (as



illustrated in the previous sections).³⁷ In terms of the model, this lowered the benefits associated with participation by the other person and raised the cost of own participation. This pulls both offer curves toward the origin. Because the two curves are highly nonlinear, even small reassessments of the costs and benefits of trading could produce a large reduction in participation. Indeed, that reassessment might lead participants to doubt the power of market convention to enforce the high-trade outcome. Thus, depending on the market, volume could decline dramatically or dry up altogether, as in Figure 5.



3. *Feedback to investors*

³⁷ Dooley (1999), in particular, has argued that implicit guarantees have played a key role in explaining capital inflows (much of which was in the form of portfolio bond flows) to emerging markets in the 1990s. Thus, the Russian default can be seen as a wake up call to investors to reassess the value of those implicit guarantees.

Withdrawals from market making may feed back to investor behavior. The owner of an asset could be thought of as having two claims: The value associated with holding the instrument until its maturity and the value of a put option to sell that instrument before it matures. High participation--or a liquid market--implies that the strike price of that put option is relatively certain and not fall below the current market price of the underlying instrument. Thus, the put option is valuable and the total price of the instrument is high. Low participation--or an illiquid market--implies that putting the instrument back to the market will entail a substantial price concession, or that the strike price of the put is uncertain and most likely well below the current price of the underlying. As a result, the total price of the instrument is low. Should participation fall, then, the price of the underlying will fall because anyone contemplating reselling it anytime soon will face a capital loss in the process.

Even abstracting from the uncertainty associated with the effects on market prices of future transactions, a wider bid-ask spread that is expected to prevail into the future imposes a direct cost on investors not intending to hold a security to maturity. In essence, the bid-ask spread is akin to a transactions tax, in that purchases of a security are made at a price above that at which the security could be sold. The effect on the holding period return depends on how long the investor intends to hold the security and the expected persistence of a wider bid-ask spread. For example, if the initial bid-ask spread, s_0 , is expected to revert to its unconditional mean, \bar{s} , at a rate of α , the incidence of the tax for an investor holding the security until time t will be:

$$\frac{\bar{s} - (s_0 - \bar{s})e^{-\alpha t}}{t} \quad (9)$$

Thus, the stronger the mean reversion (higher α) and the longer the holding period (the larger is t), the smaller will be the significance of the tax. But as is familiar from the literature on transactions taxes, the effect on investors with short holding periods can be sizable.

VI. Concluding Comments

As Table 22 summarizes, the Russian default has the largest effects both across markets and across regions, surpassing that of LTCM for emerging markets. LTCM had its largest impact on the developed markets, most noticeably Europe. The July announcement of LTCM appears to have had little impact on the markets; the same can be said of the Brazilian devaluation. The Asian crisis largely stayed in Asia--although Latin American equity markets were affected. While an analysis of more episodes is a clear necessity, one of the preliminary conclusions we draw from this exercise is, that for understanding “systemic” problems--be these defined at the global or regional level--we have to understand how a shock to the periphery spreads to the periphery (or to other financial centers), via its impact on a financial center. If the shock never reaches the center, it is doubtful it can become systemic, irrespective of the definition of systemic that is used. Because financial market participants at the center countries were largely positioned for a devaluation of the Brazilian real by early 1999, this crisis was more of a ripple in global capital markets than a tidal wave, despite Brazil’s size and importance relative to that of Russia and Thailand.³⁸ At the time of this writing, the fate of Ecuador is

³⁸ This is not to ignore the important consequences of the devaluation of the real had on key trading partners, such as Argentina. The point is that the crisis never became “systemic”--even in the more narrow regional sense.

uncertain, at best. Yet, the collapse of the country's currency, banking system, economy, and political system--not to mention its default on international obligations, have left global capital markets largely unscathed.

As regards the model, has a variety of implications for public policy making at a time of stress. For one, because these equilibria depend on confidence in the behavior of others, the public expression of concerns about market liquidity could result in either the offer curves shifting in or market coordinating on the low-trade outcome. Because the model is highly nonlinear, small reassessments of costs could produce large changes in participation. The model could, however, also be used to justify public support at times of stress. Contingent facilities, such as those provided by the discount window at the firm level or the IMF at the country level, effectively lower the cost of participating and raise the benefits I accrue from other's participation (by reducing default risk). They also serve as official reminders that the high-trade outcome may be justifiable.

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Table 1. Selected Significant Events during 1997 and 1998

Date	Event
July 2, 1997	Devaluation of the Thai baht
August 14, 1997	Indonesia abandons the rupiah trading band
October 28, 1997	US and Hong Kong markets crash
November 17, 1997	Korea abandons its defense of the won
July 6, 1998	Salomon Brothers bond arbitrage desk disbanded
July 20, 1998	First Wall Street Journal headline on LTCM losses
August 17, 1998	Russian effective default and ruble devaluation
September 1, 1998	Malaysia introduces capital controls
September 2, 1998	LTCM shareholder letter issued
September 23, 1998	LTCM recapitalization
October 15, 1998	Inter-meeting Federal reserve rate cut
January 10,	Market disrupted after Chinese government refused to help foreign creditors of GITIC
January 13	Fears of debt crisis in China sweep through Hong Kong. Brazil devalues

Sources: The authors and Bank for International Settlements, *A Review of Financial Market Events in Autumn 1998*, October 1999.

Table 2. Changes over Selected Periods in Interest Rates, Exchange Rates, and Stock Prices
(In percent)

Regional Averages ¹	July 1, 1997 to August 17, 1998	August 17, 1998 to September 1, 1998	September 1, 1998 to October 14, 1998
Cumulative Changes in Interest Rates			
Asia	7.09	-0.13	-1.47
Europe	1.18	0	-0.13
G-7	0.11	0.15	-0.3
Latin America	0.95	4.13	-0.14
Transition Economies	13.14	5.66	-5.44
Cumulative Changes in Exchange Rates			
Asia	100.87	-3.66	-5.06
Europe	13.35	1.03	3.11
G-7	6.29	-1.55	-3.04
Latin America	13.36	2.69	1.14
Transition Economies	7.71	12.06	8.66
Cumulative Changes in Stock Prices			
Asia	-56.11	-9.9	20.05
Europe	37.46	-14.02	-11.72
G-7	23.04	-9.29	-5.56
Latin America	-32.16	-20.03	5.18
Transition Economies	-18.98	-14.11	-7.24
Cumulative Changes in Bond Spreads (in basis points)			
Asia	353.58	161.25	45.17
Europe	10.64	125.47	1.48
G-7	15.39	16.41	18.24
Latin America	521.51	668.98	-289.14
Transition Economies	1000.34	868.43	137.25

Table 3. Average Daily Changes over Selected Periods in Interest Rates, Exchange Rates, and Stock Prices
(In percent, monthly rates)

Regional Averages ¹	July 1, 1997 to August 17, 1998	August 17, 1998 to September 1, 1998	September 1, 1998 to October 14, 1998
Interest Rates			
Asia	0.43	-0.23	-1
Europe	0.08	0.01	-0.09
G-7	0.01	0.3	-0.2
Latin America	0.06	8.99	-0.23
Transition Economies	0.69	15.73	-4.39
Exchange Rates			
Asia	4.12	-6.84	-3.45
Europe	0.76	2.08	2.05
G-7	0.42	-3.02	-2.07
Latin America	0.9	5.52	0.74
Transition Economies	0.53	32.58	5.24
Stock Prices			
Asia	-5.91	-18.29	12.73
Europe	2.19	-25.89	-8
G-7	1.32	-17.58	-3.77
Latin America	-2.91	-35.9	3.26
Transition Economies	-1.59	-23.89	-5.33
Bond spreads (in basis points)			
Asia	25.09	326.93	28.26
Europe	0.75	258.38	0.98
G-7	1.12	32.87	12.15
Latin America	36.73	1412.36	-197.67
Transition Economies	65.95	1936.26	88.82

Table 4. Daily Overnight Interest Rate Peaks: January 1997-August 1999

Month/Year	Country/ Date	Maximum value
January, 1997	Germany/ 1	4.66
	Hungary/ 15	28.10
March, 1997	United States/ 31	7.07
April, 1997	Japan/ 1	0.61
	Finland/ 14	7.49
May, 1997	Czech Republic/ 29	168.76
July, 1997	Thailand/ 2	27.0
	Malaysia/ 11	35.0
August, 1997	Indonesia/ 20	91.45
October, 1997	Philippines/ 7	102.63
	Greece/ 31	80.50
November, 1997	Argentina/ 4	13.50
	Brazil/ 14	70.37
	Poland/ 26	27.09
December, 1997	Chile/ 04	
	Korea/ 26	35
January, 1998	Singapore/ 8	17.50
February, 1998	Spain/ 23	10.95
March, 1998	Estonia/ 2	17.22
	Holland/ 24	4.50
April, 1998	Turkey/ 8	76.88
May, 1998	Sweden/ 29	4.56
June, 1998	Venezuela/ 19	140.40
	Italy/ 30	8.00
August, 1998	Russia/ 18	160.00
	Norway/ 25	10.00
	Hong Kong/ 31	17.50
	Canada/ 31	5.85
September, 1998	Ukraine/ 9	145.00
	Mexico/ 11	40.0
	Peru/ 24	55.0
October, 1998	UK/ 06	8.88

Table 5. Largest Daily Stock Market Declines: January 1997-August 1999

Month/Year	Country	Date	Percent Change
August, 1997	Philippines	8/28	-9.3
October, 1997	Argentina	10/27	-13.7
	Canada	10/27	-6.2
	Mexico	10/27	-13.3
	Peru	10/27	-7.3
	US	10/27	-6.9
	Germany	10/28	-8.0
	Hong Kong	10/28	-11.6
	Hungary	10/28	-16.4
	Italy	10/28	-6.2
	Poland	10/28	-9.8
	Singapore	10/28	-9.2
	November, 1997	Estonia	11/10
Korea		11/24	-11.0
Japan		11/25	-5.1
January, 1998	Indonesia	1/08	-12.0
February, 1998	Thailand	2/04	-9.5
August, 1998	Greece	8/27	-7.7
	Turkey	8/27	-13.1
	Czech Republic	8/27	-6.8
September, 1998	Ukraine	9/02	-15.4
	Malaysia	9/08	-21.5
	Brazil	9/10	-15.8
	Chile	9/10	-7.4
	Russia	9/15	-24.0
	Norway	9/17	-7.0
	France	9/17	-5.0
	Holland	9/21	-5.7
October, 1998	Finland	10/08	-6.9
	Sweden	10/08	-6.7
December, 1998	UK	12/01	-3.6
	Venezuela	12/11	-10.2
January, 1999	Spain	1/13	-6.5
	Colombia	1/28	-5.5

Table 6. Daily Peaks in Bond Spreads: January 1997-August 1999
(In basis points)

Month/Year	Country/Date	Maximum value
March, 1997	Holland/ 25	116.58
January, 1998	Hong Kong/ 12	591.17
August, 1998	Argentina/ 27 Venezuela/ 27	1525.32 4097.92
September, 1998	Turkey/ 1 Korea/ 4 Brazil/ 10 Peru/ 10 Mexico/ 11 Colombia/ 15 Philippines/ 21	1030.67 964.30 2120.99 1090.24 1598.93 1090.24 1231.03
October, 1998	Canada/ 5 Hungary/ 5 Indonesia/ 5 Poland/ 5 Singapore/ 5 Sweden/ 6 Greece/ 6 Russia/ 8 Finland/ 15 Germany/ 15 United States/ 15 Thailand/ 28	101.50 192.79 1843.30 581.76 3.36 106.77 56.20 6819.17 75.43 62.00 183.94 92.85
December, 1998	Spain/ 1	136.36
January, 1999	France/ 8 United Kingdom/ 27	37.00 110.00
August, 1999	Italy/ 20 Japan/ 20	141.15 71.00

Table 7. Short-Run Effects: Overnight Interest Rate Changes During Four Episodes of Turbulence

July 2, 1997: The devaluation of the Thai baht				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	2.13	1.30	2.98	-3.50
Europe	-0.02	-0.07	-0.01	0.14
G-7	-0.10	0.00	-0.01	0.07
Latin America	-0.06	0.00	-0.10	0.09
Transition Economies	-0.88	0.67	-2.66	1.19
August 17, 1998: The Russian devaluation and default				
Asia	0.29	0.34	0.12	-0.59
Europe	0.22	-0.43	0.18	0.25
G-7	0.08	-0.09	0.08	0.16
Latin America	0.08	-0.43	0.33	3.68
Transition Economies	0.67	11.32	0.84	-6.49
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	-1.47	-1.46	-0.62	0.01
Europe	0.07	-0.18	-0.06	0.14
G-7	-0.05	-0.08	0.08	-0.06
Latin America	0.63	0.34	5.63	2.74
Transition Economies	-2.52	0.80	13.11	-9.42
September 23, 1998: LTCM Recapitalization				
Asia	-0.55	0.15	-0.38	-0.08
Europe	-0.28	0.32	0.06	-0.12
G-7	0.04	0.00	0.07	-0.21
Latin America	0.53	0.19	-2.07	2.71
Transition Economies	3.68	0.18	3.86	-6.83

Table 8. Short-Run Effects: Exchange Rate Changes During Four Episodes of Turbulence
(In percent)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	2.75	-0.55	0.38	2.92
Europe	-0.05	-0.07	0.14	-0.55
G-7	-0.23	-0.25	0.05	0.77
Latin America	0.13	0.08	-0.04	0.14
Transition Economies	0.08	0.14	0.39	1.71
August 17, 1998: The Russian devaluation and default				
Asia	0.16	-0.64	-1.98	-1.11
Europe	0.10	0.03	0.68	0.30
G-7	0.03	-0.06	-0.13	-1.37
Latin America	0.03	0.08	1.30	1.28
Transition Economies	0.03	1.72	3.33	5.45
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	-2.08	-0.47	2.03	-1.24
Europe	-0.88	0.15	0.85	-0.05
G-7	-0.39	0.12	-0.58	-0.65
Latin America	0.01	-0.07	1.18	-0.25
Transition Economies	-1.77	-0.92	12.3	-5.48
September 23, 1998: LTCM Recapitalization				
Asia	-0.13	-1.41	0.13	-3.52
Europe	0.08	-0.12	0.70	0.23
G-7	-0.17	-0.15	0.08	-1.96
Latin America	0.02	0.07	0.31	-0.21
Transition Economies	-0.70	1.10	0.66	-2.06

Table 9. Short-Run Effects: Stock Price Changes During Four Episodes of Turbulence
(In percent)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	1.27	1.04	-2.01	0.92
Europe	0.58	1.21	2.37	1.57
G-7	0.54	0.87	0.14	3.73
Latin America	1.11	0.91	1.66	-4.13
Transition Economies	1.32	2.0	3.05	-0.04
August 17, 1998: The Russian devaluation and default				
Asia	-1.64	-1.07	0.34	-9.26
Europe	-1.81	2.93	-2.82	-14.03
G-7	0.47	2.17	-1.85	-9.57
Latin America	-1.33	-0.45	-10.37	-10.40
Transition Economies	-2.65	0.00	-0.21	-9.37
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	-3.74	2.48	7.29	-0.41
Europe	-3.0	3.4	0.96	-5.64
G-7	-0.21	1.81	0.98	-0.75
Latin America	1.64	1.64	-6.17	4.26
Transition Economies	0.70	2.54	17.17	-14.84
September 23, 1998: LTCM Recapitalization				
Asia	0.95	5.37	-1.26	3.56
Europe	3.06	1.59	-8.21	-10.28
G-7	2.22	-0.80	-6.86	-3.72
Latin America	7.74	-1.70	-3.26	-1.10

Transition Economies	2.40	2.73	-11.38	-8.59
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Table 10.Short-Run Effects: Changes in Bond Spreads During Four Episodes
(Basis points)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	3.87	4.58	1.07	6.18
Europe	4.21	-3.07	-6.41	1.28
G-7	3.34	2.82	-5.04	4.32
Latin America	-0.9	-5.16	-5.29	20.2
Transition Economies	-6.02	-11.05	-10.49	19.33
August 17, 1998: The Russian devaluation and default				
Asia	7.43	4.29	60.85	96.1
Europe	5.92	1.27	12.89	111.31
G-7	-0.6	-0.15	7.35	9.21
Latin America	82.49	-8.12	421.96	255.11
Transition Economies	144.85	268.64	349.1	250.69
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	19.45	-34.2	16.04	-27.14
Europe	23.08	-37.31	-23	12.27
G-7	-2.83	0.88	0.64	0.13
Latin America	-156.18	27.55	60.15	-87.14
Transition Economies	-269.37	-68.27	83.65	68.73
September 23, 1998: LTCM Recapitalization				
Asia	-22.15	-10.21	58.66	-27.61
Europe	-3.69	-5.78	22.3	2.24
G-7	-3.17	-0.67	7.84	-7.38
Latin America	-121.19	13.52	103.97	-59.16
Transition Economies	-107.59	-76.07	274.89	136.39

Table 11. How Persistent are These Effects? Cumulative Interest Rate Changes
(In Percent)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t+14	t-1 to t+30	t-1 to t+60	t-1 to t+90
Asia	2.90	2.62	8.60	1.81
Europe	0.03	0.55	0.90	0.48
G-7	-0.05	0.14	-0.01	-0.03
Latin America	-0.90	-0.28	0.44	-0.54
Transition Economies	-4.06	-4.66	-5.05	-3.12
August 17, 1998: The Russian devaluation and default				
Asia	0.16	-1.82	-2.55	-4.59
Europe	0.21	0.02	-0.03	-0.10
G-7	0.23	0.24	0.20	-0.16
Latin America	4.47	8.66	3.47	2.30
Transition Economies	6.33	15.98	1.56	0.98
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	-3.52	-4.04	-6.00	-7.76
Europe	-0.03	-0.16	0.02	-0.45
G-7	-0.11	0.08	-0.26	-0.49
Latin America	6.64	3.40	-0.40	-0.96
Transition Economies	1.97	1.04	-6.67	-20.49
September 23, 1998: LTCM Recapitalization				
Asia	-0.85	-2.06	-3.31	-5.31
Europe	0.33	0.21	0.02	-0.21
G-7	-0.10	-0.18	-0.58	-0.83
Latin America	1.43	-7.80	-4.74	-7.08
Transition Economies	0.87	-0.82	-13.42	-14.30

Table 12. How Persistent are These Effects? Cumulative Exchange Rate Changes
(In percent)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t+14	t to t+30	t+1 to t+60	t+7 to t+90
Asia	5.51	7.32	13.75	18.55
Europe	-0.52	-0.32	0.76	1.17
G-7	0.35	1.35	1.82	1.35
Latin America	0.31	0.45	1.35	2.17
Transition Economies	2.32	3.11	2.97	1.81
August 17, 1998: The Russian devaluation and default				
Asia	-3.58	-3.25	-9.02	-12.38
Europe	1.12	1.94	5.37	3.87
G-7	-1.54	-2.75	-5.2	-3.82
Latin America	2.69	3.52	3.82	3.64
Transition Economies	10.53	11.59	15.92	22.86
September 1, 1998: Malaysia Imposes Capital Controls ² September 2, 1998: LTCM Shareholder letter issued				
Asia	-1.76	2.65	-10.19	-11.94
Europe	0.08	0.69	0.96	1.7
G-7	-1.5	-1.44	-3.41	-2.02
Latin America	0.88	1.13	1.11	1.36
Transition Economies	4.12	16.8	16.01	19.08
September 23, 1998: LTCM Recapitalization				
Asia	-4.93	-9.13	-10.62	-10.54
Europe	0.89	0.29	0.72	2.21
G-7	-2.2	-1.54	-0.82	-1.89
Latin America	0.19	-0.05	-0.41	-0.46
Transition Economies	-1	0.3	2.97	4.16

Table 13. How Persistent are These Effects? Cumulative Stock Price Changes
(In Percent)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t+14	t-1 to t+30	t-1 to t+60	t-1 to t+90
Asia	1.21	2.05	-17.19	-12.34
Europe	5.73	6.26	2.19	13.16
G-7	5.29	6.70	0.97	6.12
Latin America	-0.45	2.20	-2.03	5.33
Transition Economies	6.33	10.92	14.16	19.22
August 17, 1998: The Russian devaluation and default				
Asia	-11.63	-3.87	11.52	30.34
Europe	-15.72	-17.13	-25.70	-11.48
G-7	-8.78	-7.49	-12.79	-3.25
Latin America	-22.22	-22.97	-13.98	-1.85
Transition Economies	-12.22	-14.61	-22.13	-1.58
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued				
Asia	5.62	7.16	30.56	46.58
Europe	-4.27	-8.57	-1.79	7.93
G-7	1.83	-4.63	1.72	9.14
Latin America	1.37	9.76	15.63	29.67
Transition Economies	5.57	5.06	6.67	18.34
September 23, 1998: LTCM Recapitalization				
Asia	8.63	25.64	46.48	48.64
Europe	-13.84	6.56	19.16	22.30
G-7	-9.16	3.59	14.09	14.25
Latin America	1.68	12.92	29.07	26.09
Transition Economies	-14.84	2.69	14.37	13.37

Table 14. How Persistent are These Effects? Cumulative Changes in Bond Spreads
(Basis points)

July 2, 1997: The devaluation of the Thai Baht				
Regional Averages ¹	t-1 to t+14	t to t+30	t+1 to t+60	t+7 to t+90
Asia	15.7	21.71	31.57	38.38
Europe	-4	-12.14	-13.08	-13.22
G-7	5.46	1.73	-1.04	2.38
Latin America	8.86	-3.97	-2.26	-13.31
Transition Economies	-8.23	-25.71	-29.93	-60.42
August 17, 1998: The Russian devaluation and default				
Asia	168.68	130.4	206.7	33.64
Europe	109.49	93.76	110.02	68.17
G-7	15.8	21.78	40.98	27.26
Latin America	751.45	869.85	412.2	319.94
Transition Economies	183.79	221.17	219.84	170.06
September 1, 1998: Malaysia Imposes Capital Controls ² September 2, 1998: LTCM Shareholder letter issued				
Asia	-25.85	97.5	-13.59	-223.45
Europe	-24.97	-8.06	-1.08	-62.54
G-7	-1.1	5.93	13.96	8.73
Latin America	-155.62	-346.52	-522.21	-631.26
Transition Economies	-185.26	-356.89	-327.15	-584.75
September 23, 1998: LTCM Recapitalization				
Asia	-1.31	-122.41	-273.99	-288.18
Europe	15.07	16.3	-38.89	-37.64
G-7	-3.3	6.41	2.18	4
Latin America	-62.86	-266.42	-464.25	-354.26
Transition Economies	46.8	-11.75	-60.86	-72.52

Table 15. Principal Component Analysis: Daily Data, January 1, 1997-August, 1999
Factor Loadings by Region

Country	Factor loading in first principal component			
	Overnight interest rates	Stock returns	Exchange rate changes	Bond spreads
Proportion of the variance explained by the first principal component	0.17	0.46	0.38	0.71
Hong Kong	0.31	0.43	0.06	n.a.
Indonesia	0.14	0.38	0.43	0.5
Malaysia	-0.19	0.32	0.18	n.a.
Philippines	-0.41	0.38	0.5	0.57
Singapore	0.68	0.47	0.36	n.a.
South Korea	0.42	0.24	0.47	0.48
Thailand	0.2	0.38	0.43	0.43
Proportion of the variance explained by the first principal component	0.16	0.57	0.32	0.63
Finland	0.34	0.44	0.44	0.55
Greece	-0.16	0.22	0.26	n.a.
Holland	0.28	0.44	0.36	n.a.
Norway	0	0.4	0.47	n.a.
Spain	0.42	0.41	0.32	0.36
Sweden	0	0.44	0.43	0.51
Turkey	0.59	0.2	0.31	0.55
Proportion of the variance explained by the first principal component	0.23	0.56	0.31	0.47
Canada	0.18	0.36	-0.01	0.49
France	0.56	0.45	-0.31	0.36
Germany	0.56	0.42	0.6	0.3
Italy	0.47	0.41	-0.39	0.16

Japan	0.1	0.21	0.4	0.26
United Kingdom	-0.08	0.43	0.47	0.45
United States	0.32	0.31	--	0.49

Table 16. Principal Component Analysis: Daily Data, January 1, 1997-August, 1999
Factor Loadings by Region

Country	Factor loading in first principal component for:			
	Changes in overnight interest rates	Stock returns	Exchange rate changes	Bond spreads
Proportion of the variance explained by the first principal component	0.27	0.49	0.2	0.93
Argentina	-0.42	0.46	0.13	0.41
Brazil	0.46	0.45	0.36	0.41
Chile	n.a.	0.4	0.44	n.a.
Colombia	0.59	0.11	0.39	0.4
Mexico	0.09	0.44	0.59	0.41
Peru	-0.53	0.38	0.39	0.41
Venezuela	n.a.	0.28	0.04	0.4
Proportion of the variance explained by the first principal component	0.22	0.38	0.28	0.75
Czech Republic	0.58	0.5	0.6	n.a.
Estonia	0.11	0.26	0.10.	n.a.
Hungary	0.39	0.54	0.58	0.59
Poland	-0.44	0.51	0.52	0.6
Russia	-0.54	0.34	0.01	0.44
Ukraine	0.14	0.14	-0.14	n.a.

Table 17. Volatility Spikes in Equity Prices: Asia
 Bollersv and Woolridge GARCH (1,1) Models

Country	Dates of volatility spikes	Comments
Asia		
Hong Kong	July 1997 late October 1997 January-February 1998 June-October 1998	Moderate Largest Large, most persistent Modest
Indonesia	July 1997 February 1998 August -December 1998 July 1999	Large Largest Large Moderate Post mid -1997 volatility has remained high relative to pre-crisis levels.
Malaysia	July 1997 January-February 1998 August-October 1998	Modest Moderate Largest, most persistent
Philippines	July 1997 September 1997 Late October 1997 January-February, 1998 June 1998 September-November 1998 January 1999	Modest Moderate Moderate Large, most persistent. Moderate Largest Modest
Singapore	Late October 1997 January-February 1998 August-October 1998	Large Largest, most persistent Moderate
South Korea	October 1997-March 1998 July-August 1998 December 1998-January 1999	Largest, most persistent Moderate Moderate Post late-1997 volatility has remained high relative to pre-crisis levels.
Thailand	June 1997 January-February 1998 July 1998 August-October 1998 February 1999 June 1999	Moderate Largest, most persistent Moderate Large Large Large More frequent spikes since the crisis in mid-1997.

Table 18. Volatility Spikes in Equity Prices: Europe
 Bollerssev and Woolridge GARCH (1,1) Models

Country	Dates of volatility spikes	Comments
European Group		
Finland	Late October-November 1997 April-May 1998 August-October 1998 January 1999 April May 1999	Large Modest Largest, most persistent Modest Moderate
Greece	April-May 1998	About a dozen spikes Largest
Holland	August-September 1997 Late October 1997 June 1998 Late August-October 1998 January 1999	Moderate Large Moderate Largest, most persistent Large
Norway	Late October-November 1997 April-May 1998 Late August-October 1998 January 1999	Moderate Modest Largest, most persistent Moderate
Spain	Late October-November 1997 April-May 1998 Late August-October 1998 January 1999	Large Modest Largest, most persistent Moderate
Sweden	Late October-November 1997 August-November 1998 January 1999	Moderate Largest, most persistent Modest
Turkey	Late October-November 1997 August-October 1998 April 1999	About ten spikes Moderate Largest, most persistent Large

Table 19. Volatility Spikes in Equity Prices: Europe
 Bollersv and Woolridge GARCH (1,1) Models

Country	Dates of volatility spikes	Comments
G7 Countries		
Canada	Late October-November 1997 August-October 1998	Large Largest, most persistent
France	June 1997 Late October-November 1997 April-May 1998 Late August-October 1998 January 1999	Modest Largest Modest Large, most persistent Modest
Germany	Late October-November 1997 August-October 1998	Large Largest
Italy	Late October-November 1997 April-May 1998 Late August-October 1998 January 1999	Large Large Largest, most persistent Modest
Japan	Late October 1997-February 1998 Late August-October 1998 March-April 1999	Largest, most persistent Large Modest Modest
United Kingdom	Late October-November 1997 August-October 1998	Modest Largest, most persistent
United States	Late October-November 1997 August-October 1998	Large Largest, most persistent

Table 20. Volatility Spikes in Equity Prices: Latin America
 Bollershev and Woolridge GARCH (1,1) Models

Country	Dates of volatility spikes	Comments
Latin America		
Argentina	Late October -December 1997 August-October 1998 January 1999 July 1999	Large Large, most persistent Largest Moderate
Brazil	July 1997 Late October-November 1997 Late August-October 1998 January 1999	Modest Moderate Large, most persistent Largest
Chile	Late October-December 1997 Late August-October 1998 January 1999 May-June 1999	Modest Largest, most persistent Large Modest
Colombia	February 1998 June 1998 August 1998 January 1999 June 1999	Modest Large Largest Modest Moderate Equity prices have been more volatile since the August 1998 devaluation.
Mexico	Late October-December 1997 Late August-October 1998 January 1999	Largest Moderate Modest
Peru	July 1997 Late October-December 1997 Late August-October 1998 January 1999 April 1999	Moderate Large Large, most persistent Largest Modest
Venezuela	Late August-October 1998 January 1999	Modest Largest

Table 21. Volatility Spikes in Equity Prices: Transition Economies
 Bollerslev and Woolridge GARCH (1,1) Models

Country	Dates of volatility spikes	Comments
Transition Economies		
Czech Republic	June 1997 Late October-December 1997 July-October 1998 January 1999 May-June 1999	Moderate Modest Largest Large Large
Hungary	Late October-December 1997 May-June 1998 August-October 1998 January 1999	Largest Modest Large Moderate
Poland	Late October-November 1997 August-October 1998 January 1999	Large Largest, most persistent Moderate
Russia	Late October-November 1997 June-October 1998 February 1999 May-June 1999	Large Largest, most persistent Modest Modest
Ukraine		

Table 22. The Markets and the Regions Affected: Summary of Findings

	Overnight Money Market	Foreign Exchange Market	Bond Market	Equity Market
July 2, 1997: The devaluation of the Thai baht	Rates increase, higher volatility in Asia	Large depreciations and higher volatility in Asia	Widening spreads in Asia	Falling markets, persistent high volatility in Asia , some decline in Latin American markets
October 28, 1997: Stock Market Crash	No effects	No effects	No effects	Large declines, all regions except Latin America —short lived volatility spike
July 6, 1998: Salomon Brothers disbands bond arbitrage desk	No effects	No effects	No effects	No effects
July 20, 1998: The first WSJ headline on LTCM	No effects	No effects	No effects	No effects
August 17, 1998: The Russian devaluation and default	Interest rates rise in transition economies and Latin America	Devaluations and high volatility in transition economies and higher volatility Latin America	Spreads widen markedly in all regions , particularly Latin America	Large declines in equity prices in all regions , very high and persistent volatility
September 1, 1998: Malaysia Imposes Capital Controls September 2, 1998: LTCM Shareholder letter issued	Further increases in rates in Latin America	Large depreciations and volatility in transition economies	Spreads remain wide and volatile	Markets continue to decline, especially in Europe and G7 very high and persistent volatility
September 23, 1998: LTCM Recapitalization	Rates begin to come down in Latin America	No effect	Spreads remain wide and volatile but begin to narrow in Asia and Latin America	Markets continue to decline in Europe and G7 , and transition economies very high and persistent volatility Asia and Latin America begin to recover

January 13, 1999: Brazil devalues the real	No effects	No effects	No effects	Brief volatility spike in Latin America , Brazil stages a rally
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Appendix Table 1
The October 28, 1997 Stock Market Crash
(In percent, unless otherwise noted)

Changes in Overnight Interest Rates				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	-1.66	0	2.43	-1.16
Europe	0	-0.06	5.97	-0.68
G-7	0.01	-0.02	0.08	-0.06
Latin America	0.66	-0.74	10.63	-0.6
Transition Economies	1.61	-2.01	-0.08	3.13
Exchange Rate Changes				
Asia	0.34	0.52	-2.4	0.55
Europe	0	0.4	0.34	0.22
G-7	-0.22	-0.12	-0.07	0.12
Latin America	-0.05	0.13	-0.09	0.47
Transition Economies	0.15	-0.34	-0.29	0.13
Changes in Stock Prices				
Asia	-7.87	4.96	6.08	-4.38
Europe	-4.92	3.93	0.12	-3.87
G-7	-2.44	3.5	0.12	-2.25
Latin America	3.47	-0.7	1.93	-6.98
Transition Economies	-10.55	8.4	-1.84	-11.07
Changes in Bond Spreads (in basis points)				
Asia	-14.71	18.87	0.16	26.98
Europe	-9.97	28.01	0.35	9.82
G-7	-9.97	7.99	1.79	-0.07
Latin America	37.05	70.77	-17.12	45.81
Transition Economies	6.4	43.41	46.89	49.32

Appendix Table 2
 Salomon Brothers disbands bond arbitrage desk, July 6, 1998
 (In percent, unless otherwise noted)

Changes in Overnight Interest Rates				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	0.26	-1.27	-0.28	-0.74
Europe	0.27	-0.15	0.2	-0.25
G-7	0.04	-0.02	0.06	0.07
Latin America				
Transition Economies	6.23	-0.72	18.08	-16.64
Exchange Rate Changes				
Asia	0.02	-0.1	-0.83	-0.81
Europe	-0.01	-0.04	0.07	0.03
G-7	0.14	-0.14	0.17	-0.07
Latin America	-0.11	0.17	0.03	0.05
Transition Economies	-0.11	0.15	-0.28	-0.93
Changes in Stock Prices				
Asia	-0.38	0.49	-4.38	5.86
Europe	0.3	0.42	0.99	0.82
G-7	0.3	0.42	0.99	0.82
Latin America	-0.34	1.32	2.59	1.39
Transition Economies	-0.16	-2.48	8.34	6.38
Changes in Bond Spreads (in basis points)				
Asia	1.42	-8.14	-4.51	11.67
Europe	0.65	-2.33	-4.69	-2.3
G-7	1.58	-0.44	-1.6	4.19
Latin America	32.84	-6.03	-59.7	-22.85
Transition Economies	39.71	0.65	-95.45	-27.97

Appendix Table 3
The first WSJ headline on LTCM, July 20, 1998
(In percent, unless otherwise noted)

Changes in Overnight Interest Rates				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	-0.35	-0.33	0.37	-0.46
Europe	-0.3	0.07	-0.04	0.21
G-7	-0.01	0.08	-0.02	0.02
Latin America	0.09	-0.03	0.35	-0.74
Transition Economies	3.95	3.53	-7.92	-1.25
Exchange Rate Changes				
Asia	0.91	-0.21	0.08	-1.2
Europe	-0.04	0.11	-0.02	0.41
G-7	-0.13	0.25	0.24	0.66
Latin America	-0.02	0.14	0.03	0.25
Transition Economies	-0.38	-0.29	0.08	-0.2
Changes in Stock Prices				
Asia	1.23	-0.9	-5.08	-3.42
Europe	0.5	-0.33	-2.9	-1.44
G-7	0.16	-0.67	-3.59	-1.65
Latin America	-0.39	-0.76	-2.14	-2.77
Transition Economies		-0.26	-3.79	-1.48
Changes in Bond Spreads (in basis points)				
Asia	-2.25	1.36	-5.3	1.87
Europe	1.01	0.4	3.39	-4.61
G-7	1.17	0.78	-2.9	2.23
Latin America	-10.52	6.49	40.51	17.71
Transition Economies	6.94	4.14	9.46	7.68

Appendix Table 4
The Brazilian devaluation of the real, January 13, 1999
(In percent, unless otherwise noted)

Changes in Overnight Interest Rates				
Regional Averages ¹	t-1 to t	t to t+1	t+1 to t+7	t+7 to t+14
Asia	0.19	-1.32	0.49	0.29
Europe	-0.01	-0.01	-0.08	0.03
G-7	-0.06	0.02	-0.09	0.06
Latin America	1.23	-0.25	2.18	-1.2
Transition Economies	0.47	-0.73	0.47	0.07
Exchange Rate Changes				
Asia	1.18	0.91	-1.28	1.75
Europe	0.6	0.16	-0.53	-0.31
G-7	-0.1	0.07	0.06	0.42
Latin America	2.54	0.18	2.05	3.6
Transition Economies	-0.27	0.16	0.47	1.05
Changes in Stock Prices				
Asia	-1.75	-2.11	1.84	-4.04
Europe	-5.73	2.11	3.92	-1.27
G-7	-246	-0.2	3.48	-1.61
Latin America	-5.32	-3.24	12.87	0.43
Transition Economies	-4.46	-3.52	4.12	-0.12
Changes in Bond Spreads (in basis points)				
Asia	25.57	9.25	-43.98	25.02
Europe	6.41	6.85	-2.25	0.72
G-7	1.55	1.6	-4.49	4.4
Latin America	208.26	78.67	-285.23	183.3
Transition Economies	149.4	-30.38	-92.11	4.25

Data Appendix

Stock Market Indices

Country	Index	Source
Argentina:	Merval Index (local currency)	BLOOMBERG
Brazil:	IBOV Index (local currency)	BLOOMBERG
Canada:	TS300 Index (local currency)	BLOOMBERG
Chile:	IPSA index (local currency)	BLOOMBERG
Colombia:	COSMIBB Index (local currency)	BLOOMBERG
Czech Republic:	PX50L Index (local currency)	BLOOMBERG
Estonia:	TALSE Index (local currency)	DOW JONES ONLINE
Finland:	HEX Index (local currency)	BLOOMBERG
France:	SBF250 Index (local currency)	BLOOMBERG
Germany:	DAXI Index (local currency)	BLOOMBERG
Greece:	ASE Index (local currency)	BLOOMBERG
Holland:	AEX Index (local currency)	BLOOMBERG
Hong Kong:	HKAOI Index (local currency)	BLOOMBERG
Hungary:	BUX Index (local currency)	BLOOMBERG
Indonesia:	JCI Index (local currency)	BLOOMBERG
Italy:	MIB30 Index (local currency)	BLOOMBERG
Japan:	TPX Index (local currency)	BLOOMBERG
Korea:	KOSPI Index (balanced) (local currency)	BLOOMBERG
Malaysia:	KLCI Index (local currency)	BLOOMBERG
Mexico:	MEXBOL Index (local currency)	BLOOMBERG
Norway:	OBX Index (local currency)	BLOOMBERG
Peru:	ISBVL Index (local currency)	BLOOMBERG
Philippines:	PCOMP Index (local currency)	BLOOMBERG
Poland:	PWSMWIG Index (local currency)	BLOOMBERG
Russia:	ASPGEN Index (local currency)	BLOOMBERG
Singapore:	STI Index (local currency)	BLOOMBERG
Spain:	MADX Index (local currency)	BLOOMBERG
Sweden:	GENX Index (local currency)	BLOOMBERG
Thailand:	SET Index (local currency)	BLOOMBERG
Turkey:	TKSMSCOMP Index (local currency)	BLOOMBERG
UK:	IBVC Index (local)	BLOOMBERG
Ukraine:	PFTSOTC Index (local currency)	BLOOMBERG
USA:	SPX Index (local currency)	BLOOMBERG
Venezuela:	IBVC Index (local currency)	BLOOMBERG

Data Appendix

Overnight Interest Rates

Country	Interest rate description	Source
Argentina	ARLBP1 Index: Buenos Aires Interbank Offer rate	Bloomberg
Brazil	BROVERN Code: Brazil Financing Overnight - Middle Rate	Datastream
Canada	CCLR Index: Canadian Call Loan rate	Bloomberg
Chile	CLREP1D Code: Chile Repo 1 Day- Middle Rate	Datastream
Colombia	CBIBKON Code: Colombian Interbank Overnight- Middle Rate	Datastream
Czech Repu.	PRIBOVN Index: Czech Interbank Rates, Overnight	Bloomberg
Estonia	ETONO/N: Estonian interbank O/N rate	Bloomberg
Finland	FNIWAON Code: Finland Interbank W/A Overnight- MiddleRate	Datastream
France	TMP Index: Taux Moyen Pondere	Bloomberg
Germany	FD00ON Index: Fibor DEM Zka 11 A.m fixing	Bloomberg
Greece	GIBOON Index: Greech Drachma Interbank Deposit	Bloomberg
Holland	DGCMR Index: Netherlands Overnight Call Rate : EURO:	Bloomberg
Hong kong	HIBRON Index: Hong Kong Dollar Interbank , Overnight	Bloomberg
Hungary	HFDRO/N Index: Hungarian Forint depo Rates Overnight	Bloomberg
Indonesia	JINON Index: JAKARTA interbank Offering rate	Bloomberg
Italy	RIBORMON Index: Rome Interbank Offer Rate	Bloomberg
Japan	JYMU1T Curncy: JPY MUTAN CALL : 1DY	Bloomberg
Korea	KWCR1T Curncy: KRW CALL RATE: Overnight	Bloomberg
Malaysia	KLIMON Index: Klibor Interbank Offer Rate, Overnight	Bloomberg
Mexico	MXRPRP1 Index: Mexican Governemnt Paper Rate (Overnight)	Bloomberg
Norway	NOBRON Index: Norway Overnight Lending Rate	Bloomberg
Peru	PSDR1T Curncy: PEN DEPOSIT 1DY Peru New Sol	Bloomberg
Philippines	PPCALL Index: Philippine Peso Interbank	Bloomberg
Poland	WIBOTN: Warsaw Interbank Offer/Bid Rate	Bloomberg
Russia	RSBIBK Code: Russian Interbank 1 day- Middle Rate	Datastream
Singapore	SISDON Index: Singapore Dollar Interbank , Overnight	Bloomberg
Spain	ESMIBON Code: SPAIN Interbank Overnight_ Middle Rate	Datastream
Sweden	SIBORTN Code: Sweden Interbank Tomorrow/Next	Datastream
Thailand	BITBON Index: Bangkok Interbank Offer Rate	Bloomberg
Turkey	TUIBON Index: Turkish Interbank Rates , Overnight	Bloomberg
UK	BPODR Index: British Pound Overnight Deposit	Bloomberg
Ukraine	UIBRON Index: UKRAINE Average interbank overnight	Bloomberg
USA	FEDL01 Index: Federal Funds Effective Rate	Bloomberg

Data Appendix

Exchange Rates

Country	Description	Source
Argentina	Local currency/US\$	Bloomberg
Brazil	Local Currency/US\$	Bloomberg
Canada	Local Currency/US\$	Bloomberg
Chile	Local Currency/US\$	Bloomberg
Colombia	Local Currency/US\$	Bloomberg
Czech Republic	Local Currency/US\$	Bloomberg
Estonia	Local currency/DM	Bloomberg
Finland	Local currency/DM	Bloomberg
France	Local currency/DM	Bloomberg
Germany	Local Currency/US\$	Bloomberg
Greece	Local currency/DM	Bloomberg
Holland	Local currency/DM	Bloomberg
Hong kong	Local Currency/US\$	Bloomberg
Hungary	Local Currency/US\$	Bloomberg
Indonesia	Local Currency/US\$	Bloomberg
Italy	Local currency/DM	Bloomberg
Japan	Local Currency/US\$	Bloomberg
Korea	Local Currency/US\$	Bloomberg
Malaysia	Local Currency/US\$	Bloomberg
Mexico	Local Currency/US\$	Bloomberg
Norway	Local currency/DM	Bloomberg
Peru	Local Currency/US\$	Bloomberg
Philippines	Local Currency/US\$	Bloomberg
Poland	Local Currency/US\$	Bloomberg
Russia	Local Currency/US\$	Bloomberg
Singapore	Local Currency/US\$	Bloomberg
Spain	Local currency/DM	Bloomberg
Sweden	Local currency/DM	Bloomberg
Thailand	Local Currency/US\$	Bloomberg
Turkey	Local currency/DM	Bloomberg
UK	Local Currency/US\$	Bloomberg
Ukraine	Local Currency/US\$	Bloomberg
Venezuela	Local Currency/US\$	Bloomberg

Data Appendix

SPREADS

Table 1: Description of government bonds

Government Bond	Coupon Rate	Currency	Maturity Date	Security Type	Source
Argentina	6.8125	USD	03/31/2005	EMERGING MARKETS	Bloomberg
Brazil	7	USD	04/15/2009	EMERGING MARKETS	Bloomberg
Bulgaria	6.5	USD	07/28/2011	EMERGING MARKETS	Bloomberg
Canada					FED
Chile	6.875	USD	04/28/09	GLOBAL	Bloomberg
Colombia	7.25	USD	02/23/04	YANKEE	Bloomberg
Finland	5.875	USD	02/27/06	GLOBAL	Bloomberg
France					FED
Germany					FED
Greece	6.75	DM	11/13/2006	EURO MTN	Bloomberg
Holland	6.5	EUR	04/15/2003	N-US,INTRNAL DOM	Bloomberg
Hungary	6.5	USD	04/08/2003	EURO-DOLLAR	Bloomberg
Indonesia	7.75	USD	08/01/2006	YANKEE	Bloomberg
Italy	11.5	EUR	03/01/2003	N-US,INTRNAL DOM	Bloomberg
JAPAN					FED
Korea	8.875	USD	04/15/2008	GLOBAL	Bloomberg
Malaysia	8.75	USD	06/01/09	GLOBAL	Bloomberg
Mexico	6.0675	USD	12/31/2019	EMERGING MARKETS	Bloomberg
Norway	8.375	CAD	01/27/03	EURO NON-DOLLAR	Bloomberg
Peru	3.75	USD	03/07/2017	EMERGING MARKETS	Bloomberg
Philippines	6	USD	06/01/2008	EMERGING MARKETS	Bloomberg
Poland	4	USD	10/27/2024	EMERGING MARKETS	Bloomberg
Russia	9.25	USD	11/27/2001	EURO-DOLLAR	Bloomberg
Spain	10.5	EUR	10/30/2003	N-US,INTRNAL DOM	Bloomberg
Sweden	5.75	USD	03/26/2001	EURO MTN	Bloomberg
Thailand	7.75	USD	04/15/07	YANKEE	Bloomberg
Turkey	10	USD	05/23/2002	EURO-DOLLAR	Bloomberg
UK					FED
USA	5.875	USD	11/15/2005	US GOVERNMENT	Bloomberg
Venezuela	6.875	USD	03/31/2007	EMERGING MARKETS	Bloomberg

Data Appendix **SPREADS**

Table 2: Description of corporate Bonds

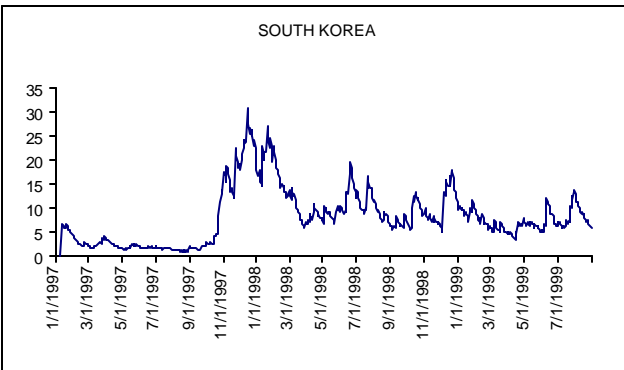
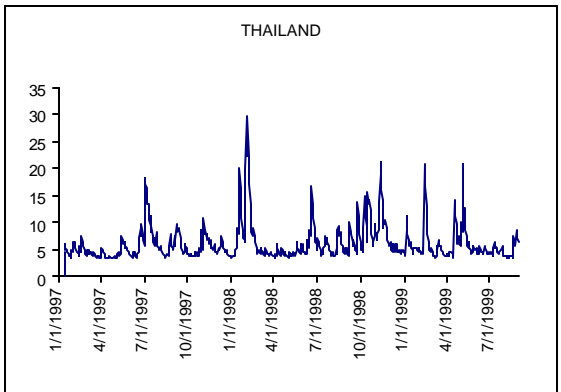
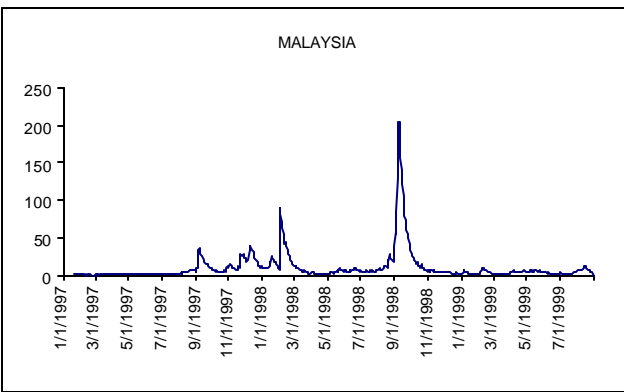
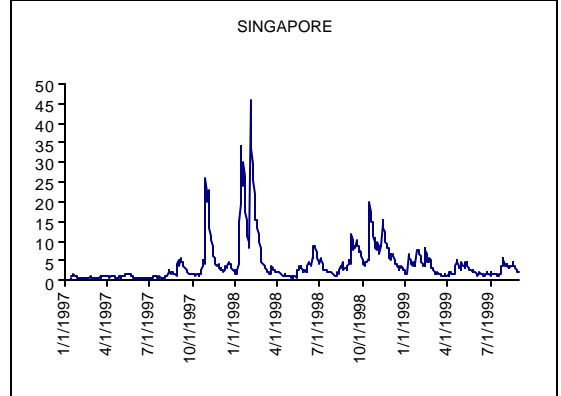
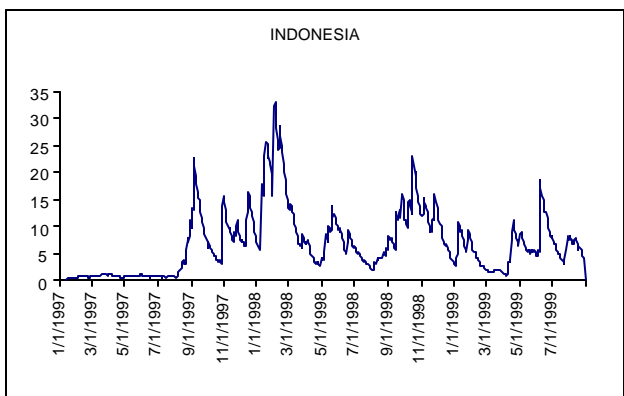
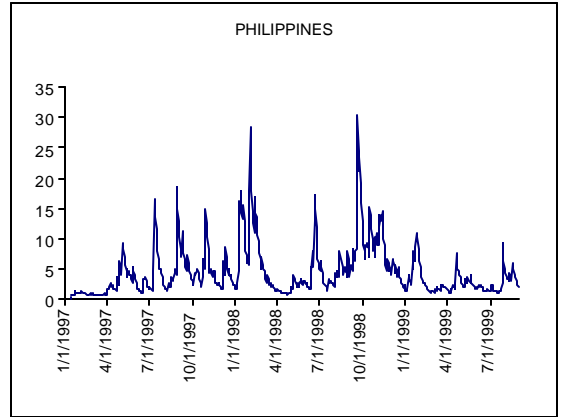
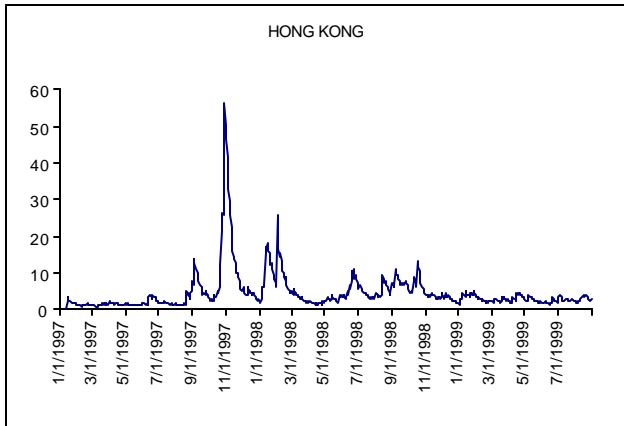
Source	Bonds Name	Currency	Bonds Description
CANADA	FED Data	CAD	AA corporate- 10 year maturity
France	FED Data	FF	AA Corporate- 10 year maturity
Germany	FED Data	DM	Mortgage backed- 10 year maturity
ITALY	Bloomberg ELFV2A10 Index	ITL	Euro Lira Fair Value AA 10 Yea
UK	Fed data	UKP	AA Corporate- 10 year maturity
USA	Bloomberg C6A0 12/72 U.S. Corporates, 5-10 Yrs	US	Index C6A0 ORIGINAL SERIES MLyr
SPAIN	Bloomberg EPFV2A10 Index	ESP	Euro Peseta Fair Value AA 10 Y

Table 3: Construction of spreads:

Given availability of data, spreads were either constructed with respect to corporate bond or with respect to government bond (US or German). Here is a breakdown of spreads used

Countries	Spread Construction
Greece	Spread between Greek government bond and German government bond (DM)
Canada, France, Germany, Italy, UK, USA, Spain	Spread between local government bonds and respective corporate bonds (local currency)
All other countries in the sample	Spread between local government bonds and US government bond (US\$)

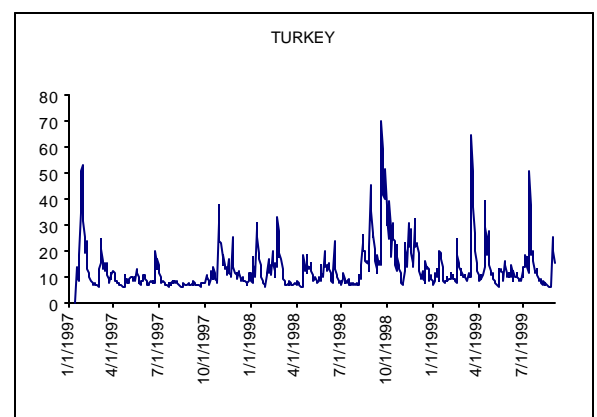
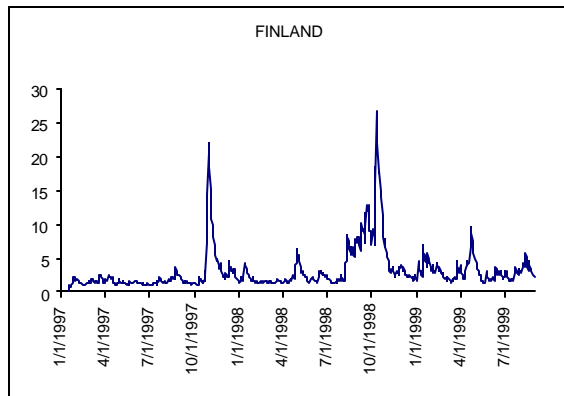
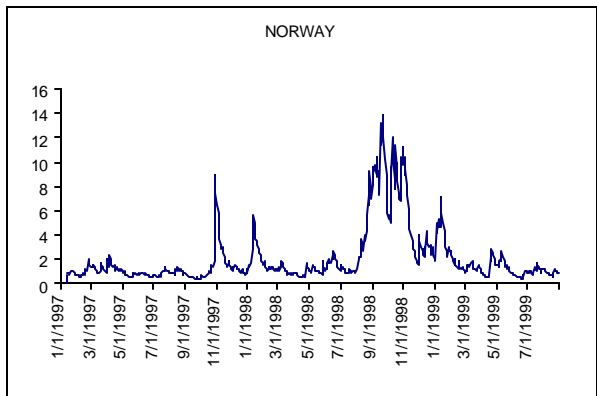
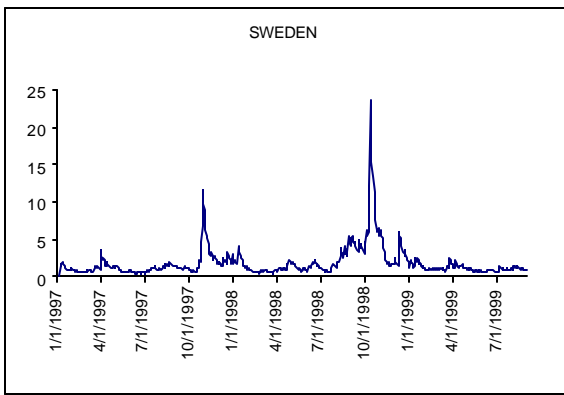
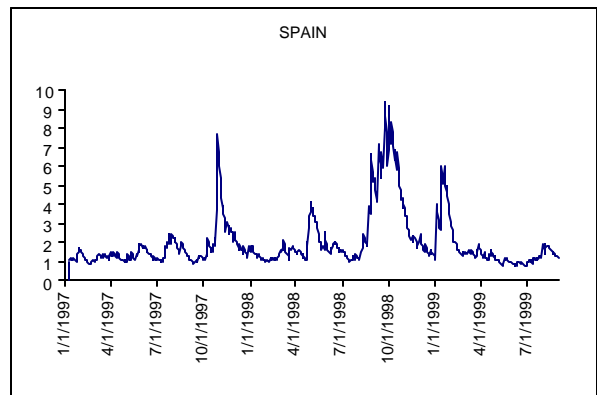
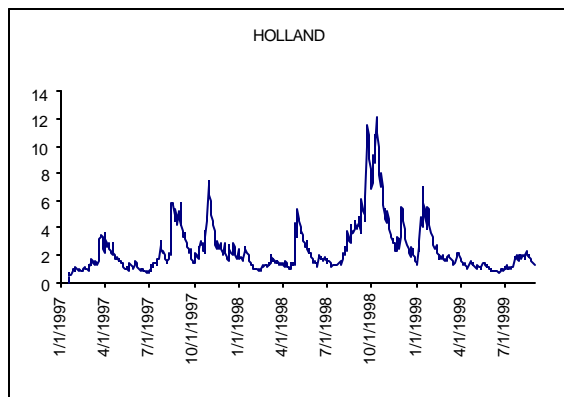
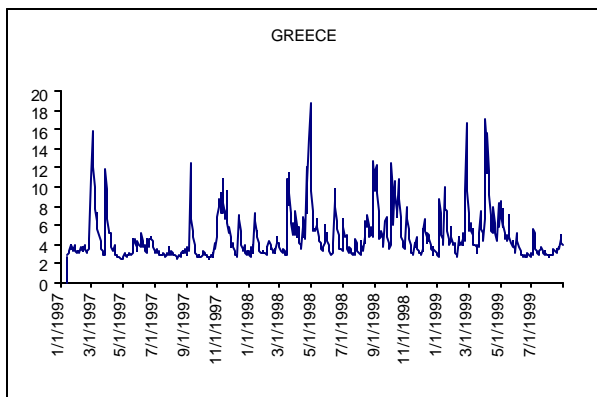
Conditional Volatility of Stock Market Returns Asia



Note:

Daily stock market returns are in % terms

Conditional Volatility of Stock Market Returns Europe

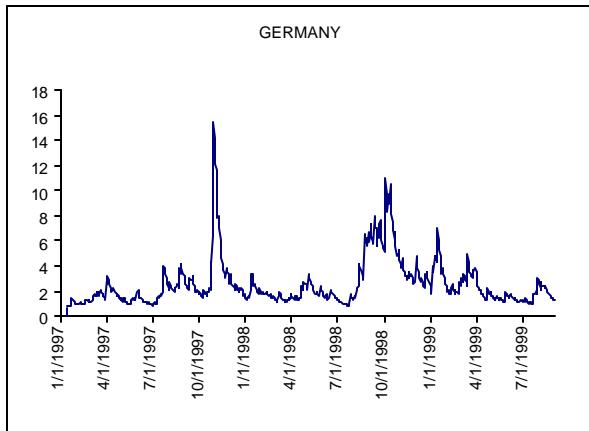
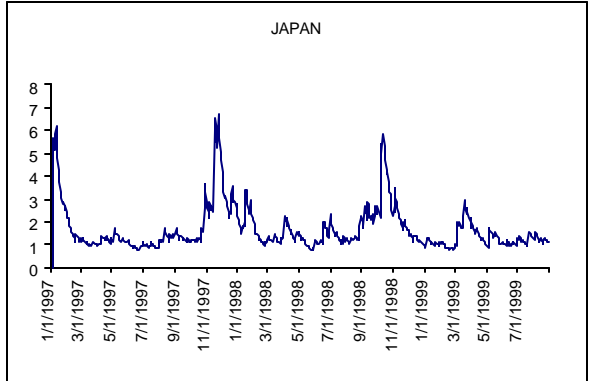
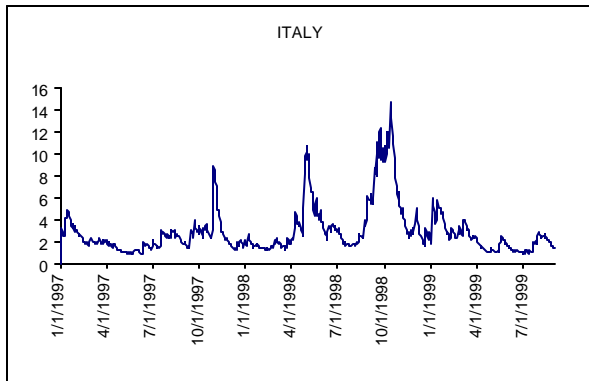
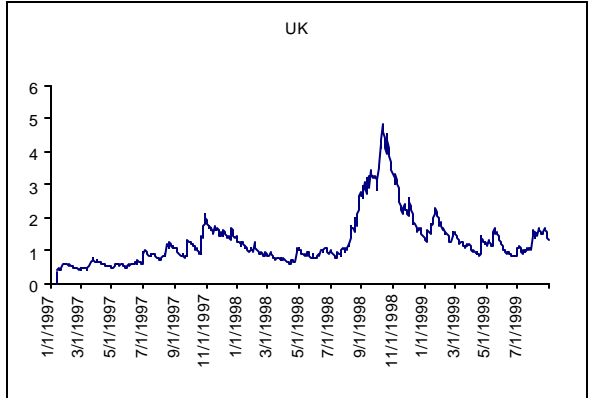
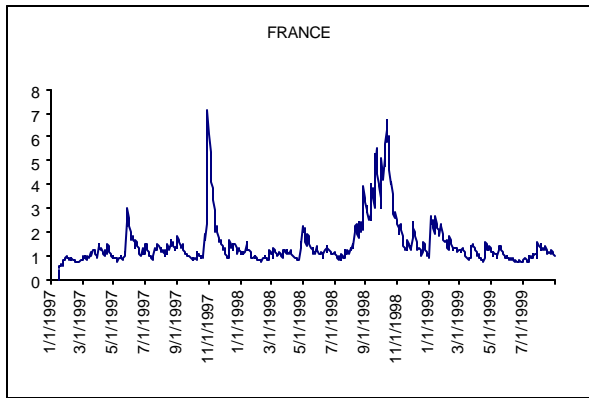
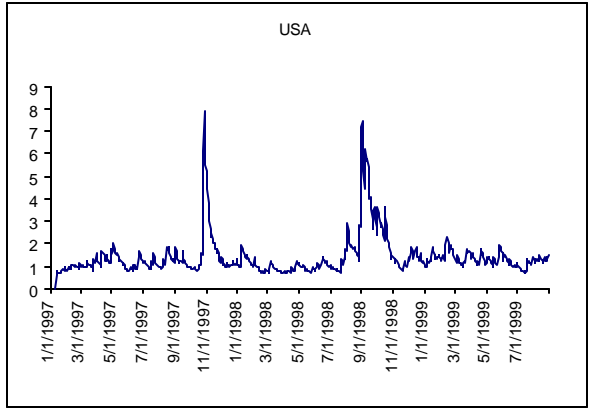
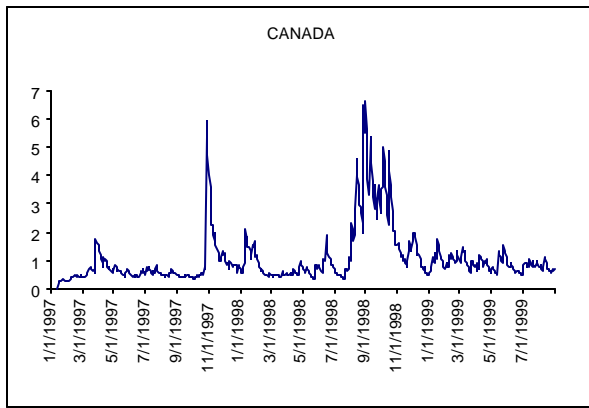


Note:

Daily stock market returns are in % terms

Conditional Volatility of Stock Market Returns

G-7



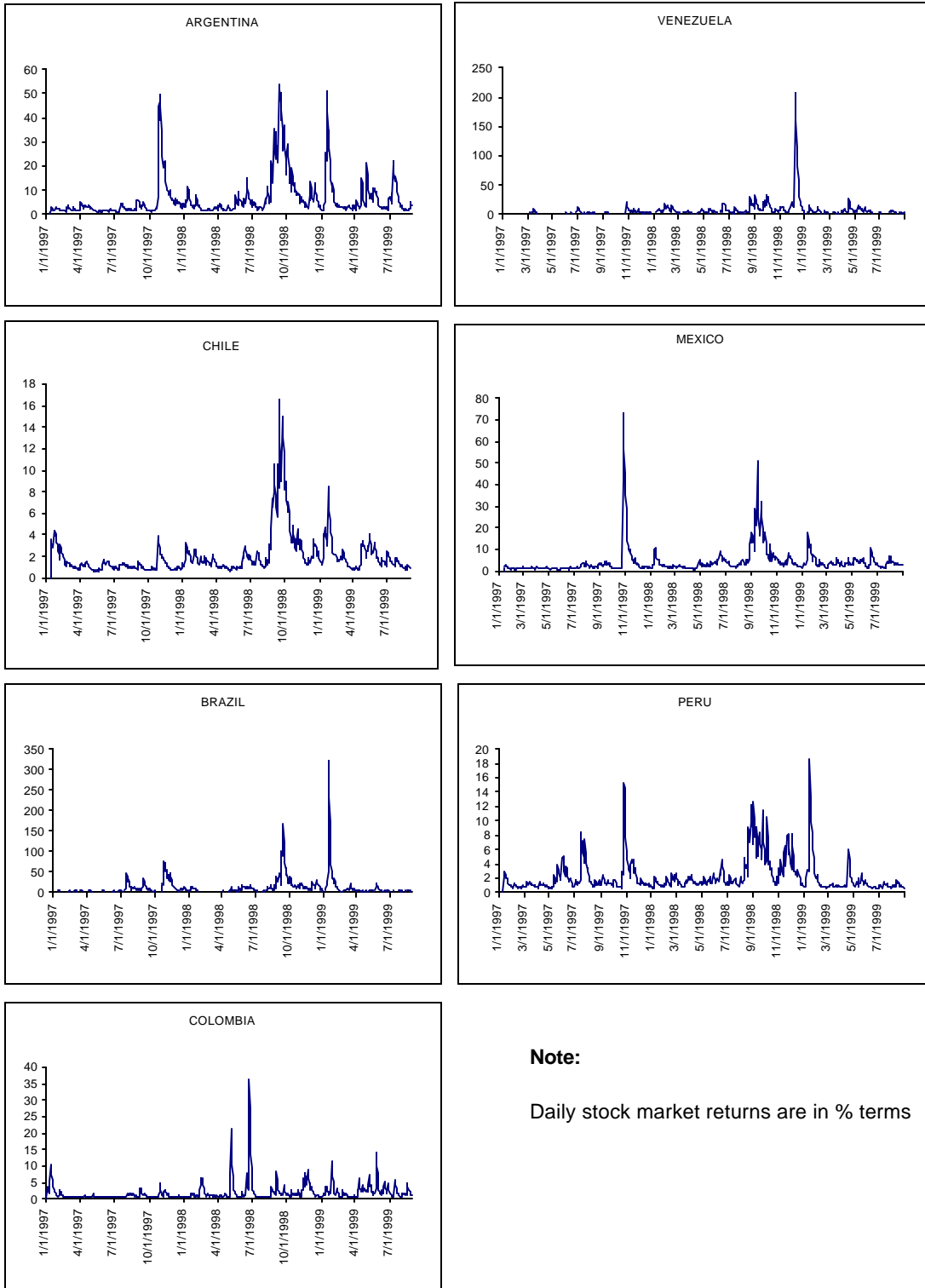
Note:

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Appendix : Figure 4

Conditional Volatility of Stock Market Returns

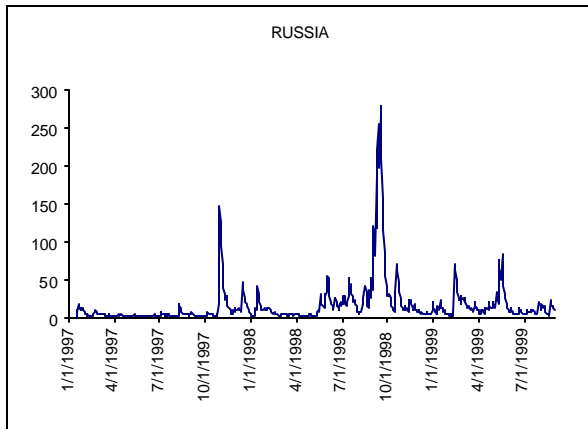
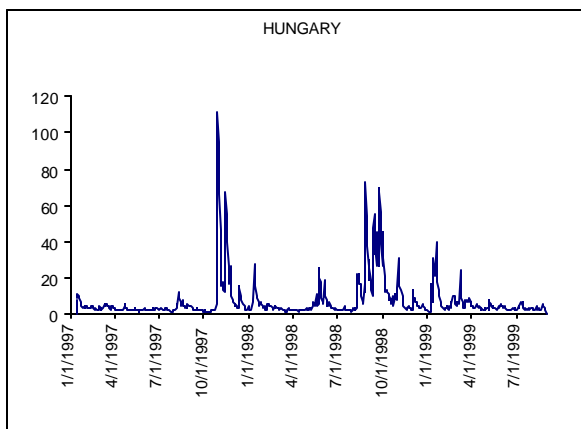
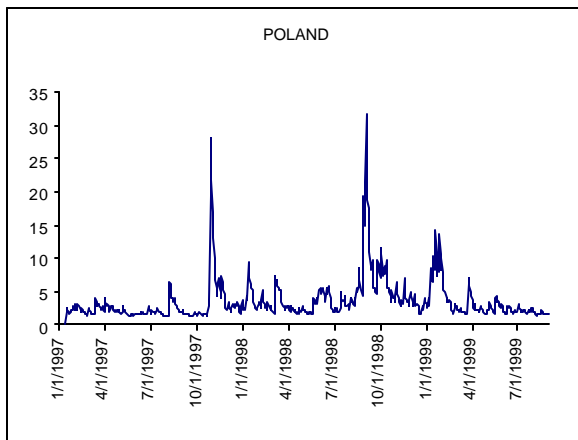
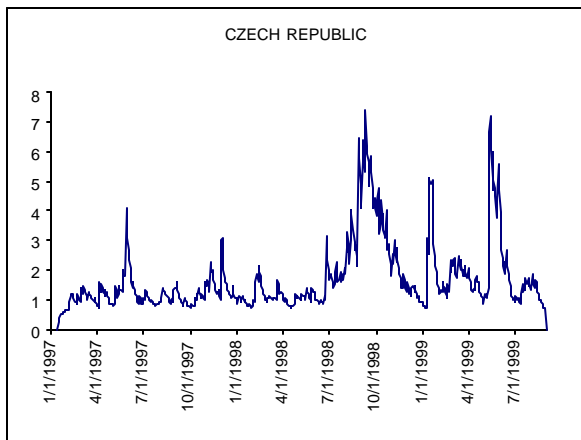
Latin America



Note:

Daily stock market returns are in % terms

Conditional Volatility of Stock Market Returns Transition Economies



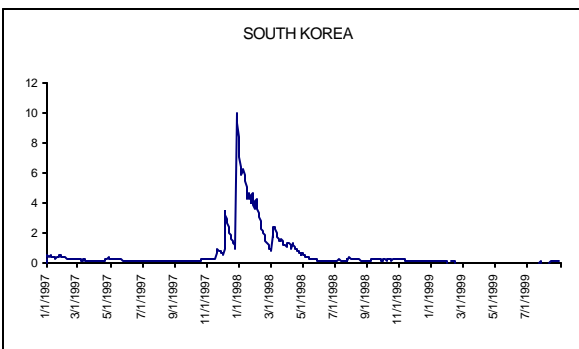
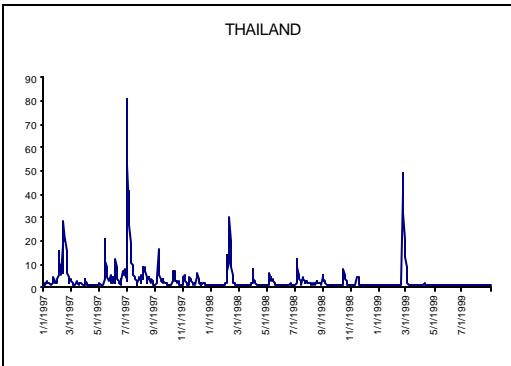
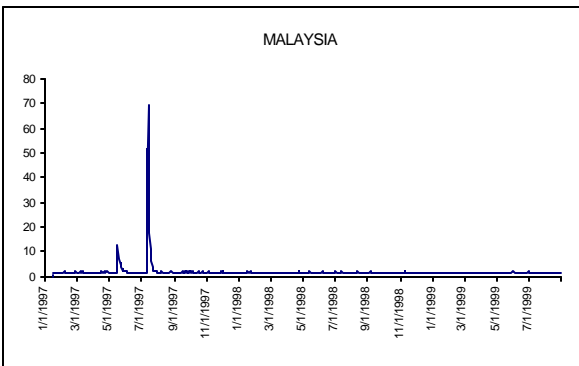
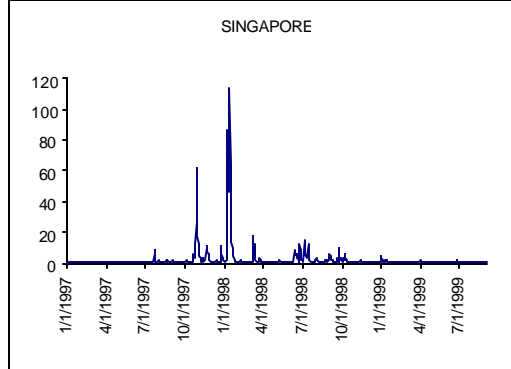
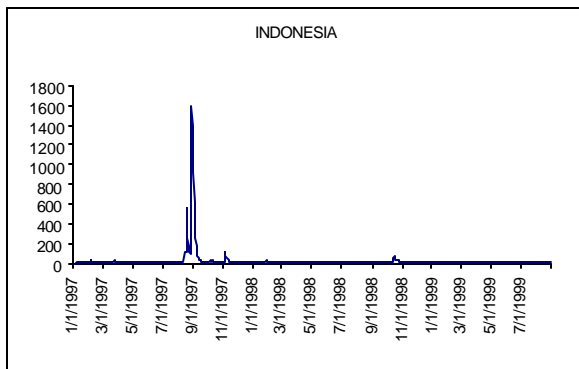
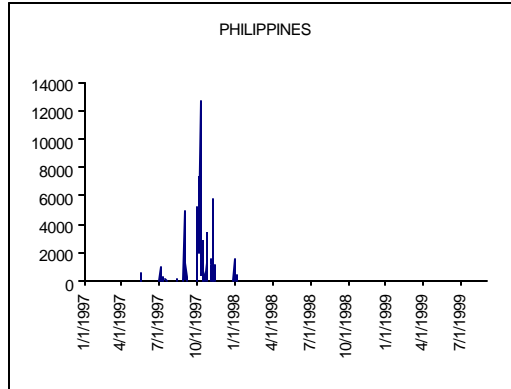
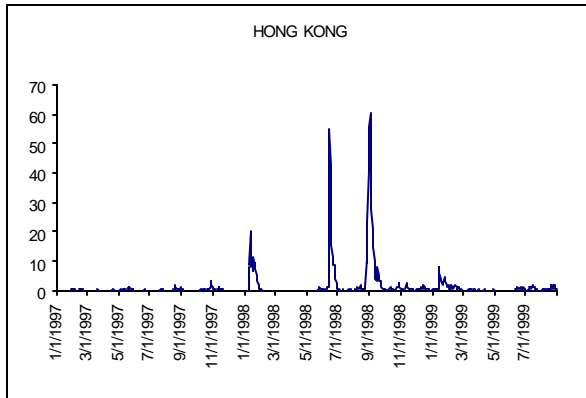
Note:

Daily stock market returns are in % terms

Appendix : Figure 1

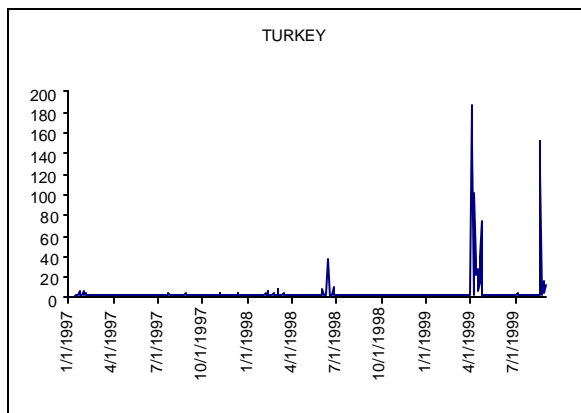
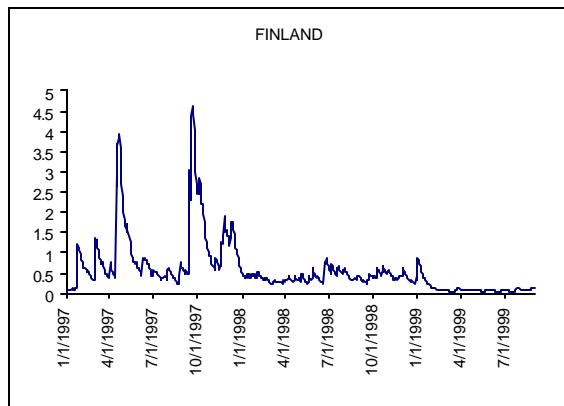
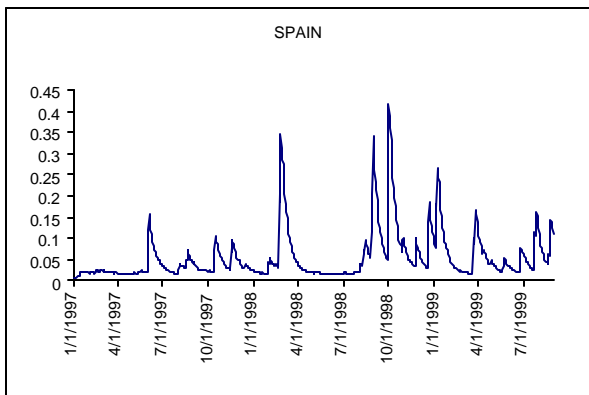
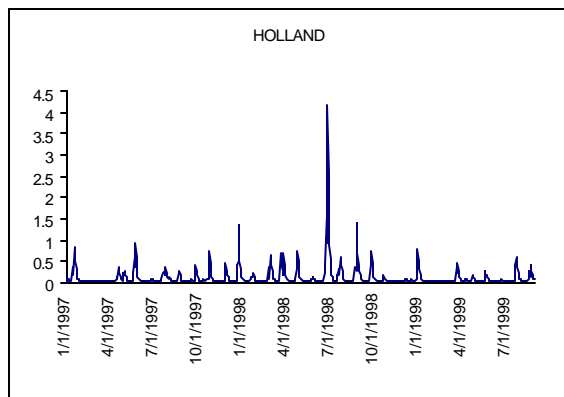
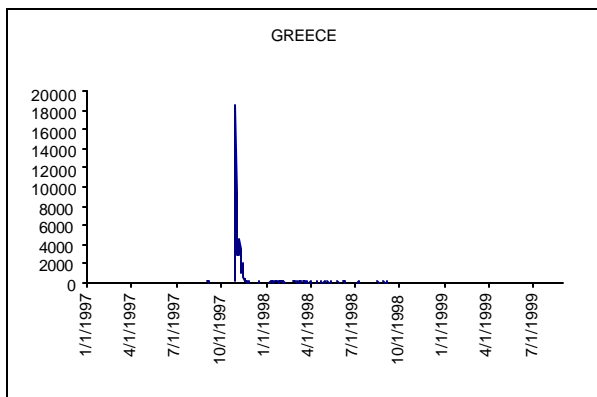
Conditional Volatility of Interest Rates

Asia



Note:
Daily interest rates are in % terms

Conditional Volatility of Interest Rates Europe

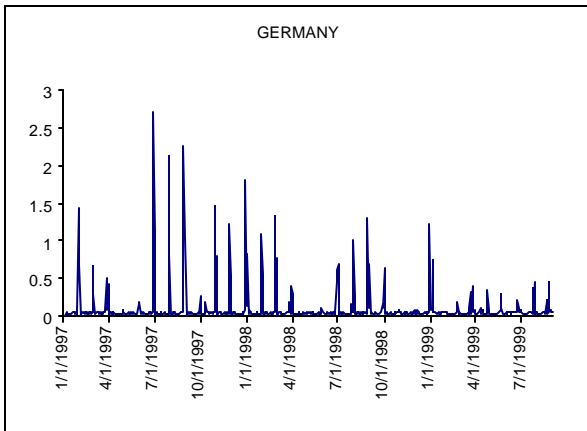
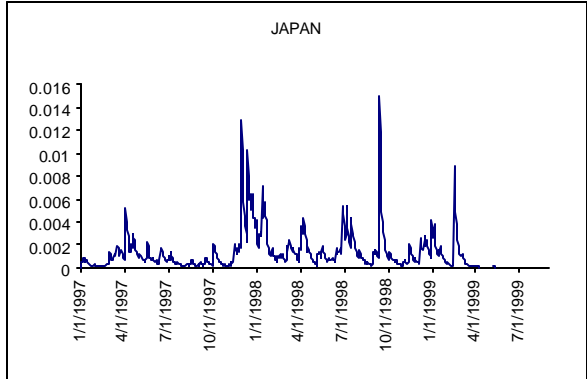
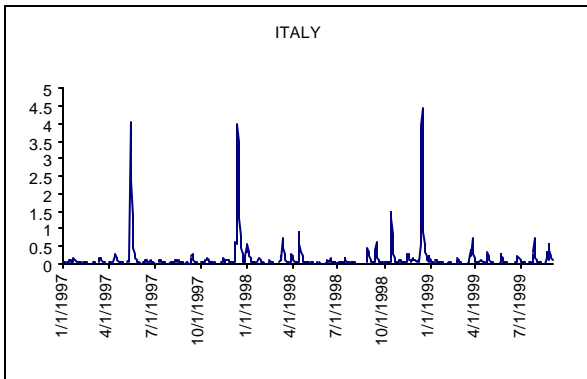
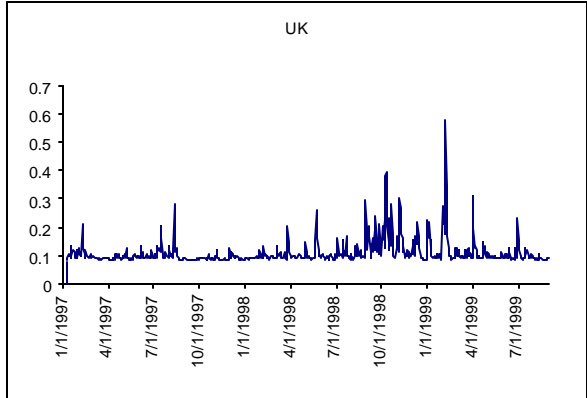
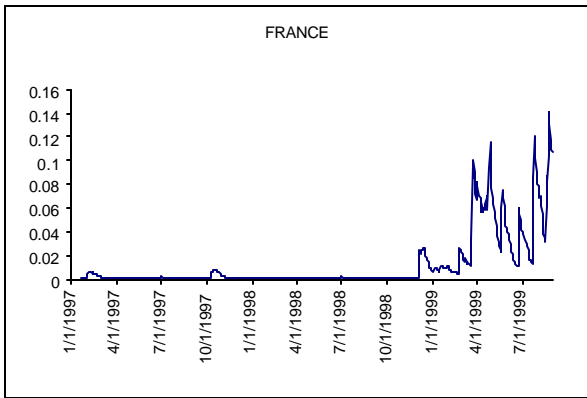
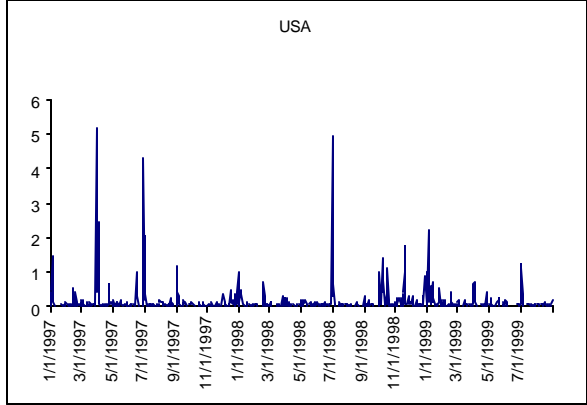
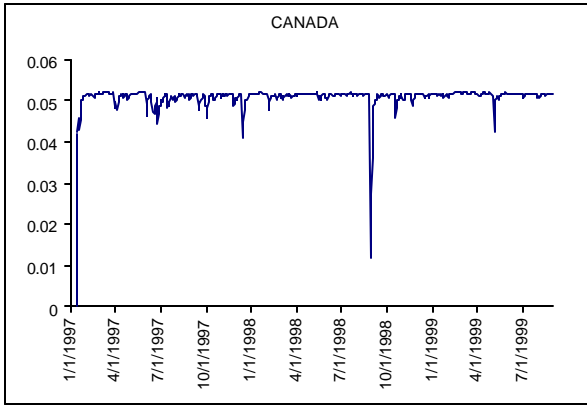


Note:

Daily interest rates are in % terms

Conditional Volatility of Interest Rates

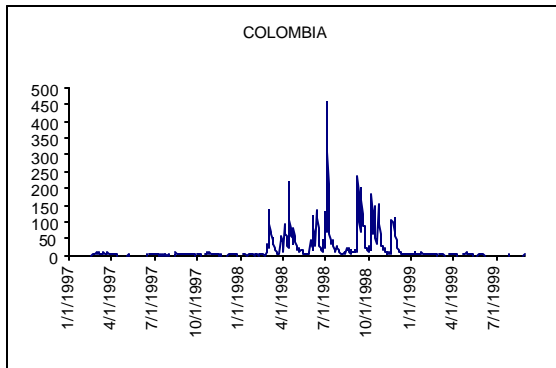
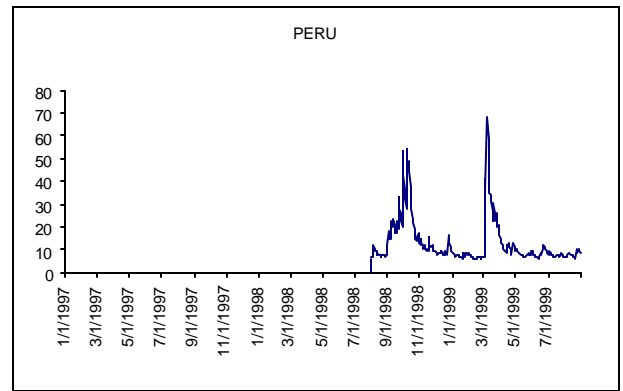
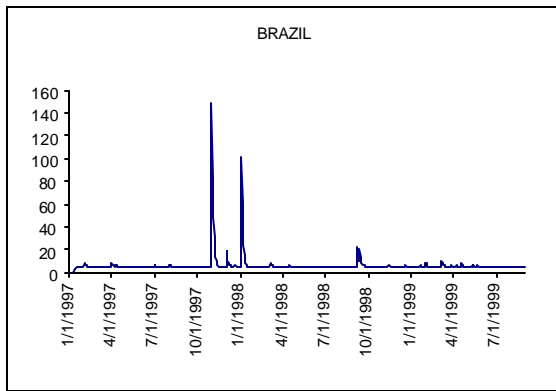
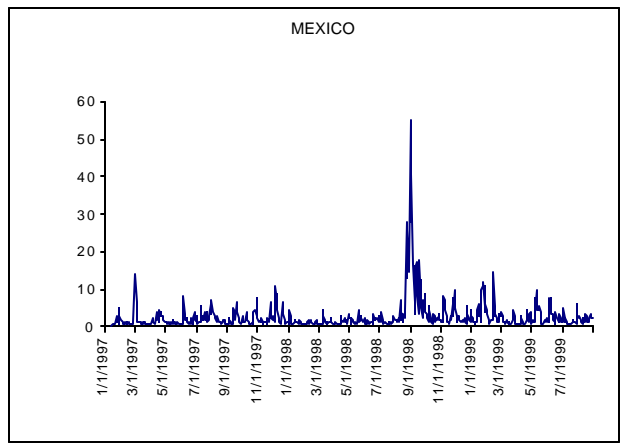
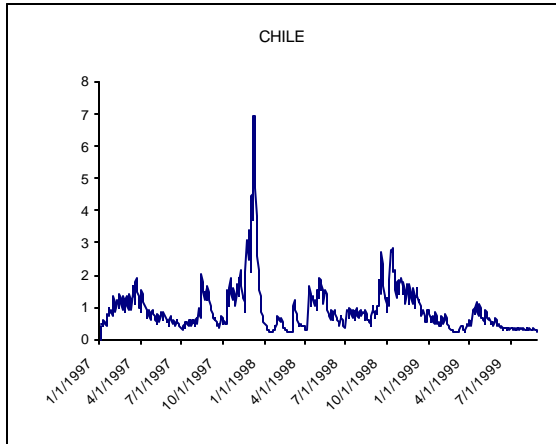
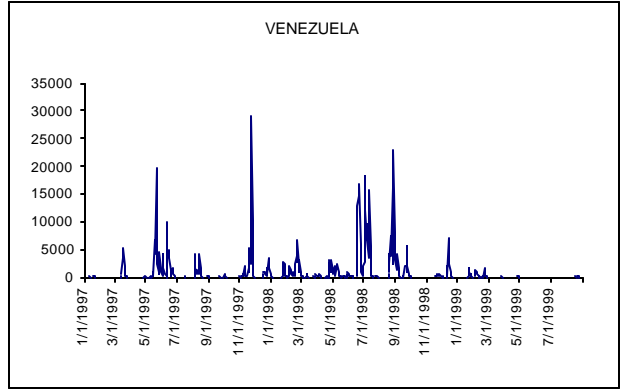
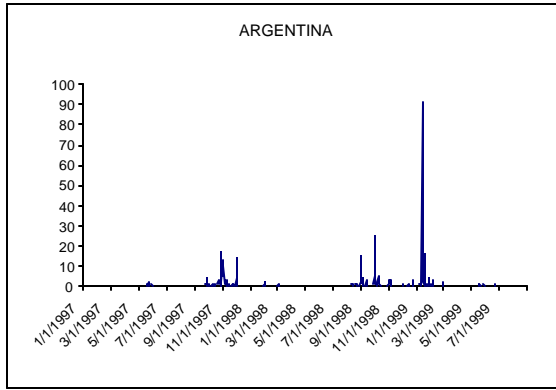
G-7



Note:

Daily interest rates are in % terms

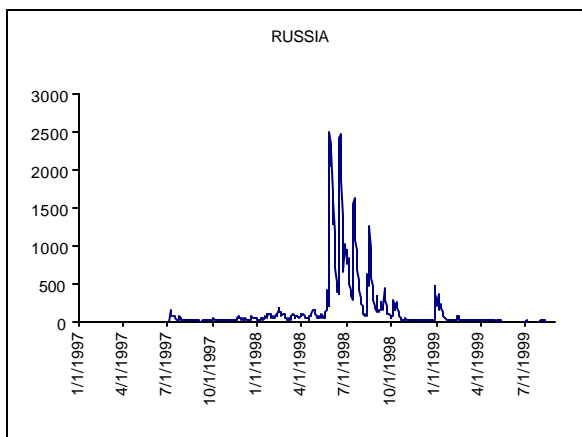
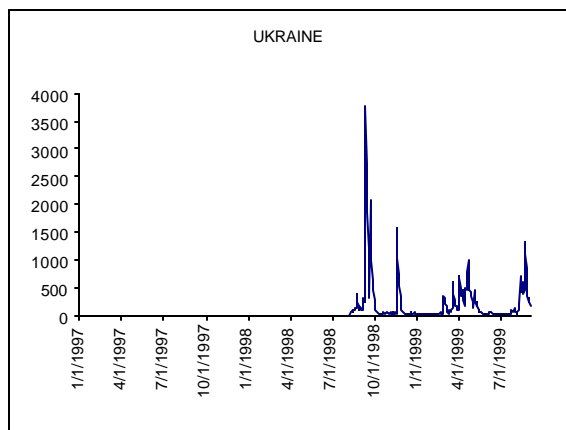
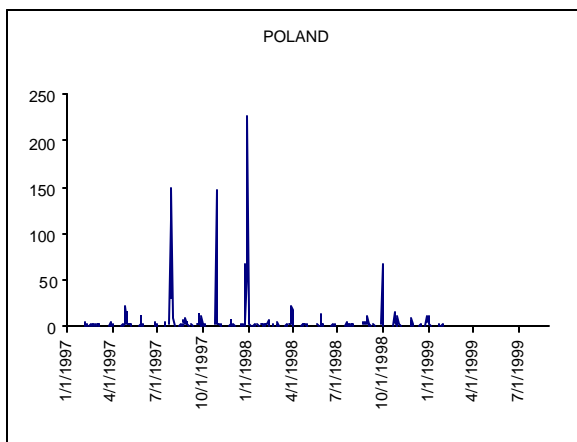
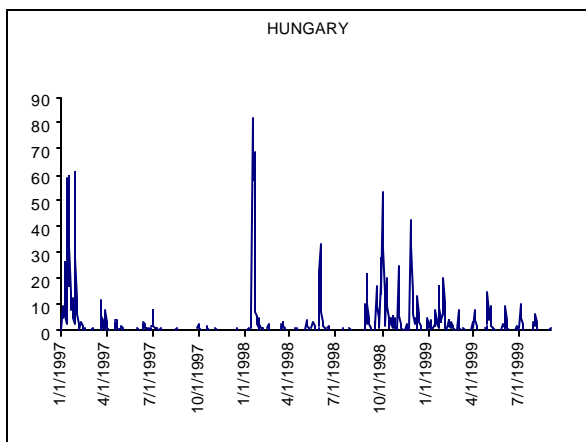
Conditional Volatility of Interest Rates Latin America



Note:

Daily interest rates are in % terms

Conditional Volatility of Interest Rates Transition Economies

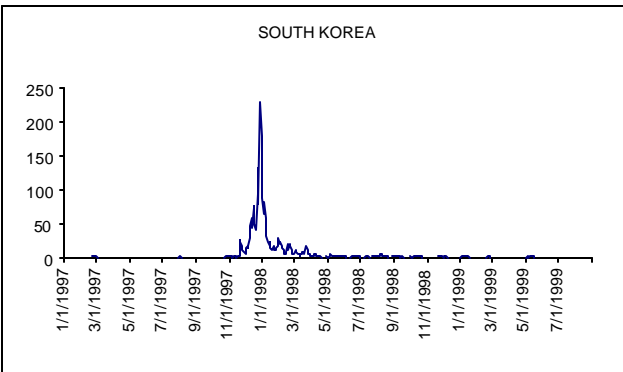
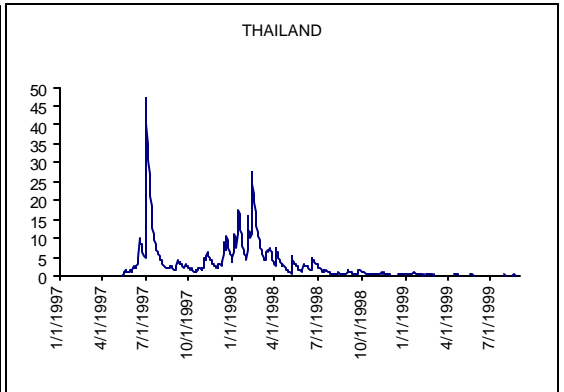
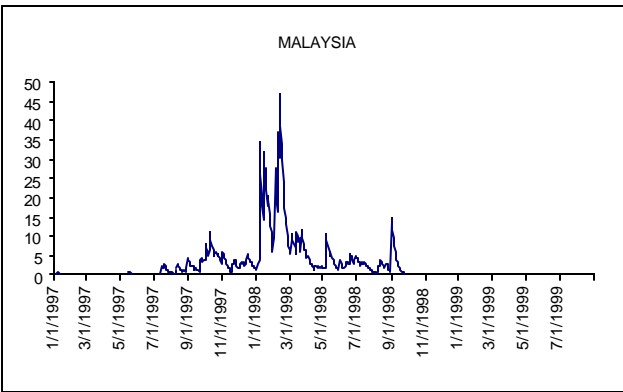
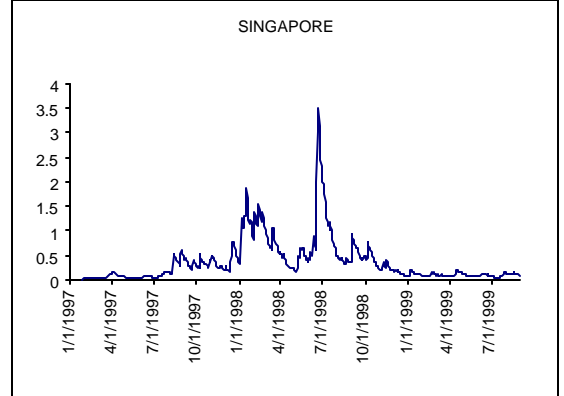
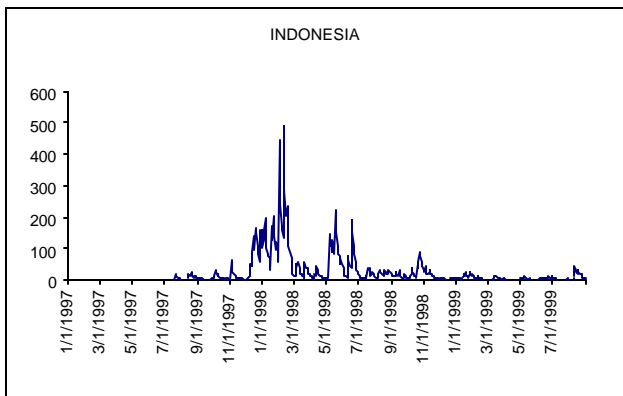
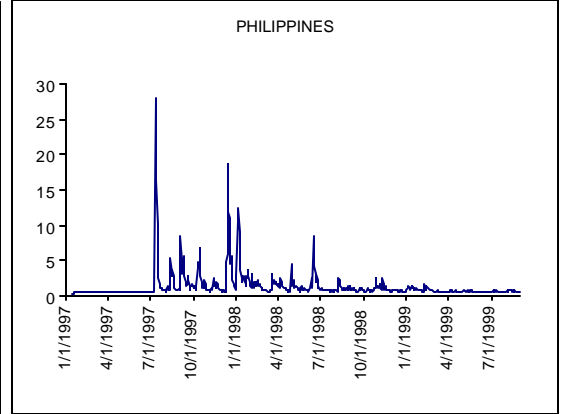
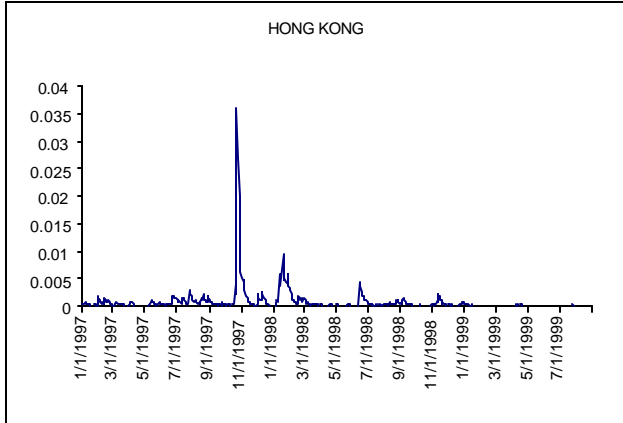


Note:

Daily interest rates are in % terms

Conditional Volatility of Exchange Rate Returns

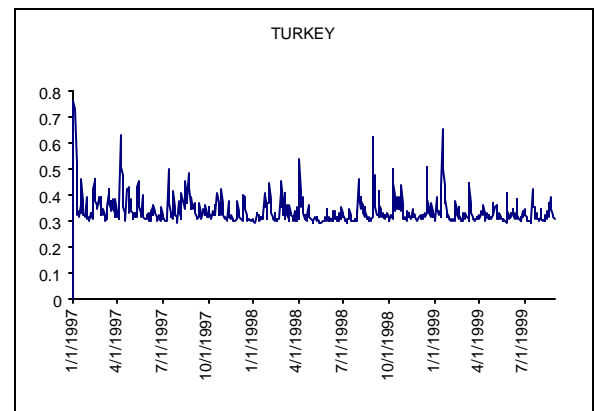
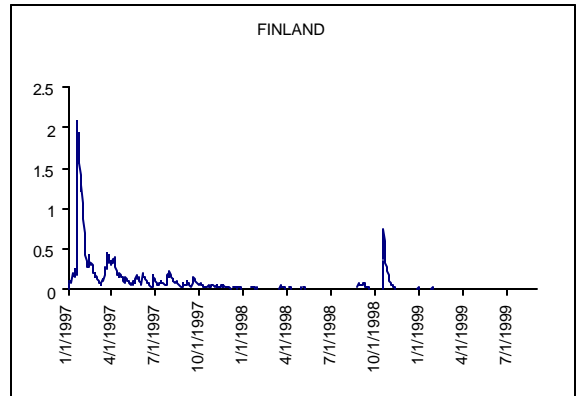
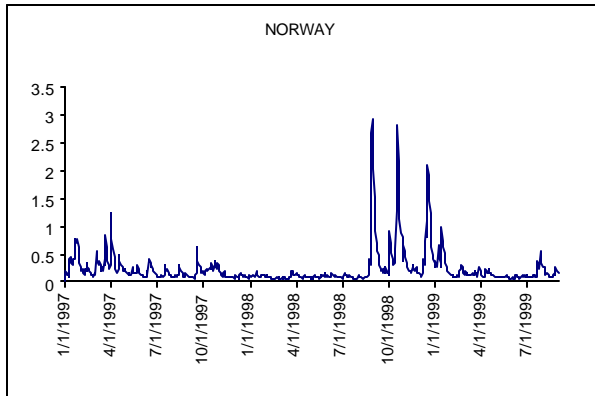
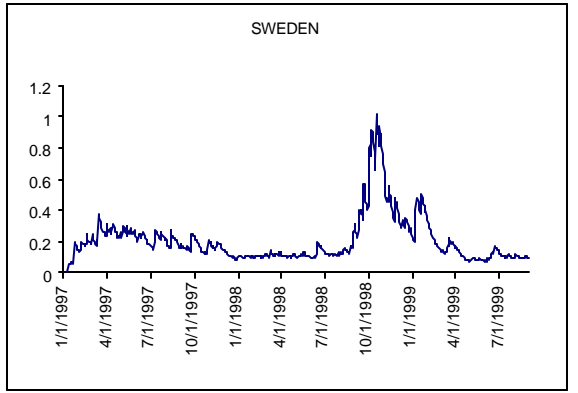
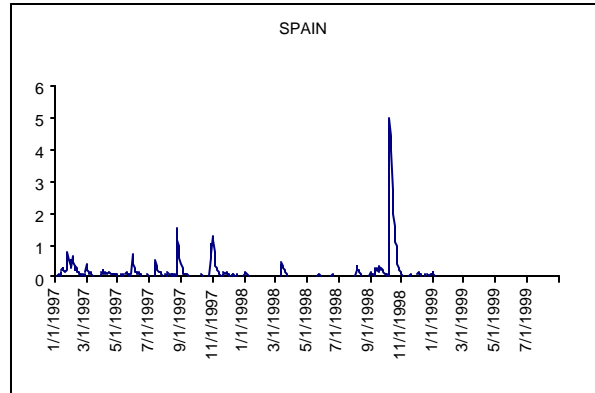
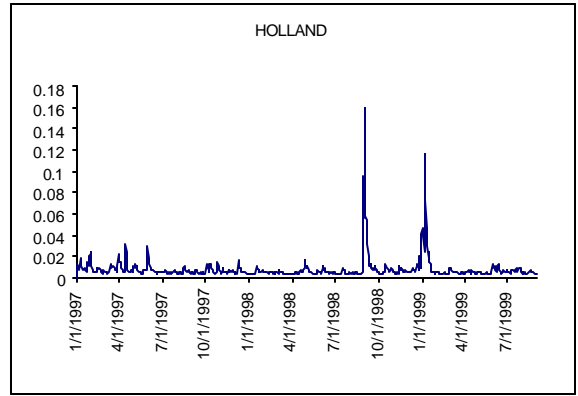
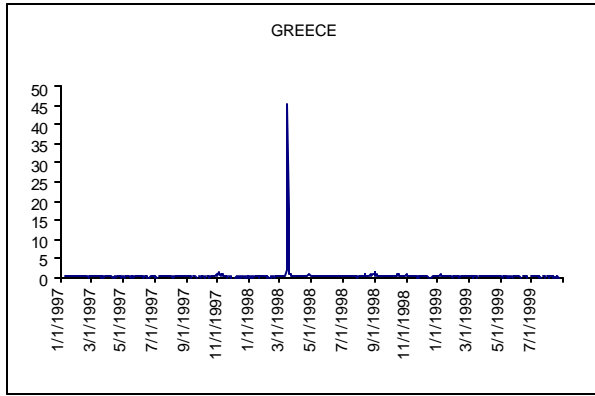
ASIA



Note:

Daily changes in the exchange rate are in % terms

Conditional Volatility of Exchange Rate Returns Europe

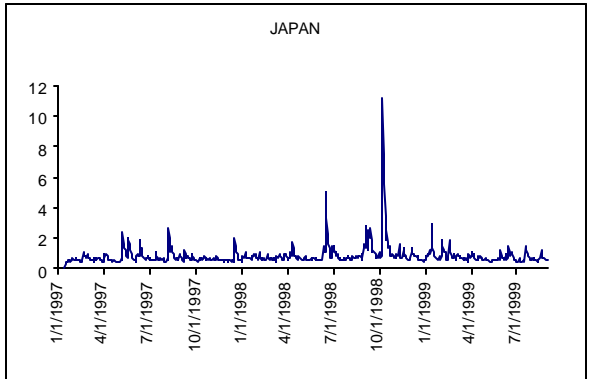
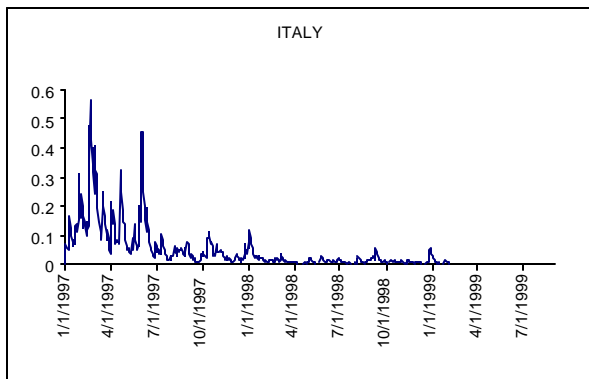
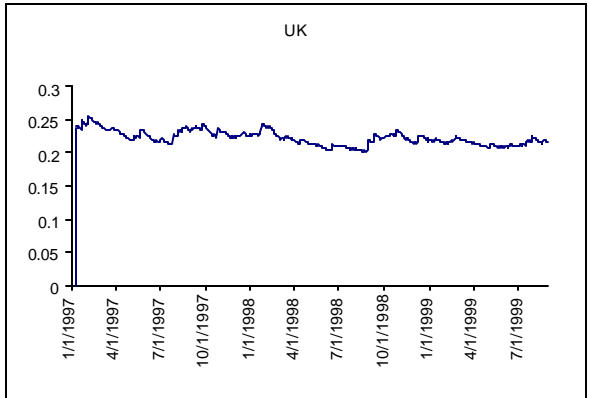
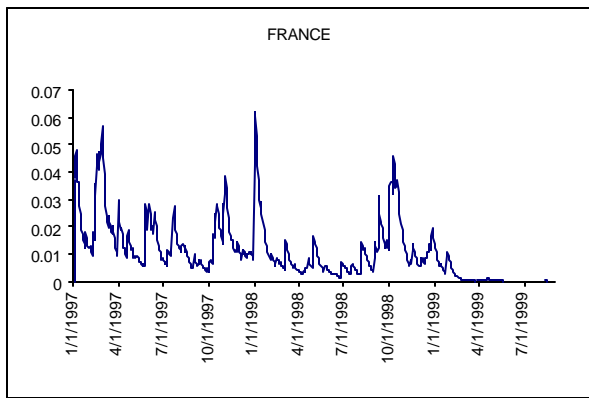
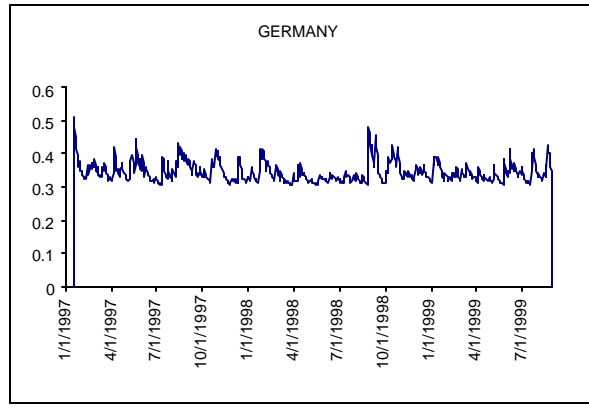
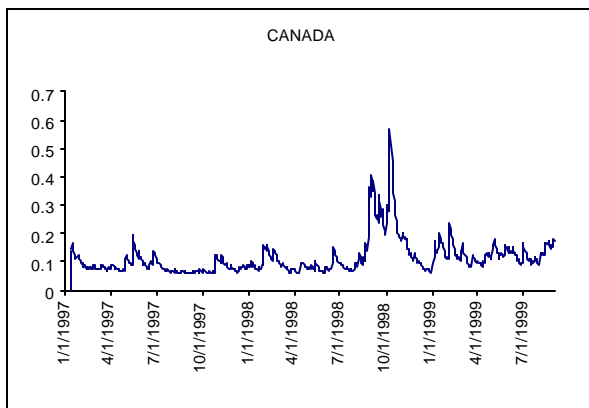


Note:

Daily changes in the exchange rate are in % terms

Conditional Volatility of Exchange Rate Returns

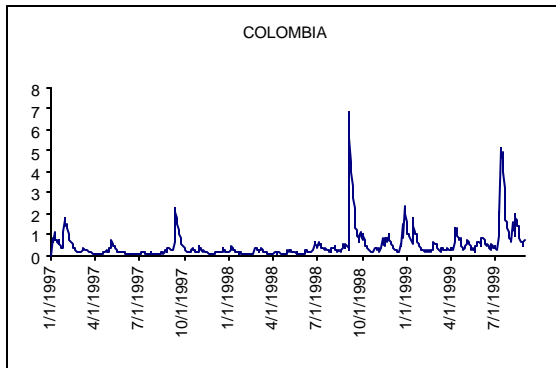
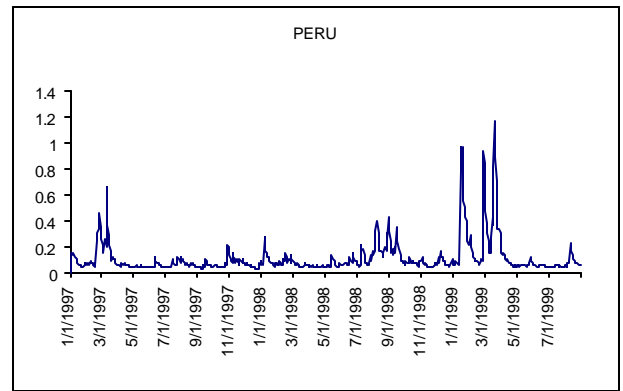
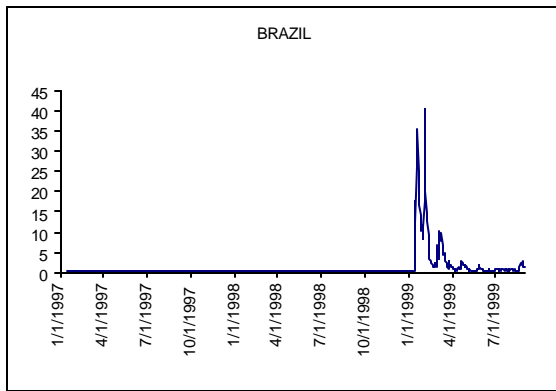
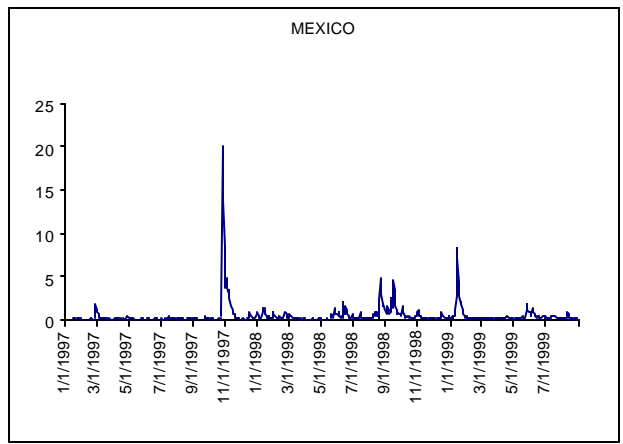
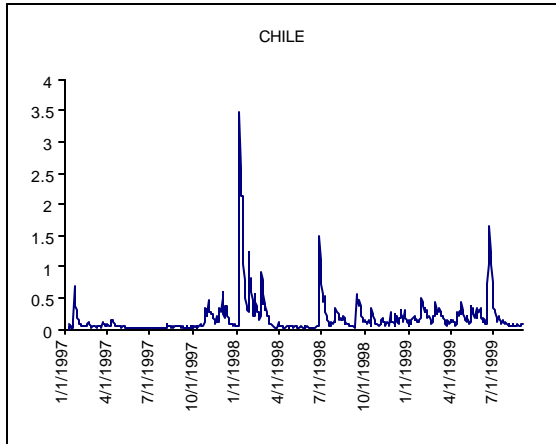
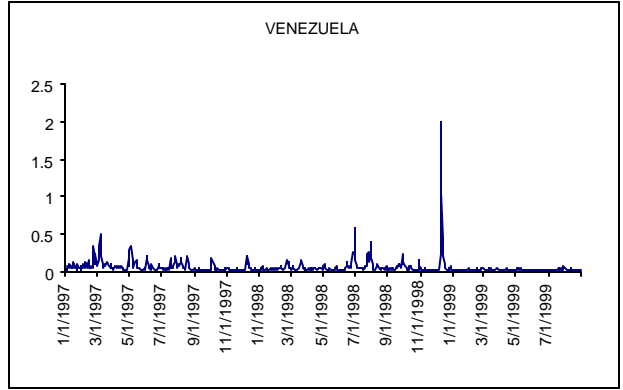
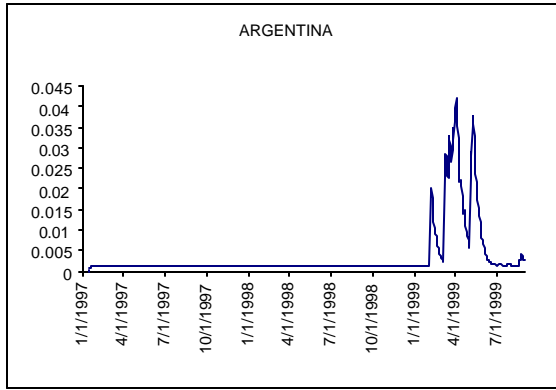
G7



Note:

Daily changes in the exchange rate are in % terms

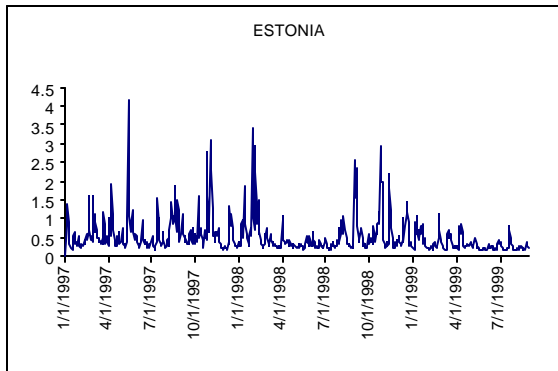
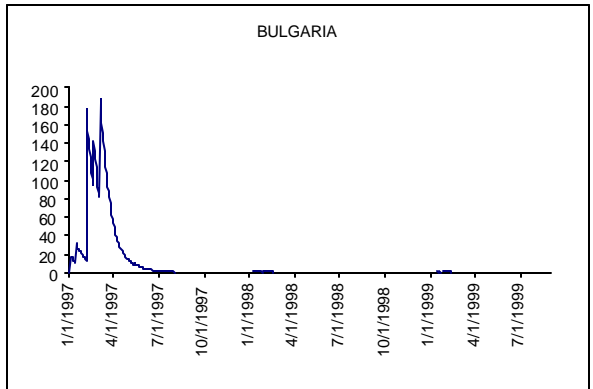
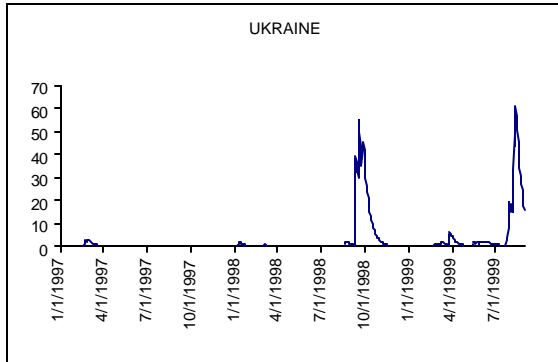
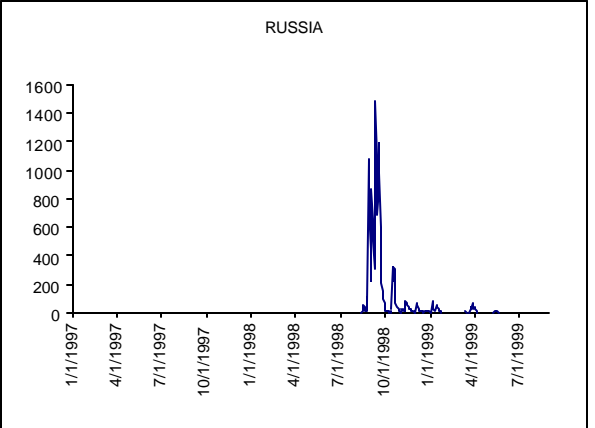
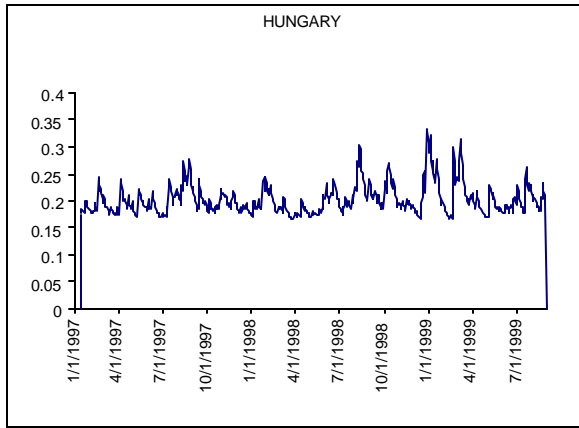
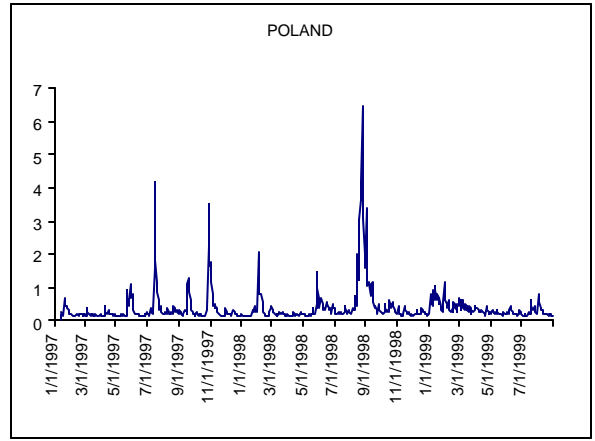
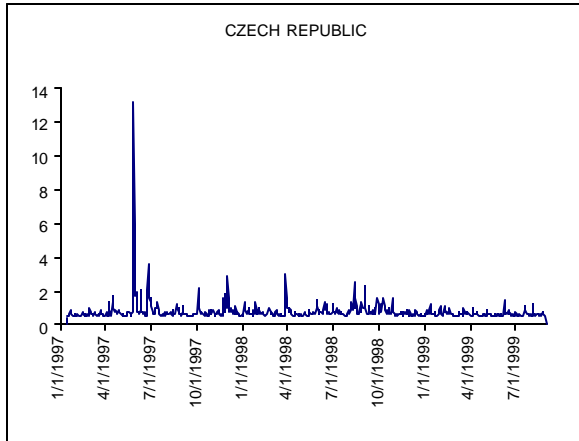
Conditional Volatility of Exchange Rate Returns Latin America



Note:

Daily changes in the exchange rate are in % terms

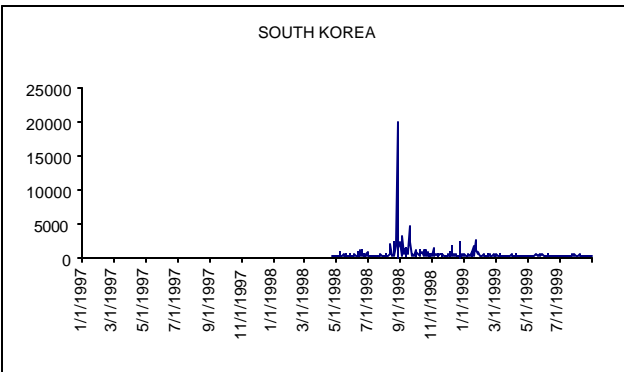
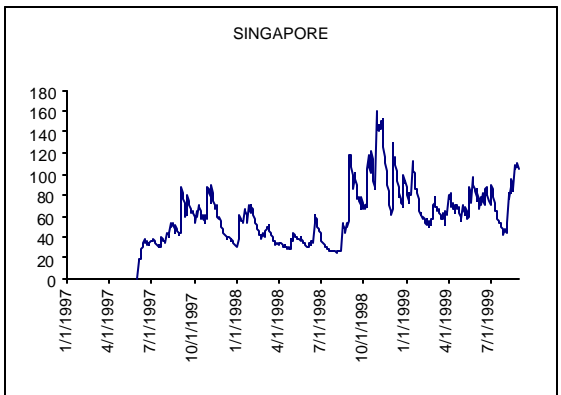
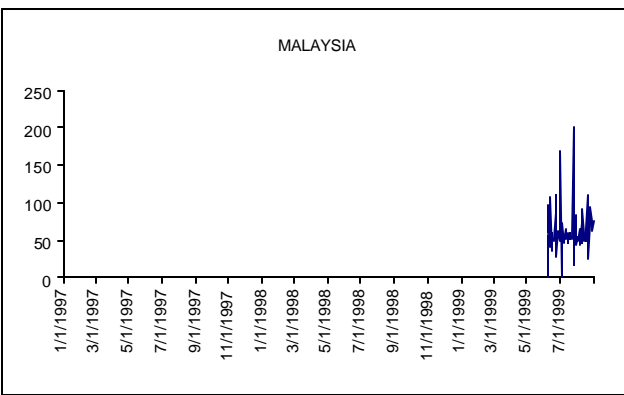
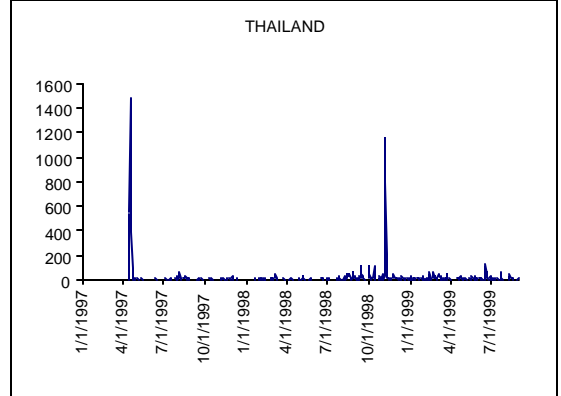
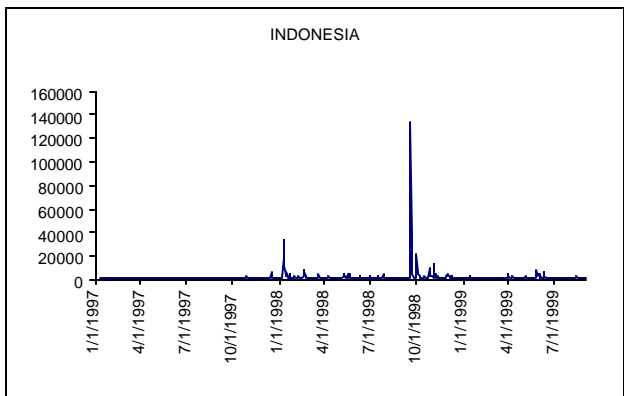
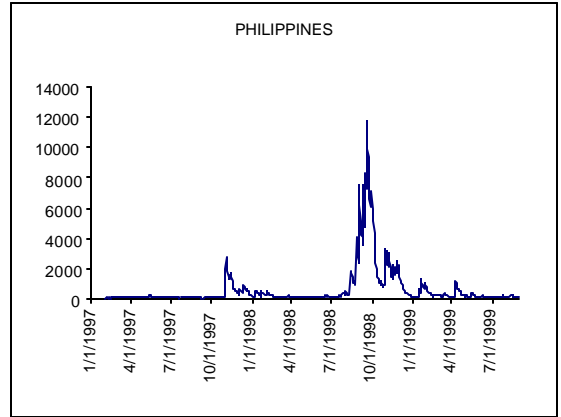
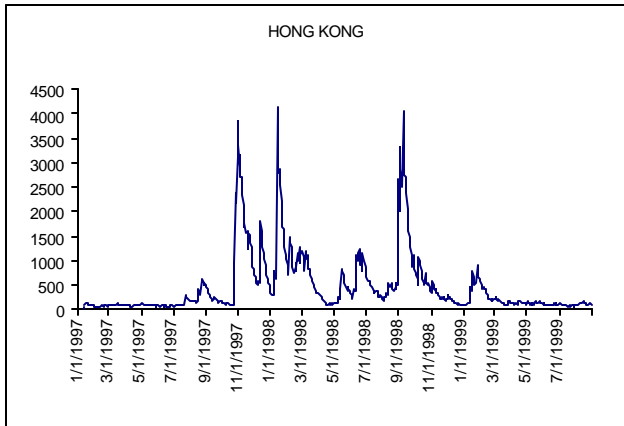
Conditional Volatility of Exchange Rate Returns Transition Economies



Note:

Daily changes in the exchange rate are in % terms

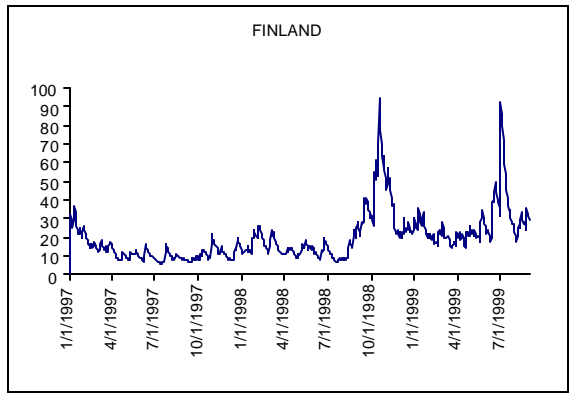
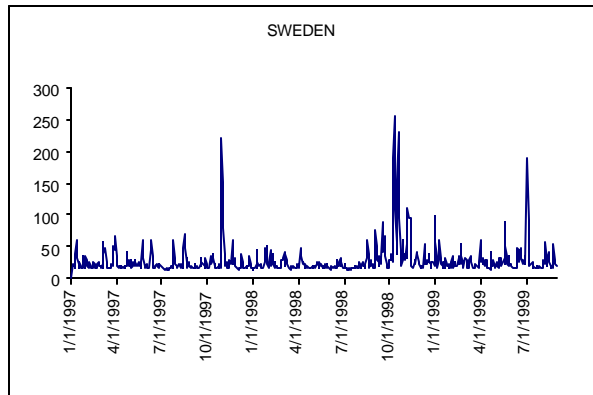
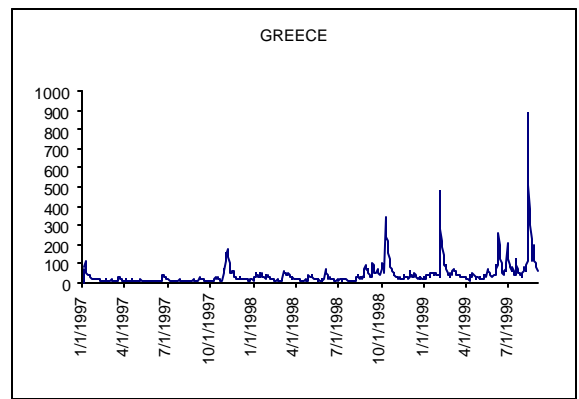
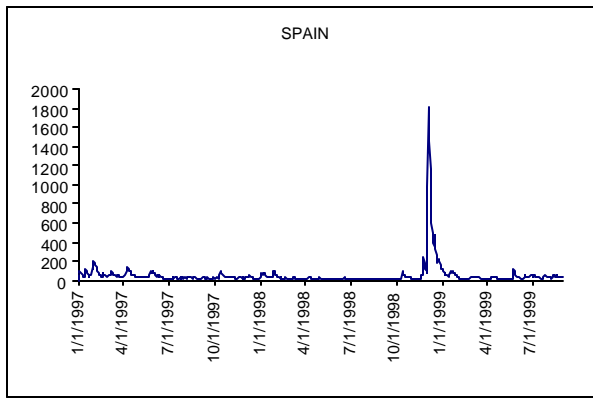
Conditional Volatility of Yield Spreads Asia



Note:

Daily spreads are in basis points

Conditional Volatility of Yield Spreads Europe

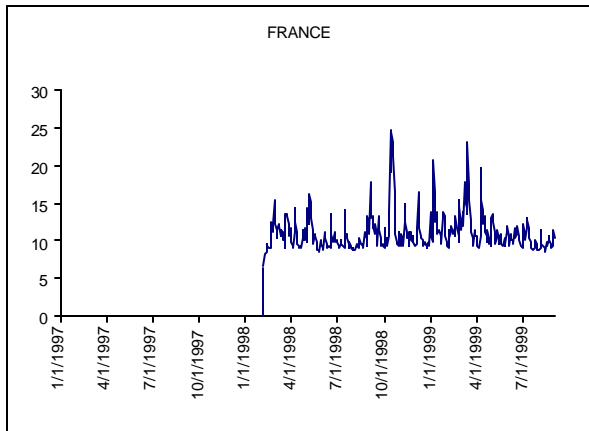
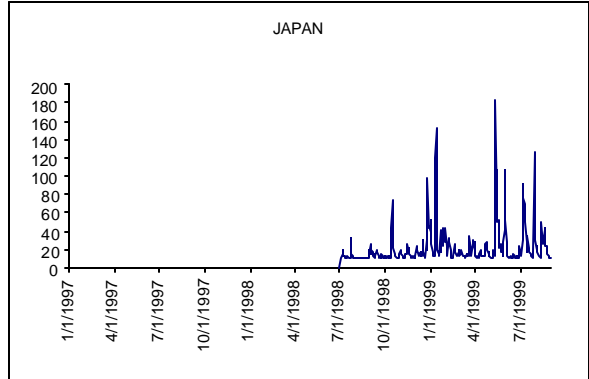
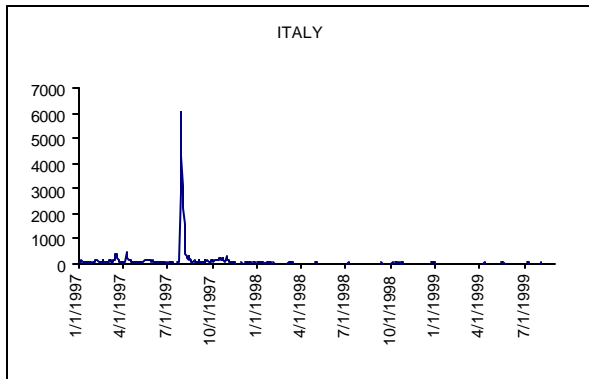
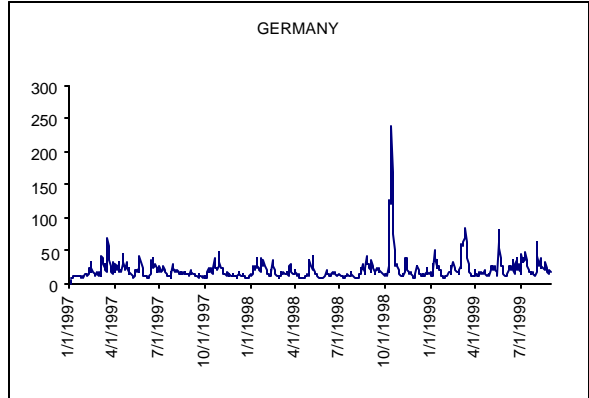
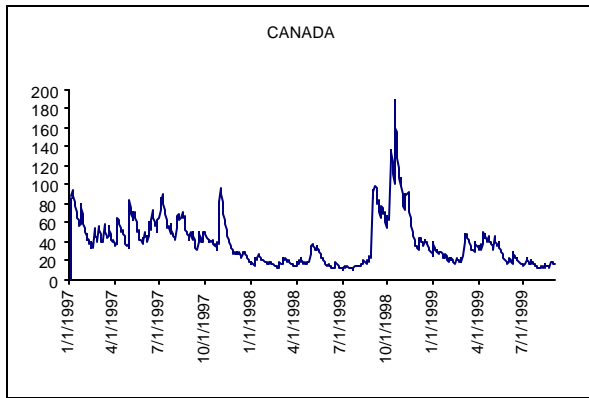
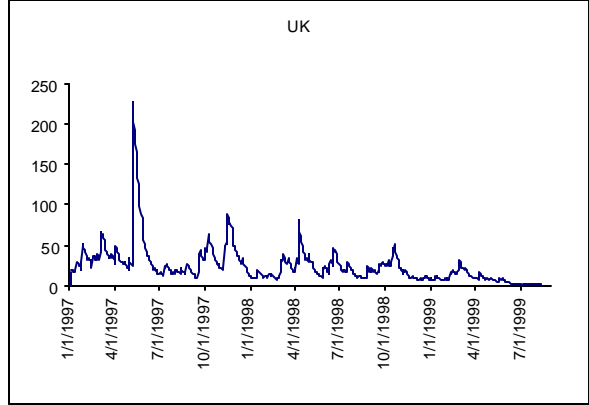
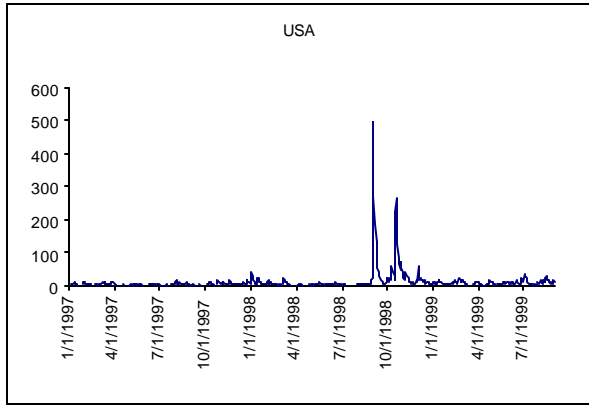


Note:

Daily spreads are in basis points

Conditional Volatility of Yield Spreads

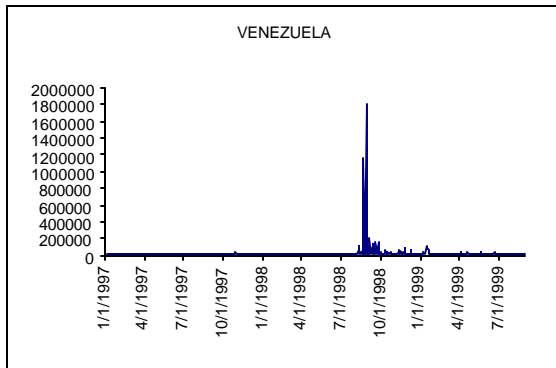
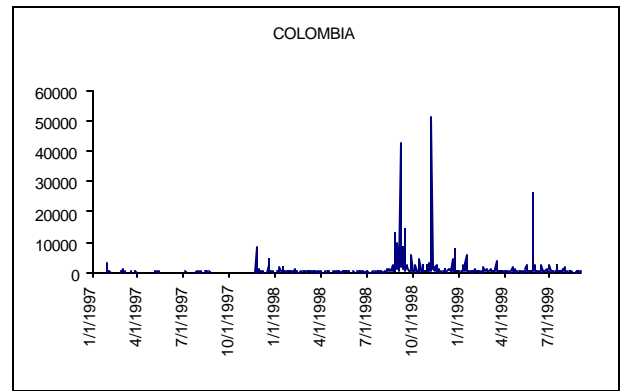
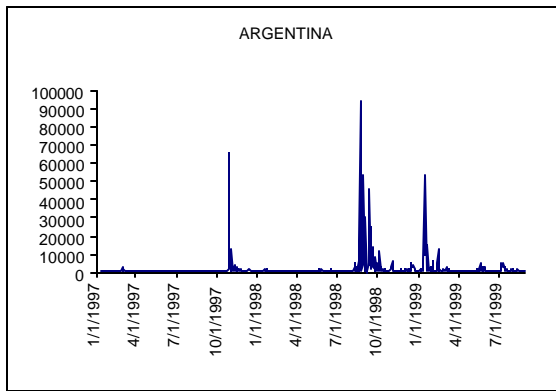
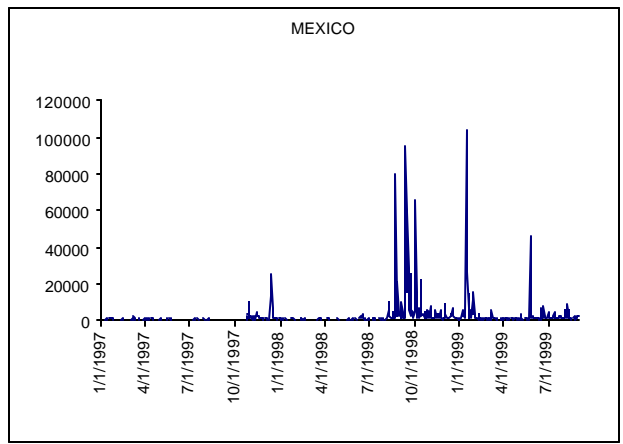
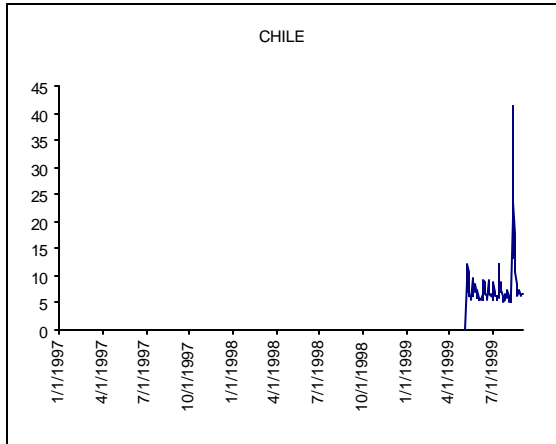
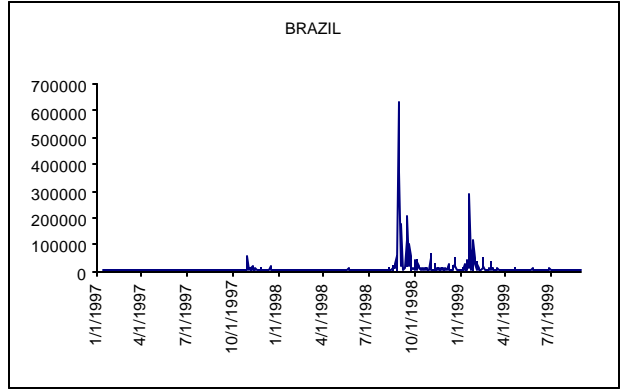
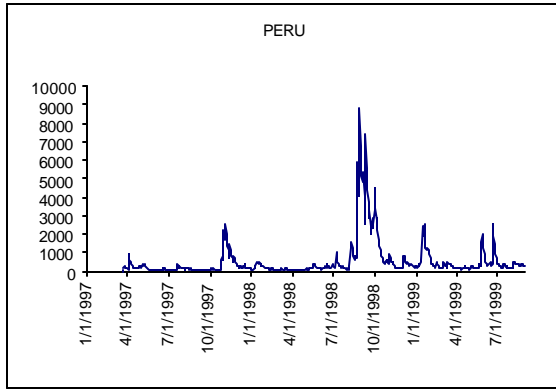
G-7



Note:

Daily spreads are in basis points

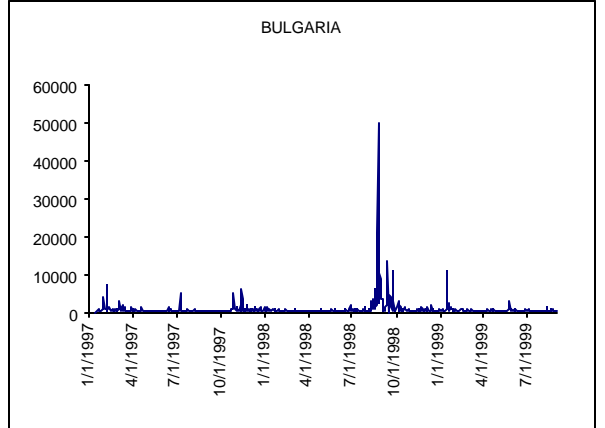
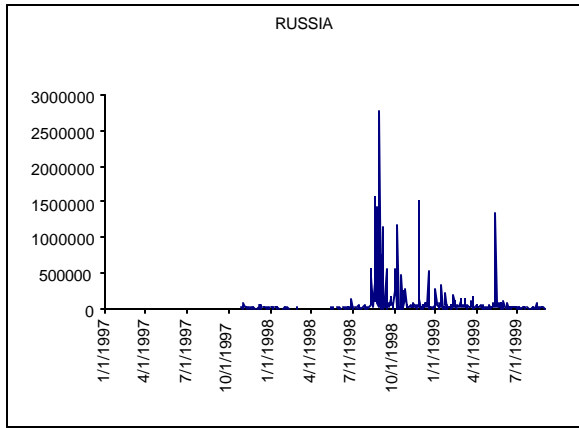
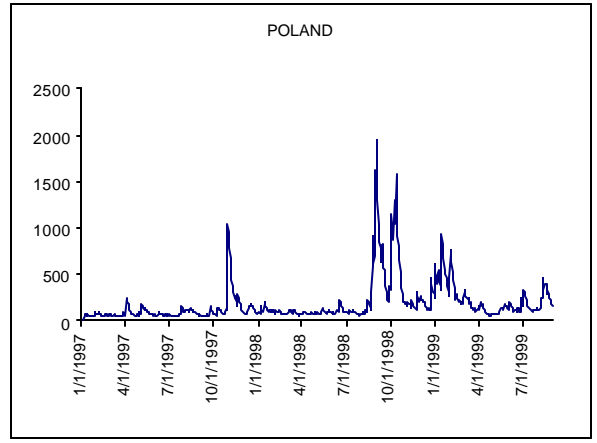
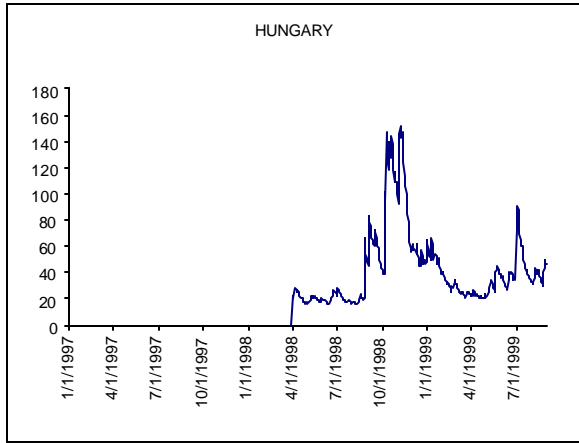
Conditional Volatility of Yield Spreads Latin America



Note:

Daily spreads are in basis points

Conditional Volatility of Yield Spreads Transition Economies



Note:

Daily spreads are in basis points