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Has 1997 Asian Crisis increased Information Flows between International Markets?♣♦

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Abstract

The Asian crisis started on July 2, 1997 and caused turmoil in developed as well as emerging international stock markets. The objective of this paper is to analyse the movements and dynamic relationships among stock markets, together with their implications for information flows. We use the Morgan Stanley National and International Indexes (MSCI). These indexes refer to four geographic areas (Asia, Europe, North America and Latin America) for two homogeneous and non-overlapping time intervals. The econometric techniques used in this paper include the cointegration test, vector autoregression analysis, forecast error variance decomposition and impulse-response relationships. Our results show that: i) there are no multivariate cointegration relationships across markets, ii) the leadership role played by the U.S. became stronger after the crisis, iii) the response of Asian markets to external markets is more relevant than vice versa, especially after the crisis, iv) the degree of integration, in Phylaktis (1999) sense, between Asian and the rest of the international stock markets has increased after the crisis and, finally, v) the contagion effect determines significantly the dynamic relationships between international stock markets.

Key words: Asian crisis, stock market, information flow, cointegration, VAR.

JEL: C32, F21, F32, F36, G15

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1. Introduction

The crisis began with five stock markets: Thailand, Philippines, Indonesia, Malaysia and South Korea and even spread to seemingly more solid economies from the macroeconomic point of view. The reasons could be summarised as: i) the appreciation of the dollar against the yen between 1995 and 1997 which weakened the rest-of-the world sector of several Asian countries, ii) the high degree of influence that the internal crisis of one country can cause on the fundamental variables of another, via commercial relationships, or via the linkage of capital markets, and iii) the downward revision of Asian economic fundamental variables made by international creditors.

According to the Organisation for Cooperation and Economic Development (OCED, 1998), the World Bank (1998), and the International Monetary Fund (Adams *et al*., 1998), there are two singularities that differentiate this crisis from those that have taken place in other developing countries especially the debt crisis of the 80´s and the 1994 Mexican crisis. First, the largest turbulence was caused by financial decisions that were adopted in the private sector (strongly indebted short-term), while public debt did not have a significant responsibility, because most Asian countries had fiscal surpluses. Second, the international context had been globally favourable, with a solid and stable growth of production and trade in the major western economies, together with historically low interest rates that facilitated indebtedness at a low cost.

According to the IMF (1998), the vulnerability of these countries was caused by the weakness of their financial sectors, together with the lack of diligence and speed in adopting macroeconomic policies that could enable an exit from the crisis with the smallest possible cost. What began as an exchange crisis in one country —Thailand— finished causing a recession in most Southeast Asian nations, and global financial uncertainty that eventually affected the rest of the world.

The process of financial liberalisation is one of the main causes of the Asian crisis. The process was not correctly applied and caused a distortion in the allocation of resources and a weakness in the financial system. The marked reduction in interest rates in the industrialised world, contributed decisively to a smaller aversion to risk and a movement of investor preferences towards financial assets in emerging economies. The result was short-term saturation of foreign capital causing a speculative bubble in Asian real estate and stock markets that pulled along a relatively undeveloped banking system. The resulting market crisis and withdrawal of foreign capital caused massive devaluation and the crash of the economic model.

In short, efforts to support the currency in Thailand in the first semester of 1997 —which included, interest rate increases (18% in June 1997, compared to 12% in January) and restrictions on foreign speculation— were fruitless. This was because Thai companies, trying to protect themselves from the exchange rate risk, paid off foreign debt and then carried out various hedging operations to reduce their exposure in the foreign exchange market (Miller, 1998). On July, 2 1997, after having spent 8,700 million dollars in reserves to support the currency, the Thai Central Bank set the exchange rate free and, at the end of the same year, the *bhat* had depreciated 93% compared to June 1997.

The forced flotation of the *bhat*, with regard to the dollar, put the exchange rates of other countries on trial. The secondary effects were quickly felt in Indonesia, Malaysia and the Philippines. Measures adopted to reduce liquidity in Indonesia were unable to brake the growing pressures on the foreign exchange market and the authorities floated the *rupiah* by the middle of

August. The situation degraded notably over the two following months, and the effects spread to other countries like Hong Kong and Japan.

The *Hong Kong dollar* was subjected to strong pressures and therefore, interest rates rose steeply in October. This was followed by a sharp decrease in the stock market, causing a domino effect in most world stock markets[1]; as well as an increase in pressure on the currencies of developing countries. In South Korea, the downward pressure on the *won* intensified at the end of October, after the attack on the *Hong Kong dollar*.

By way of synthesis, the importance of this crisis does not just reside in the structural nature of the problems caused, but in the easy spread inside and outside the region. The relatively quick contamination of other economies, distant geographically and economically from the epicentre of the convulsion, could be a result of the globalisation of world financial markets. This globalisation has had positive effects by allowing a better allocation of resources, the effective exploitation of comparative advantage, and an increase in growth rates. However, the advantages may be put into question if globalisation reveals a long series of deficiencies in financial markets.[2]

This paper studies the relationships between those Southeast Asian markets most affected by the crisis of 1997 (Thailand, Philippines, Indonesia, Malaysia, South Korea, Hong Kong and Japan) and the markets of three different geographical areas (Europe, North America and Latin America). We attempt to verify if interdependence has increased among the markets as a

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1 On 27 and 28 October 1997 the Hong Kong MCI index fell 5.33% and 12.87%. The variations in the same indexes for Spain, Eurozone, and the USA were: on the 27th: -3.37%, -2.55% and -6.66%; and on the 28th: -2.67%, +4.83% and -3.57%, respectively.

2 For a more detailing see Bustelo (2000) and Lane *et al.* (1999).

response to the globalisation process over recent years and to determine possible relationships of leadership, contagion effects, and strategies of international portfolio diversification. We also check if the crisis has altered the degree of integration between the markets. Information flows is also studied in the international stock markets in the face of abrupt changes in behaviour, and we examine if these events have caused structural or economic trend changes. To achieve these objectives, the methodology of vector autoregressive models (VAR) is applied, as proposed by Sims (1980); as well as two complementary elements: forecast error variance decomposition (FEVD) and impulse-response function (IRF).

This paper includes novelties compared with previous studies on market crises: i) we use the Morgan Stanley homogeneous local and supra-national indexes (MSCI), ii) considered markets represent four different geographical areas (Asia, Europe, North America and Latin America) as well as developed and emerging markets, iii) the analysis period, 1995-2000, gives us a wide sample, both before and after the Asian crisis, without considering exclusively the crisis period (July to October 1997).

This paper is structured as follows: section 2 is devoted to a bibliographical revision of the main works that analyse market crises. Section 3 describes the sample analysed and the methodology. Section 4 presents an analysis of the series. Section 5 analyses the short and long-term relationships among the markets and section 6 studies the Impulse-Response Function (IRF) and the Forecasting Error Variance Decomposition (FEVD). Finally, section 7 summarises the main conclusions.

2. Bibliographical revision

First, those papers that analysed the effect of the 1987 crash on the stock markets are reviewed. Malliaris and Urrutia (1991) examined causality among the daily indexes of the four main stock markets during several months around the crash of 1987. They concluded that the number of the cointegration relationships diminished after the crash. The same authors repeated their work of the previous year, but examining six markets with a smaller sample period (Malliaris and Urrutia, 1992). The results revealed that a contemporary causality existed in two directions in October 1987, indicating that the crash began simultaneously in all the countries.

Arshanapalli and Doukas (1993) studied the relationships between the biggest five world stock markets in the period 1980-1990, before and after the 1987 crash. They worked with the cointegration methodology proposed by Engle and Granger (1987). For the whole sample, they observed that the markets of Japan, United Kingdom and France are cointegration with the American market, however, they did not observe cointegration relationships between the European markets and Japan. They did not detected long run relationships before the crash, yet detect such relationships after the crash and equally for the whole period. In the post-crash period, causality was shown in one direction, from USA towards Europe. The degree of international integration has increased except in the case of Japan. Rogers (1994) examined the relationships between the stock markets of Southeast Asian and America in the period 1986-1990. The principal objective was to examine the effect of entrance barriers in the transmission of stock market shocks. His results indicate that, in markets without entrance barriers, the crash of 1987 caused a substantial increase in volatility and co-movement of the markets, although this effect was temporary and normality returned after the crisis.

Cashin *et al.* (1995), used the cointegration methodology of Johansen (1988) to determine stock markets with similar behaviour and analysed the contagion effect using the error correction model. The results of the cointegration test showed an increase in the integration of emerging markets during the 90´s. However, the industrialised markets were integrated from the beginning of the same period. Lastly, they studied contagion after local and global shocks and detected that the local shocks disappear in a few weeks, while the global shocks require several months before returns recover to equilibrium. Masih and Masih (1997) demonstrated how cointegration techniques, error correction models, and techniques of variance decomposition, can be used to determine the relationships among the six main international stock markets over the period 1979-1987. They verified that the American market has not been affected in its role as leader by the market crash of 1987, and that the German and British markets increased their dependence on other markets after the crash.

Kanas (1998) studied the cointegration relationships between the USA and the six main European markets during the period 1983-1996. The results revealed that none of the markets are cointegration in any of the examined periods. Kanas concluded by affirming that the absence of relationships of long-term equilibrium between the USA and the six main European markets implies that there are long-term potential benefits to be obtained by reducing the risk derived from the international diversification of US shares and of the rest of the European markets. Soydemir (2000) analyse the transmission mechanism of movements in stock markets, for the period 1988-1994 and in both developed (Europe and USA) and emerging (Latin America) markets. The methodology consists in the analysis of the impulse-response function and forecast error variance decomposition. Soydemir concludes that fundamentals, such as imports and exports, play a decisive role, and so rejects the existence of a contagion effect.

Finally, various papers have analysed the effect of the Asian crisis. Tan (1998) analysed eight Southeast Asian stock markets during the period 1995-1998 and verified the contagion effect during the Asian financial crisis by using an error correction model, impulse-response function and Forecast Error Variance Decomposition. Baig and Goldfajn (1999) compared contagion among the markets most involved in the Asian crisis (Thailand, Malaysia, Indonesia, Korea and the Philippines) during the period 1995-1998. They concluded that during periods of uncertainty, the markets tend to move together; and that shocks generated in one market are quickly transmitted to other markets and they discarded fundamental variables as decisive elements in the movement of markets and favour the contagion effect. Lastly, Masih and Masih (1999) studied dynamic causality between eight daily market indexes (four developed markets and four Asians) and quantified the dynamic interdependence between them. Their results indicate that the USA is the market leader, in both the short and long-term. At a regional level, Hong Kong is the market leader and, finally, the fluctuations of the Asian stock markets are explained consistently with the hypothesis of contagion effect, the hypothesis being more true for the regional markets, than for the developed markets.

3 .- Data and Methodology

The data used refers to MSCI share price indexes. These indexes are expressed in dollars[3], and have been designed with a common base for all countries and regions. The MSCI index is calculated using the Laspeyres formula and represents approximately 60% of the market capitalisation of the markets. The indexes are adjusted following changes in company capital structure so facilitating comparison over time.

[3] The perspective of an American investor is adopted. This allows us to eliminate noise in the stock market fluctuations caused by currency changes.

The data used refers to the daily closing rates of the MSCI share indexes for the stock markets of four different geographical areas: Asia (Thailand, Malaysia, Indonesia, Philippines, South Korea, Hong Kong and Japan); Europe: UK and Eurozone (Germany, Austria, Belgium, Spain, Finland, France, Holland, Ireland, Italy and Portugal); North America (United States of America) and Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela)[4]. The objective with the selection of these indexes is to globally analyse the different trading hours of the big three stock market areas.[5]

The sample interval covers the period from January 4, 1995 to May 15, 2000. Two sub-periods are examined: one from January 4, 1995 through July 1, 1997 before the Asian crisis and termed *Precrash* (653 observations). The other is termed *Postcrash* and runs from the end of the crisis -November 1, 1997- until the end of the period -May 15, 2000- (662 observations).

Starting from these data, the steps followed to determine the dynamic relationship among the analysed stock markets are: firstly, a descriptive analysis of the series; secondly, a comparison of stationarity; thirdly, the existence of long-term equilibrium relationships and short-term causality is analysed, and lastly; a multivariate dynamic analysis is performed using the impulse-response function and the forecast error variance decomposition.

4.- Analysis of series

Firstly, we analyse the variability degree of stock index series (Table 2). The quotient between the annualised return and the annualised volatility of each market is considered as a relative measure

[4] Eurozone and Latinamerican series are supranational stock indices.

[5] Table 1 shows the trading hours in local time and GMT (Greenwich Mean Time).

of comparison[6]. It can be seen that the period after the crash is more variable and witnesses significant setbacks in the returns.

In second place, the existence of unit roots has been tested with the purpose of identifying the order of integrability of each stock index series. Some studies have established that when a unit root and moving average are simultaneously present in the process, and the root is near to the unit, then the traditional of Dickey and Fuller (1979) and Phillips and Perron (1988) tests, tend to accept the null hypothesis of the existence of a unit root with excessive frequency. That is to say, the null hypothesis is only rejected if strong evidence exists to the contrary. For this reason, the test of Kwiatkowski *et al* (1992) - hereafter referred to as KPSS - has been used. In this test, the null hypothesis is the stationarity of the series around a level or trend.[7] The results obtained with the KPSS test are presented in Table 3. In all the cases, and independently of the considered interval, it is shown that the series are integrated of order one.

Lastly, according to Baig and Goldfajn (1999, p.169), if the stock markets are correlated historically, a change in one market will be accompanied by a change in other markets. In this sense, if during a period of crisis, the cross correlation do not suffer a significant variation, then the markets are evolving according to their traditional relationship. On the other hand, if a

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[6] Since the risk free interest rate of each market is not available it has not been possible to calculate Sharpe's index, which is a measure more adequate for comparing the evolution of the returns and risk variables.

[7] The KPSS test proposes the following hypothesis. Let X_t , $t=1,2,....T$, be the series under study. Assuming that this series can be decomposed in the sum of a deterministic trend t, a random walk $r_t = r_{t-1} + u_t$ and a stationary error ε_t , in this way: $X_t = \xi t + r_t + \varepsilon_t$ where $u_t \sim iid\ (0, \sigma_u^2)$. The null hypothesis of stationarity is established in the following way, $H_0 : \sigma_u^2 = 0$ against the alternative hypothesis $H_A : \sigma_u^2 > 0$. Under the null hypothesis, X_t is stationary around the trend, in the case that $\xi = 0$, X_t is stationary around a level (r_0).

substantial change takes place in the cross correlation after the beginning of a crisis, this can be interpreted as a *contagion effect*.

The results obtained with the analysis of cross correlation are presented in Table 4.[8] The following conclusions are obtained: i) correlation increases, in most of cases, when passing from the period precrash to postcrash, ii) with regard to the rest of the markets, an increase in contemporary correlation takes place, especially in the United Kingdom postcrash period, with respect to the Asian countries, and lastly, iii) it is worth highlighting a notable increase in the correlation of all Asian countries (except Indonesia), and especially for Thailand and South Korea. These results show that an important change has taken place in the correlation level between the Asian markets and the other ones. This allows the preliminary verification of the existence of a contagion effect related to the Asian crisis.

5.-Long and short-term relationships

This section analyses the existence of cointegration relationships in three possible groups of market indexes, in such a way that the relationships are independently determined among the stock markets involved directly in the Asian crisis and each one of the others markets (Eurozone, United Kingdom, United States and Latin America). The test used is that proposed by Johansen (1988).

The concept of efficient market has been a focus for conflict in the literature regarding the linkage of the international stock markets. An initial approach to this linkage was proposed by Granger (1986, p.218). He argued that two series of prices of efficient markets cannot be

8 The series are transformed in logarithmic differences.

cointegrated, because if they were, then one could be used to help to predict the other; and this contradicts the assumption of efficient markets in a weak sense.

Against this argument is a series of studies that differ regarding the direct relationship between the existence of cointegration and the efficiency of markets. Specifically, Sephton and Larsen (1991) studied the efficiency of foreign exchange markets by using cointegration analysis and they called into question the direct relationship between the existence of cointegration relationships and the absence of efficiency. They showed that the statement is excessively ambitious as the results can differ substantially depending on the period and the sample frequency, and the existence, or not, of structural changes. Even the method of estimating a cointegration relationship can be important.

This theory has been defended by various authors who have studied cointegration relationships among financial markets and have published conclusions about their relationships with market efficiency. Dwyer and Wallace (1992), Lien (1996) and Masih and Masih (1999) argued that the existence of cointegration does not necessarily contradict the notion of information efficiency of Fama (1991), who defined an efficient market as that in which arbitrage opportunities do not exist. These authors pointed out that although the existence of cointegration implies prediction, it does not necessarily imply that arbitrage opportunities exist, because of the shortness of the opportunity period or because transaction costs can eliminate the differences revealed by the prediction.

In our opinion the incompatibility between cointegration and efficiency depends on the definition of the latter. If it is assumed that efficient markets are those where asset prices are unpredictable, then the existence of cointegration would imply inefficiency. However, this incompatibility is resolved if an efficient market is defined as one without arbitrage opportunities.

It is not enough to simply establish a direct relationship between the existence of cointegration relationships and the inefficiency of the market. Instead, it is necessary to jointly consider other additional factors in pricing models that allow us to determine the existence, or not, of abnormal returns and in this way, to establish the efficiency, or not, of the markets.

The results of the cointegration test are presented in Table 5. A relationship of long-term equilibrium is not detected in the four possible combinations. The acceptance of the non cointegration hypothesis could be related with the high number of markets (eight) and the small sample period (653/662 observations). However, the long-term non-existence of relationships does not imply the non-existence of dynamic short-term relationships. The dynamic relationships are later studied using vector autoregressive models (VAR). These models were proposed originally by Sims (1980), with the objective of specifying models that faithfully reflect empirical regularities and interactions among variables.

In a VAR model, a group of endogenous variables is considered, each of which is explained by the lagged values of the same variable and of the remaining variables. The VAR model is expressed as:

$$Z(t) = C + \sum_{s=1}^{m} A(s)Z(t-s) + e(t) \qquad (1)$$

where *Z(t)* is an 8×1 column vector of rates of returns of stock markets; *C* is the deterministic component; *A(s)* are an 8×8 matrices of coefficients; *m* is the lag length, and *e(t)* is the 8×1 innovation vector. By construction, *e(t)* is uncorrelated with all the past Z(s). According to Sims (1980), this type of approach offers a greater degree of understanding of the macroeconomic relationships than structural models can do, because the latter are based on inaccurate identification restrictions.

As a first step, the relationships of bivariant causality are studied, following the methodology of Granger (1969), with the purpose of determining which variable causes, or best helps predict, another variable. The estimation process is divided, in the same way as the previous cointegration test, into four cases (Eurozone, United Kingdom, United States and Latin America, regarding the Asian markets) and two sub-periods. In each VAR model, the optimal number of lags is determined following the Schwarz information criteria. It is also jointly verified by using the statistic Q of Ljung-Box that the residuals of the model do not show autocorrelation. Starting from each VAR model, a short-term analysis of causality is carried out, so that by selecting any VAR bivariant model, one obtains the following representation:

$$\Delta Y_t = \alpha_1 + \sum_{i=1}^{s} \phi_{i1} \Delta Y_{t-i} + \sum_{j=1}^{w} \phi_{j1} \Delta X_{t-j} + \mu_{t1}$$

$$\Delta X_t = \alpha_2 + \sum_{i=1}^{g} \phi_{i2} \Delta Y_{t-i} + \sum_{j=1}^{h} \phi_{j2} \Delta X_{t-j} + \mu_{t2} \qquad (2)$$

The independent terms of the two equations —α— represent the returns spread for the period of analysis; and the coefficients of the variables —ϕ— measure the direct effect of a change of the return on the dependent variable. If the null hypothesis (H_0) that $\phi_{j1} = 0$, for j=1,···, w, is accepted, then we can affirm that X is not the cause of Y, in the sense of Granger. If the H_0 that $\phi_{i2} = 0$, for i=1,···, g, is accepted then Y does not, in the sense of Granger, cause X. The test of combined hypothesis is carried out with the F test. The results of the analysis of bivariant causality are presented in Table 6. In the precrash period, it can be seen that the USA market influences all the Asian countries in the short-term, except South Korea. A similar behaviour can be seen in the Latin American market influenced, possibly, by the effect of sharing trading hours with the United States. In the postcrash period, the results vary in a significant way, a relationship of unidirectional causality being detected in the international stock markets towards the countries of Southeast Asia, except Malaysia. This fact is indicative of the greater dependence of the Asian countries on flows of information coming from the main stock markets.

6.- Impulse-Response Functions and Forecast Error Variance Decomposition

Although VAR models allow us to determine the existence of short-term causality in the sense of Granger, they do not reveal anything about the dynamic properties of the system. Starting from an estimation of the VAR pattern, Sims (1980) suggests that for studying these properties it would be useful to operate with a moving average representation of the system; in which the variables forming Y_t appear as linear combinations of the forecast errors. We use the Wold decomposition as a base and start from equation 1, which represents an autoregressive (AR) multivariate structure. If the system is stationary, it can be expressed as a process of multivariate moving averages (MA) in the following way:

$$Z(t) = \sum_{s=0}^{x} B(s)e(t-s) \qquad (3)$$

where Z(t) is a linear combination of current and past one-step-ahead forecast errors or innovations. The i,j*th* component of B(s) shows the response of the i*th* market in *s* periods after a unit random shock in the j*th* market. The e(t) are serially uncorrelated by construction, although they may be a contemporaneously correlated.

In order to capture "pure" responses, it is important to transfer the error terms. A lower triangular matrix V is chosen to obtain the orthogonalized innovations *u* from *e* = Vu, so:

$$Z(t) = \sum_{s=0}^{x} B(s)Vu(t-s) \qquad (4)$$

The i,j*th* component of B(s)V in equation 4 represents the impulse response of the i*th* market in s periods to a shock of one standard error in the j*th* market. The objective is to measure the response to shocks in each of the stock markets on the part of each of the remaining markets. This analysis allows us to see if a significant influence exists among the markets and to measure its persistence. Following Lütkepohl (1993), this technique can be interpreted as a type of causality different from that of Granger, because the isolated impulses in a variable cause responses in another variable and it is therefore possible to determine if the first variable causes the second variable.

According to the Cholesky decomposition, the variable that first enters in the system operates as the most exogenous, and its changes contemporaneously affect the remaining process variables. In turn, the variable that is introduced in second place, is the second most exogenous and its interferences rebound contemporarily on the other series, except the first, where it can only impact in a delayed way. This behaviour model continues successively for all the components of the model, and for this reason the order of the markets is important and can alter the dynamics of the VAR system. Following the usual approach in the literature regarding VAR modelling, and with the aim of avoiding the adoption of arbitrary decisions as much as possible, it is advisable that certain theoretical considerations guide, a priori, the ordering of the variables.

The impulse response function (IRF) allows us to characterise the dynamic relationship among the considered series of prices, since it detects the impact caused by the interaction of all the variables. In this sense, these functions constitute a much more useful analytical tool than the individual analysis of the parameters of the model, since they synthesise all the information contained in these parameters (Lütkepohl and Reimers, 1992). As the IRF allows us to analyse the speed with which a shock in a market is transmitted to the other markets, according to Eun and Shim (1989) and Phylaktis (1999), this adjustment speed is an indicator of the degree of market integration.

In any case, for a better understanding of the existent dynamic linkages among the variables that constitute the system, it is useful to analyse the IRF together with the forecast error variance decomposition (FEVD). This allows us to value the relative importance of random changes in the different components of the model in the variance of the forecast error of the returns.

In summary, the IRF reflects to what degree the shocks in the variables are transitory, or persistent, in their impact on the stock market returns; while the analysis of the forecast error variance decomposition allows to evaluate the relative importance of random changes in the explanation of the forecast error variance decompositions of the return of other markets. In this way, the technique helps to determine what percentage of forecast error variance decomposition of the return of a market is attributable to the fluctuations of each one of the variables over several time horizons (Lütkepohl and Reimers, 1992).

Starting from the VAR models previously estimated, we go on to analyse the IRF and FEVD. As stated previously, the order of the series is important because it can change the interpretation of the results. Therefore, an objective ordering approach has been adopted that is based on the trading hours (GMT). In the case of the IRF, and with the aim of being able to compare the graphic results, the scales have been homogenised and a time horizon of 10 days is fixed.

The results of the impulse response function are presented in graphs 1 to 8. As a synthesis, it can be said that in the period of stability (precrash) the Asian markets respond significantly to unitary shocks from the United States. In the period of turbulence (postcrash) the effects of an USA shock grow on the Asian markets and, to a lesser degree, the UK and Eurozone markets. The responsiveness of the Eurozone, UK and United States markets increases to shocks from Asian markets. These results allow us to confirm that after the crisis, the degree of integration increased in the direction suggested by Eun and Shim (1989) and Phylaktis (1999).

The FEVD for the United States (Table 7) shows that, in spite of being considered a priori the most endogenous, it is positioned as one of the most exogenous markets. This is because the seven Asian markets in the precrash and postcrash periods can only account for 4% of the variance of the total forecast error. It is worth highlighting that the explicative capacity of United States in the rest of the markets is very significant during the precrash period. In the postcrash period, being the most exogenous market, its explicative capacity increases in four markets.

During the precrash period, the United Kingdom (Table 8) shows an explicative level in its variance of the forecast error, that is similar to that of the United States. In the postcrash period, its explicative capacity is increased, as well as the percentage of its variance of forecast error that can be explained by the other markets (from 5% to 21%). Eurozone during the precrash period (Table 9) is a market with a reduced explicative capacity, never above 1%. In the postcrash period, the explicative capacity of each market decreases. However, the hierarchy established in the previous period is maintained. The Latin American market (Table 10) is less exogenous than the United States in absolute value, but generally presents a similar behaviour regarding its explicative capacity over the Asian markets (and vice versa) in both intervals.

In summary, the FEVD verifies the exogenous degree of the New York Stock Exchange, as seen in the previous analysis, as well as its great explicative capacity over what happens in the Asian markets. This reasoning can be expanded to the case of Latin America. The European markets present a disparate behaviour because, while in the precrash period the United Kingdom is one of the most exogenous, Eurozone is one of the least exogenous. However, in the postcrash period their positions become closer and the results are similar. In most cases, the postcrash period shows an increase in the percentage of the forecast error variance deviation of each market that is explained by the other markets. According to Rogers (1994) and Tan (1998), this indicates a generalisation after the crisis period of the global contagion effect.

7. - Conclusions

The objective of this paper has been to analyse the effect of the Asian crisis on the short and long-term relationships among the stock markets of Southeast Asia (Thailand, Philippines, Malaysia, Indonesia, South Korea, Hong Kong and Japan) and a group of international stock markets (United States, United Kingdom, Eurozone and Latin America) during the period 1995-2000.

With regard to long-term equilibrium, relationships of multivariate cointegration are not detected in the two analysed periods (precrash and postcrash) and in the four outlined cases. In conclusion, the potential for long-run international diversification across these markets still exists, and may be an effective investment strategy.

An analysis of short-term bivariant causality shows that the United States best predicts the Asian markets, although after the crisis period, this role extends to other stock markets, and this indicates greater linkage.

On the other hand, the forecasting error of variance decomposition shows the United States to be the most exogenous market, before and after the crisis. It is also shown that in the postcrash period, in most of the cases, the markets significantly reduce the explicative capacity of their own forecast error deviation variance. In this way, a global contagion effect can be seen as the consequence of turbulences generated in Southeast Asia.

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Table 1. - Trading Hours

Stock market	Local Time	GMT	Difference
South Korea	9:00-12:00 13:00-15:00	1:00-4:00 5:00-7:00	GMT+8
Philippines	9:30-12:00	1:30-4:00	GMT+8
Indonesia	9:30-12:00 and 13:30-16:00	2:30-5:00 6:30-9:00	GMT+7
Malaysia	9:30-12:30 and 14:30-17:00	1:30-4:30 6:30-9:00	GMT+8
Thailand	10:00-12:30 and 14:30-16:30	3:00-5:30 7:30-9:30	GMT+7
Hong Kong	10:00-12:30 and 14:30-16:30	2:00-4:30 6:30-8:30	GMT+8
Japan	9:00-11:00 and 12:30-15:00	0:00-2:00 3:30-6:00	GMT+9
United States	9:30 - 16:00	14:30-21:00	GMT-5
United Kingdom	9:30 - 17:30	9:30-17:30	GMT
Area Euro	8:30 - 17:45	7:30-16:45	GMT+1
Latin America	10:00-18:00		

GMT: Greenwich Mean Time.

Table 2. - Stock Market Variability

Annualised return and volatility considering the number of trading days

	Japan	*Hong Kong*	*Indonesia*	*Malaysia*	*South Korea*	*Philippines*	*Thailand*	*United Kingdom*	*Eurozone*	*United States*	*Latin America*
					1/1/1995-1/7/1997						
Annual return	-4%	21%	13%	5%	-14%	-6%	-38%	18%	17%	26%	24%
Annual Volatility	19%	19%	18%	17%	21%	18%	25%	11%	10%	11%	15%
$\left(\mathrm{Re}turn/_{Volatil.}\right)$	-0.19	1.13	0.75	0.33	-0.66	-0.32	-1.52	1.66	1.70	2.36	1.62
					1/11/97-15/5/2000						
Annual return	12%	7%	-36%	9%	26%	-9%	-11%	5%	19%	18%	-1%
Annual Volatility	28%	37%	86%	60%	66%	34%	52%	18%	20%	20%	33%
$\left(\mathrm{Re}turn/_{Volatil.}\right)$	0.41	0.19	-0.42	0.15	0.40	-0.27	-0.22	0.26	0.92	0.91	-0.02

Table 3. - KPSS Stationarity Test

	Levels		First differences	
	4/1/1995 - 1/7/1997			
	η_μ	η_τ	η_μ	η_τ
Japan	5.6793*	1.6827*	0.0796	0.0845
Hong Kong	11.6284*	0.6857*	0.0329	0.032
Indonesia	10.5771*	0.37*	0.0468	0.0413
Malaysia	8.6927*	0.5809*	0.1074	0.0659
South Korea	10.6403*	2.3258*	0.1052	0.093
Philippines	1.2266*	0.4584*	0.07	0.0701
Thailand	9.5815*	2.8988*	0.4589	0.0376
United Kingdom	11.8834*	1.9024*	0.0947	0.0366
Eurozone	11.9024*	1.214*	0.119	0.0575
United States	12.4946*	0.8251*	0.0511	0.0511
Latin America	8.4012*	1.3322*	0.2939	0.0456
	1/11/1997 - 15/5/2000			
	η_μ	η_τ	η_μ	η_τ
Japan	10.9057*	2.4146*	0.1656	0.0675
Hong Kong	8.5911*	1.6147*	0.1192	0.0814
Indonesia	4.1513*	1.4566*	0.2378	0.1421
Malaysia	5.6682*	2.4889*	0.2635	0.0637
South Korea	11.6388*	1.2371*	0.1409	0.121
Philippines	1.9131*	1.0183*	0.1339	0.1048
Thailand	3.0886*	0.9449*	0.1009	0.0982
United Kingdom	4.8174*	0.6653*	0.1566	0.038
Eurozone	8.5973*	0.9072*	0.1127	0.0673
United States	11.9341*	0.6298*	0.0603	0.025
Latin America	2.5482*	2.4610*	0.1584	0.0714

Note: KPSS test (Kwiatkowski *et al*, 1992) for the null hypothesis of stationarity regarding a model with constant (η_μ) or with constant and trend (η_τ). The critical values to 5% for η_μ and η_τ are 0.463 and 0.146, respectively. Four lags are used to calculate the statistic. *Significant at 5%.

Table 4. - Cross Correlation Analysis

	Japan	*Hong Kong*	*Indonesia*	*Malaysia*	*South Korea*	*Philippines*	*Thailand*
	Precrash 4/1/1995 - 1/7/1997 (653 Obs.)						
Hong Kong	0.22						
Indonesia	0.05*	0.33					
Malaysia	0.17	0.44	0.37				
South Korea	0.01*	0.05*	0.02*	0.01*			
Philippines	0.08	0.29	0.37	0.32	0.06		
Thailand	0.07*	0.28	0.22	0.29	0.01*	0.17	
United Kingdom	0.13	0.15	0.13	0.15	0.05*	0.06*	0.07*
Eurozone	0.27	0.23	0.17	0.17	0.06*	0.11	0.07*
Latin America	0.08	0.15	0.19	0.14	0.12	0.18	0.08
United States	0.01*	0.08	0.09	0.02*	0.09	0.08	0.01*
United States(-1)	0.18	0.40	0.21	0.24	0.09	0.19	0.11
	Postcrash 1/11/1997 - 15/5/2000 (662 Obs.)						
Hong Kong	0.35						
Indonesia	0.24	0.39					
Malaysia	0.28	0.33	0.35				
South Korea	0.22	0.24	0.18	0.21			
Philippines	0.27	0.43	0.44	0.28	0.26		
Thailand	0.31	0.48	0.43	0.39	0.33	0.54	
United Kingdom	0.27	0.41	0.13	0.23	0.20	0.23	0.25
Eurozone	0.27	0.37	0.14	0.17	0.17	0.21	0.25
Latin America	0.16	0.26	0.11	0.15	0.17	0.21	0.19
United States	0.03*	0.14	0.03*	0.03*	0.07*	0.12	0.07*
United States(-1)	0.21	0.34	0.18	0.19	0.20	0.29	0.22

* Not significant at 5%

	$\left(\frac{\text{Postcrash - Precrash}}{\text{Precrash}}\right)\%$						
Hong Kong	62						
Indonesia	408	18					
Malaysia	61	-26	-8				
South Korea	2086	365	787	2036			
Philippines	250	50	17	-12	361		
Thailand	356	69	97	37	3152	212	
United Kingdom	103	171	3	49	347	263	277
Eurozone	0	58	-16	0	167	87	258
Latin America	100	73	-42	7	42	17	138
United States	235	66	-69	34	-21	51	626
United States(-1)	16	-14	-17	-21	135	48	95

Table 5. - Multivariate Cointegration Test

The test of multivariate cointegration between the Asian stock markets (Japan, South Korea, Philippines, Malaysia, Hong Kong, Indonesia and Thailand) and the major international stock markets (United States, United Kingdom, Eurozone and Latin America) uses statistics to contrast the null hypothesis (H_0) that there are r cointegration vectors, against the alternative hypothesis (H_1) that there exists, at least, r+1 cointegration vectors, where r goes from 0 to 7 and the λ maximum, which tests the null hypothesis (H_0) that there are, as a maximum, r cointegration vectors against the alternative hypothesis (H_1) stating that there are, as a maximum, r+1cointegration vectors, where r goes from 0 to 7. The series used are the logarithms of the daily closing prices of the indexes of each market, expressed in dollars. The sample consists of two sub-intervals divided by the Asian crisis. The estimated models have been determined in function of the Schwartz information criteria (no more than two lags are used). The models incorporate trend in the data and constants in the cointegration equation. The critical values have been taken from the work of Osterwald-Lenum (1992) -statistics test: 156 (5%) and 168.36 (1%); test of the λ maximum: 51.42 (5%) and 33.24 (1%).

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		TRACE TEST							
		4/1/1995 - 1/7/1997				1/11/1997 - 15/5/2000			
Hypothesis		United States	United Kingdom	Eurozone	Latin America	United States	United Kingdom	Eurozone	Latin America
H0	H1								
r=0	*r>0*	139.94	147.50	142.56	149.66	153.87	0.0542	154.38	145.39
r <=1	*r>1*	95.72	101.18	95.67	101.18	114.95	0.0435	111.59	98.03
r <=2	*r>2*	66.30	70.14	68.44	64.76	78.31	0.0364	76.31	68.74
r <=3	*r>3*	45.46	47.29	46.82	54.16	54.16	0.0320	52.98	47.07
r <=4	*r>4*	27.94	28.20	30.63	33.80	34.52	0.0259	33.12	29.54
r <=5	*r>5*	13.80	16.42	17.50	18.70	18.46	0.0158	18.59	18.28
r <=6	*r>6*	5.62	6.90	7.10	7.54	8.05	0.0103	7.31	8.27
r <=7	*r>7*	1.12	1.31	1.36	0.75	0.69	0.0014	0.63	1.17

		TEST λ MAXIMUM							
		4/1/1995 - 1/7/1997				1/11/1997 - 15/5/2000			
Hypothesis		United States	United Kingdom	Eurozone	Latin America	United States	United Kingdom	Eurozone	Latin America
H0	H1								
r=0	*r=1*	44.21	46.33	46.89	48.48	38.92	36.92	42.79	47.35
r=1	*r=2*	29.42	31.04	27.23	36.42	36.64	29.47	35.28	29.29
r=2	*r=3*	20.84	22.85	21.62	21.48	24.15	24.54	23.33	20.95
r=3	*r=4*	17.52	19.09	16.19	20.36	19.34	21.22	19.56	17.53
r=4	*r=5*	14.15	11.79	13.13	15.10	15.82	17.08	14.31	11.25
r=5	*r=6*	8.17	9.51	10.40	11.15	10.25	10.38	11.11	10.01
r=6	*r=7*	4.51	5.59	5.74	6.80	7.25	6.74	6.58	7.11
r=7	*r=8*	1.12	1.31	1.36	0.75	0.68	0.91	0.62	1.17

Table 6. - Short-term Bivariant Causality

The sample refers to the daily returns of the market indexes. The lags have been determined according to the Schwarz information criteria and jointly requiring the non-existence of serial correlation in the residuals. In the first row, the null hypothesis (H_0) is shown. F is the value of the statistic F-Snedecor that tests for short-term causality. "p-value" indicates the minimum level of probability to which the null hypothesis is accepted. (*) Indicates the rejection of H_0 at 1% level.

	Causality of X_i on Y_j							**Causality of Y_j on X_i**						
	Japan$_j$	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**Japan$_j$**	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**
4/1/1995 - 1/7/1997 (Precrash)														
United States$_i$														
F	13.136(*)	2.118	11.742(*)	19.553(*)	63.924(*)	16.134(*)	4.797(*)	0.675	1.938	1.086	0.989	0.157	2.902	0.924
p-value	0.000	0.121	0.000	0.000	0.000	0.000	0.009	0.510	0.145	0.338	0.373	0.854	0.056	0.398
United Kingdom$_i$														
F	4.209	1.293	2.088	5.453(*)	6.579(*)	2.557	1.105	0.158	1.372	2.297	0.153	5.635(*)	0.316	0.824
p-value	0.015	0.275	0.125	0.004	0.001	0.078	0.332	0.854	0.254	0.101	0.858	0.004	0.729	0.439
Eurozone$_i$														
F	3.306	0.349	2.277	1.325	0.952	0.438	0.453	0.083	0.944	0.771	0.042	3.086	0.517	1.186
p-value	0.037	0.706	0.103	0.267	0.387	0.646	0.636	0.921	0.390	0.463	0.959	0.046	0.597	0.306
Latin America$_i$														
F	4.590	1.683	6.707(*)	7.951(*)	19.740(*)	12.469(*)	1.872	2.859	0.132	1.108	0.326	1.130	0.384	0.181
p-value	0.011	0.187	0.001	0.000	0.000	0.000	0.155	0.058	0.876	0.331	0.722	0.324	0.682	0.834
1/11/1997 - 15/5/2000 (Postcrash)														
United States$_i$														
F	16.438(*)	13.718(*)	24.757(*)	11.556(*)	41.998(*)	10.540(*)	16.054(*)	0.488	0.909	0.892	3.175	0.084	2.742	2.658
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.614	0.403	0.410	0.042	0.919	0.065	0.071
United Kingdom$_i$														
F	22.222(*)	13.562(*)	26.584(*)	1.108	13.477(*)	6.232(*)	10.789(*)	3.307	0.466	0.326	0.645	0.321	1.566	0.235
p-value	0.000	0.000	0.000	0.331	0.000	0.002	0.000	0.037	0.628	0.722	0.525	0.726	0.210	0.791
Eurozone$_i$														
F	16.862(*)	12.817(*)	27.796(*)	2.903	6.853(*)	7.754(*)	11.143(*)	4.413	0.380	1.198	2.330	0.817	0.495	0.831
p-value	0.000	0.000	0.000	0.056	0.001	0.000	0.000	0.012	0.684	0.302	0.098	0.442	0.610	0.436
Latin America$_i$														
F	17.699(*)	11.520(*)	33.360(*)	3.950	24.242(*)	11.807(*)	18.276(*)	1.908	0.076	0.143	0.254	0.709	3.607	0.243
p-value	0.000	0.000	0.000	0.020	0.000	0.000	0.000	0.149	0.927	0.867	0.776	0.493	0.028	0.785

Table 7. - Forecast Error Variance Decomposition
(Asia vs United States)

Each row shows the proportion of the variance of the return X_i that is explained by each of the returns X_j. Each column shows the explicative capacity of the return X_j in the return X_i. The variable "Rest" shows the percentage of the decomposition of the variance of the forecast error of X_i explained by the rest of returns X_j . The order of presentation of the returns is not arbitrary, it follows the trading hours (GMT) of each market.

	4/1/1995 - 1/7/1997									1/11/1997 - 15/5/2000								
Days	**$Japan_j$**	**South $Korea_j$**	**$Philippines_j$**	**$Malaysia_j$**	**Hong $Kong_j$**	**$Indonesia_j$**	**$Thailand_j$**	**United $States_j$**	**$Rest_j$**	**$Japan_j$**	**South $Korea_j$**	**$Philippines_j$**	**$Malaysia_j$**	**Hong $Kong_j$**	**$Indonesia_j$**	**$Thailand_j$**	**United $States_j$**	**$Rest_j$**
$Japan_i$																		
5	95.958	0.089	0.047	0.573	0.125	0.054	0.030	3.123	4.042	94.183	0.464	0.188	0.596	0.248	0.299	0.033	3.989	5.817
10	95.958	0.089	0.047	0.573	0.125	0.054	0.030	3.123	4.042	94.182	0.464	0.188	0.596	0.248	0.299	0.033	3.989	5.818
South $Korea_i$																		
5	0.048	99.220	0.003	0.058	0.024	0.038	0.002	0.606	0.780	4.915	89.334	0.377	0.004	1.078	0.010	0.438	3.844	10.666
10	0.048	99.220	0.003	0.058	0.024	0.038	0.002	0.606	0.780	4.915	89.334	0.377	0.004	1.078	0.010	0.438	3.844	10.666
$Philippines_i$																		
5	0.322	0.277	90.082	2.811	0.061	1.744	1.050	3.653	9.918	5.445	6.580	72.688	2.368	1.058	3.807	0.533	7.522	27.312
10	0.322	0.277	90.082	2.811	0.061	1.744	1.050	3.653	9.918	5.445	6.580	72.687	2.368	1.058	3.807	0.533	7.522	27.313
$Malaysia_i$																		
5	1.995	0.086	6.119	84.804	0.870	0.087	0.241	5.798	15.196	5.684	2.380	3.575	84.819	0.266	0.238	0.051	2.988	15.181
10	1.995	0.086	6.119	84.804	0.870	0.087	0.241	5.798	15.196	5.684	2.380	3.575	84.819	0.266	0.238	0.051	2.989	15.181
Hong $Kong_i$																		
5	3.555	0.074	4.004	9.128	67.500	0.746	0.018	14.974	32.500	7.918	3.481	6.994	2.290	68.078	0.254	0.150	10.833	31.922
10	3.555	0.074	4.004	9.128	67.500	0.746	0.018	14.974	32.500	7.918	3.482	6.994	2.290	68.078	0.254	0.150	10.833	31.922
$Indonesia_i$																		
5	0.175	0.375	8.932	8.262	1.287	74.809	1.752	4.409	25.191	4.039	5.417	9.532	4.644	2.471	70.934	0.171	2.792	29.066
10	0.175	0.375	8.932	8.262	1.287	74.809	1.752	4.409	25.191	4.039	5.417	9.532	4.644	2.471	70.934	0.171	2.792	29.066
$Thailand_i$																		
5	0.313	0.257	2.105	4.918	4.341	0.526	86.018	1.522	13.982	8.386	7.586	14.866	3.960	3.544	2.415	55.019	4.225	44.981
10	0.313	0.257	2.105	4.918	4.341	0.526	86.018	1.522	13.982	8.386	7.586	14.866	3.960	3.544	2.415	55.018	4.225	44.982
United $States_i$																		
5	0.159	0.745	0.840	0.022	0.287	1.743	0.411	95.793	4.207	0.085	0.700	0.672	0.790	1.076	0.658	0.151	95.867	4.133
10	0.159	0.745	0.840	0.022	0.287	1.743	0.411	95.793	4.207	0.085	0.700	0.672	0.790	1.076	0.658	0.151	95.867	4.133

Table 8.- Forecast Error Variance Decomposition
(Asia vs United Kingdom)

Each row shows the proportion of the variance of the return X_i that is explained by each of the returns X_j. Each column shows the explicative capacity of the return X_j in the return X_i. The variable "Rest" shows the percentage of the decomposition of the variance of the forecast error of X_i explained by the rest of returns X_j. The order of presentation of the returns is not arbitrary, it follows the trading hours (GMT) of each market.

Days		4/1/1995 - 1/7/1997									1/11/1997 - 15/5/2000								
		Japan$_j$	**South Korea $_j$**	**Philippines $_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**	**Japan$_j$**	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**
	Japan$_i$																		
5		97.902	0.100	0.041	0.540	0.158	0.007	0.016	1.235	2.098	93.747	0.539	0.325	0.535	0.239	0.262	0.019	4.335	6.253
10		97.902	0.100	0.041	0.540	0.158	0.007	0.016	1.235	2.098	93.747	0.539	0.325	0.535	0.239	0.262	0.019	4.335	6.253
	South Korea$_i$																		
5		0.040	99.618	0.001	0.067	0.031	0.027	0.001	0.216	0.382	5.192	90.313	0.251	0.012	1.067	0.044	0.453	2.668	9.687
10		0.040	99.618	0.001	0.067	0.031	0.027	0.001	0.216	0.382	5.192	90.313	0.251	0.012	1.067	0.044	0.453	2.668	9.687
	Philippines$_i$																		
5		0.667	0.323	92.890	2.988	0.094	1.595	1.106	0.337	7.110	5.811	7.259	74.628	2.199	1.071	3.697	0.513	4.820	25.372
10		0.667	0.323	92.889	2.988	0.094	1.595	1.106	0.337	7.111	5.811	7.259	74.628	2.199	1.071	3.697	0.513	4.820	25.372
	Malaysia$_i$																		
5		2.828	0.029	7.563	86.764	1.013	0.015	0.215	1.574	13.236	7.204	3.083	4.640	84.409	0.280	0.181	0.037	0.166	15.591
10		2.828	0.029	7.563	86.764	1.013	0.015	0.215	1.574	13.236	7.204	3.084	4.640	84.409	0.280	0.181	0.037	0.166	15.591
	Hong Kong$_i$																		
5		5.282	0.216	6.315	11.840	73.745	0.506	0.025	2.071	26.255	9.482	4.285	9.061	2.654	70.735	0.149	0.125	3.508	29.265
10		5.282	0.216	6.315	11.840	73.745	0.506	0.025	2.071	26.255	9.482	4.285	9.061	2.654	70.735	0.149	0.125	3.508	29.265
	Indonesia$_i$																		
5		0.330	0.215	10.783	9.381	1.945	75.109	1.790	0.448	24.891	4.624	5.821	10.551	4.596	2.537	70.855	0.158	0.858	29.145
10		0.330	0.215	10.783	9.381	1.945	75.109	1.790	0.448	24.891	4.624	5.821	10.551	4.596	2.537	70.855	0.158	0.858	29.145
	Thailand$_i$																		
5		0.523	0.206	2.607	5.355	4.601	0.467	86.048	0.194	13.952	8.998	8.221	15.941	3.843	3.485	2.364	55.053	2.094	44.947
10		0.523	0.206	2.607	5.355	4.601	0.467	86.048	0.194	13.952	8.998	8.221	15.941	3.843	3.485	2.364	55.053	2.094	44.947
	United Kingdom$_i$																		
5		1.804	0.549	0.422	1.643	0.611	0.495	0.027	94.449	5.551	7.606	2.852	2.736	1.203	6.801	0.585	0.041	78.176	21.824
10		1.804	0.549	0.422	1.643	0.611	0.495	0.027	94.449	5.551	7.606	2.852	2.736	1.203	6.801	0.585	0.041	78.176	21.824

Table 9.- Forecast Error Variance Decomposition
(Asia vs Eurozone)

Each row shows the proportion of the variance of the return X_i that is explained by each of the returns X_j. Each column shows the explicative capacity of the return X_j in the return X_i. The variable "Rest" shows the percentage of the decomposition of the variance of the forecast error of X_i explained by the rest of returns X_j. The order of presentation of the returns is not arbitrary, it follows the trading hours (GMT) of each market.

	4/1/1995 - 1/7/1997									1/11/1997 - 15/5/2000								
Days	**Japan$_j$**	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**	**Japan$_j$**	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**
Japan$_i$																		
5	99.141	0.092	0.037	0.555	0.147	0.005	0.017	0.006	0.859	93.932	0.519	0.297	0.547	0.245	0.257	0.021	4.182	6.068
10	99.141	0.092	0.037	0.555	0.147	0.005	0.017	0.006	0.859	93.932	0.519	0.297	0.547	0.245	0.257	0.021	4.182	6.068
South Korea$_i$																		
5	0.043	99.626	0.001	0.066	0.035	0.027	0.001	0.201	0.374	5.271	90.548	0.261	0.006	1.075	0.046	0.463	2.331	9.452
10	0.043	99.626	0.001	0.066	0.035	0.027	0.001	0.201	0.374	5.271	90.548	0.261	0.006	1.075	0.046	0.463	2.331	9.452
Philippines$_i$																		
5	0.754	0.353	92.986	3.022	0.092	1.591	1.101	0.101	7.014	5.627	7.146	74.152	2.247	1.078	3.720	0.487	5.544	25.848
10	0.754	0.353	92.986	3.022	0.092	1.591	1.101	0.101	7.014	5.627	7.146	74.151	2.247	1.078	3.720	0.487	5.544	25.849
Malaysia$_i$																		
5	3.258	0.008	7.700	87.430	1.011	0.013	0.216	0.364	12.570	6.715	2.888	4.408	84.954	0.277	0.180	0.028	0.550	15.046
10	3.258	0.008	7.700	87.430	1.011	0.013	0.216	0.364	12.570	6.715	2.888	4.408	84.954	0.277	0.180	0.028	0.550	15.046
Hong Kong$_i$																		
5	5.844	0.301	6.452	12.299	74.152	0.509	0.017	0.427	25.848	10.300	4.456	9.547	2.499	71.127	0.151	0.114	1.806	28.873
10	5.844	0.301	6.452	12.299	74.152	0.509	0.017	0.427	25.848	10.300	4.456	9.547	2.499	71.127	0.151	0.114	1.806	28.873
Indonesia$_i$																		
5	0.387	0.194	10.921	9.616	2.014	75.069	1.785	0.015	24.931	4.375	5.760	10.225	4.681	2.498	70.913	0.146	1.402	29.087
10	0.387	0.194	10.921	9.616	2.014	75.069	1.785	0.015	24.931	4.375	5.760	10.225	4.681	2.498	70.913	0.146	1.402	29.087
Thailand$_i$																		
5	0.591	0.198	2.642	5.444	4.620	0.456	86.030	0.019	13.970	8.888	8.157	15.771	3.885	3.450	2.384	55.057	2.408	44.943
10	0.591	0.198	2.642	5.444	4.620	0.456	86.030	0.019	13.970	8.888	8.157	15.771	3.885	3.450	2.384	55.057	2.408	44.943
Eurozone$_i$																		
5	7.590	0.472	1.025	1.149	2.068	1.217	0.031	86.448	13.553	7.119	1.585	1.943	0.393	5.709	0.084	0.389	82.779	17.221
10	7.590	0.472	1.025	1.149	2.068	1.217	0.031	86.448	13.553	7.119	1.585	1.943	0.393	5.709	0.084	0.389	82.779	17.221

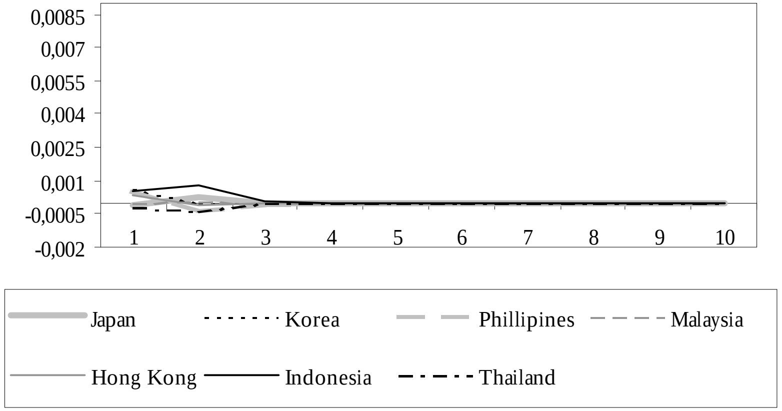
Table 10.- Forecast Error Variance Decomposition
(Asia vs Latin America)

Each row shows the proportion of the variance of the return X_i that is explained by each of the returns X_j. Each column shows the explicative capacity of the return X_j in the return X_i. The variable "Rest" shows the percentage of the decomposition of the variance of the forecast error of X_i explained by the rest of returns X_j. The order of presentation of the returns is not arbitrary, it follows the trading hours (GMT) of each market.

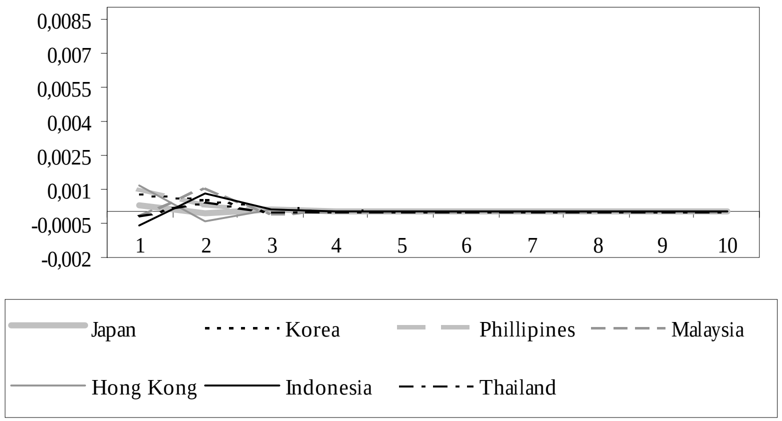
		4/1/1995 - 1/7/1997									1/11/1997 - 15/5/2000								
Days		**Japan$_j$**	**South Korea $_j$**	**Philippines $_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**	**Japan$_j$**	**South Korea$_j$**	**Philippines$_j$**	**Malaysia$_j$**	**Hong Kong$_j$**	**Indonesia$_j$**	**Thailand$_j$**	**United States$_j$**	**Rest$_j$**
	Japan$_i$																		
5		96.632	0.209	0.177	1.133	0.200	0.099	0.007	1.543	3.368	94.288	0.421	0.191	0.580	0.237	0.306	0.029	3.948	5.712
10		96.632	0.209	0.177	1.133	0.200	0.099	0.007	1.543	3.368	94.288	0.421	0.191	0.580	0.237	0.306	0.029	3.948	5.712
	South Korea$_i$																		
5		0.387	98.983	0.021	0.002	0.034	0.003	0.091	0.481	1.017	5.145	90.187	0.374	0.004	1.056	0.004	0.416	2.815	9.813
10		0.387	98.983	0.021	0.002	0.034	0.003	0.091	0.481	1.018	5.145	90.186	0.374	0.004	1.056	0.004	0.416	2.815	9.814
	Philippines$_i$																		
5		0.350	0.279	92.304	2.419	0.069	0.739	1.591	2.249	7.696	5.545	6.304	72.373	2.348	0.989	4.076	0.439	7.927	27.627
10		0.350	0.279	92.302	2.419	0.069	0.739	1.591	2.250	7.698	5.544	6.304	72.373	2.348	0.989	4.076	0.439	7.927	27.627
	Malaysia$_i$																		
5		2.037	0.088	4.135	90.497	0.005	0.121	0.137	2.980	9.503	6.594	2.760	4.204	85.022	0.264	0.242	0.036	0.877	14.978
10		2.037	0.088	4.135	90.497	0.005	0.121	0.137	2.980	9.503	6.594	2.760	4.204	85.022	0.264	0.242	0.036	0.877	14.978
	Hong Kong$_i$																		
5		3.928	0.486	4.312	5.470	78.326	1.178	0.022	6.278	21.674	9.065	3.761	7.971	2.634	70.265	0.323	0.094	5.888	29.735
10		3.928	0.486	4.312	5.470	78.326	1.178	0.022	6.278	21.674	9.065	3.761	7.971	2.634	70.265	0.323	0.094	5.888	29.735
	Indonesia$_i$																		
5		0.258	0.350	8.403	5.930	1.927	77.132	1.936	4.065	22.868	4.190	5.369	9.660	4.732	2.412	71.020	0.135	2.483	28.980
10		0.258	0.350	8.403	5.930	1.927	77.130	1.936	4.066	22.870	4.190	5.369	9.660	4.732	2.412	71.020	0.135	2.483	28.980
	Thailand$_i$																		
5		0.626	0.019	0.830	2.893	5.027	0.397	89.807	0.403	10.193	8.370	7.430	14.624	3.960	3.321	2.550	55.090	4.655	44.910
10		0.626	0.019	0.830	2.893	5.027	0.397	89.807	0.403	10.193	8.370	7.430	14.624	3.960	3.321	2.550	55.090	4.655	44.910
	Latin America$_i$																		
5		1.083	1.118	2.281	0.442	0.176	1.288	0.168	93.444	6.556	2.026	1.391	1.447	0.554	2.171	1.286	0.008	91.116	8.884
10		1.083	1.118	2.281	0.442	0.176	1.288	0.168	93.444	6.556	2.026	1.391	1.447	0.554	2.171	1.286	0.008	91.116	8.884

Graph 1.- Response of the United States to one standard error shock in the Asian markets

4/1/1995 - 1/7/1997

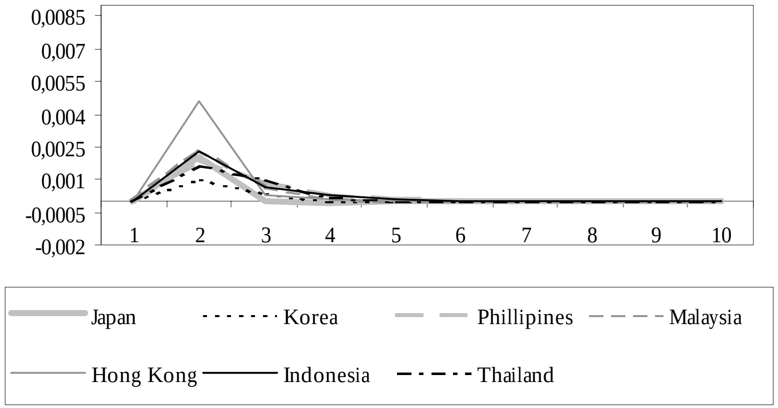


1/11/1997 – 15/5/2000

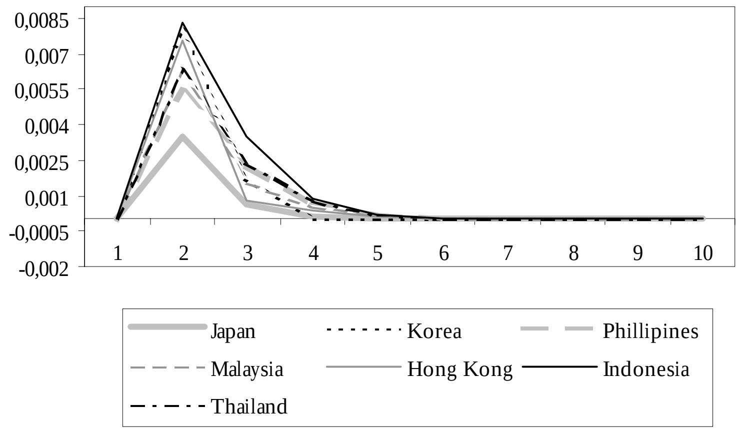


Graph 2.- Response of the Asian markets to one standard error shock in the United States

4/1/1995 - 1/7/1997

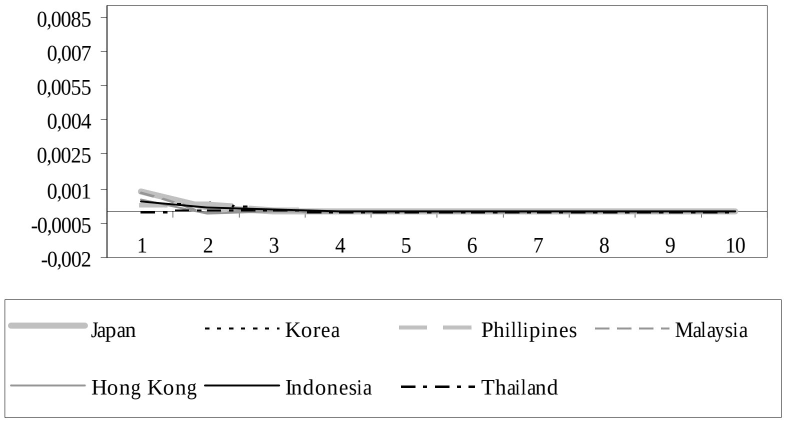


1/11/1997 – 15/5/2000

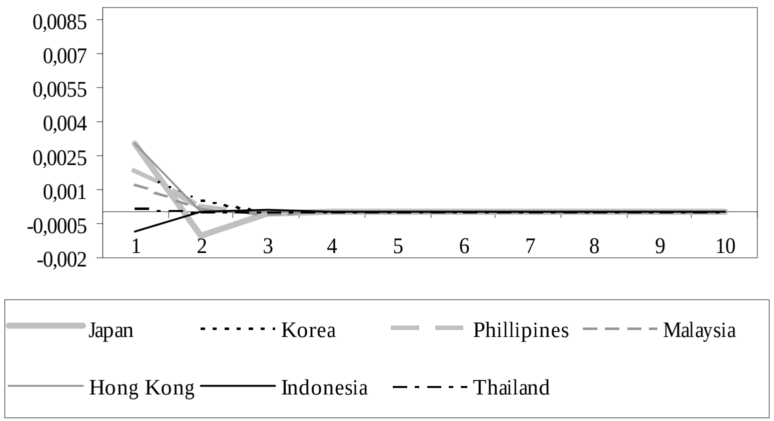


Graph 3.- Response of the United Kingdom to one standard error shock in the Asian markets

4/1/1995 - 1/7/1997

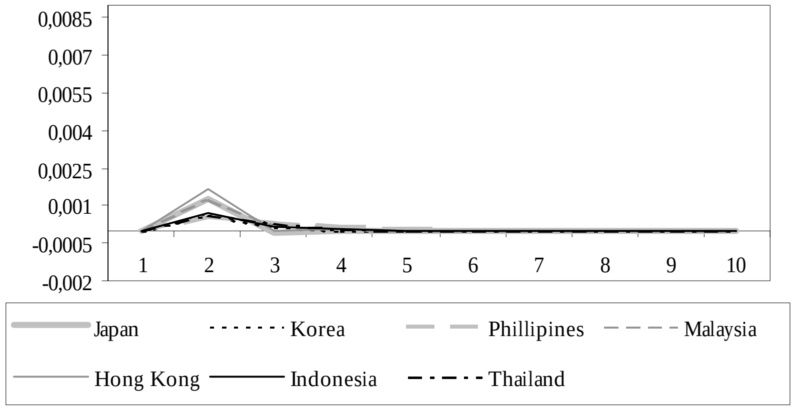


1/11/1997 – 15/5/2000

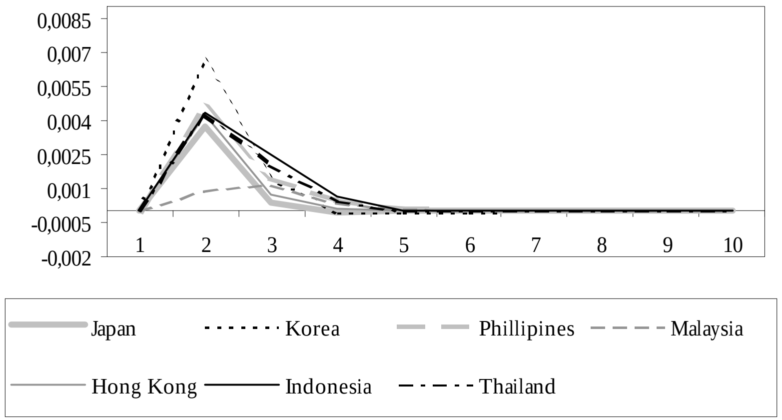


Graph 4.- Response of the Asian markets to one standard error shock in the United Kingdom

4/1/1995 - 1/7/1997

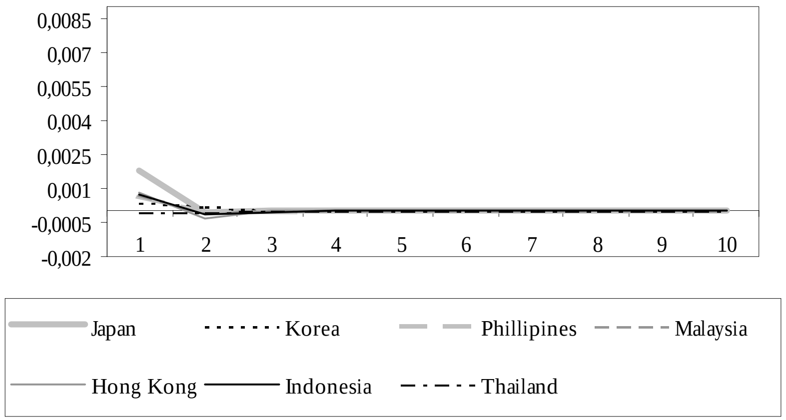


1/11/1997 – 15/5/2000

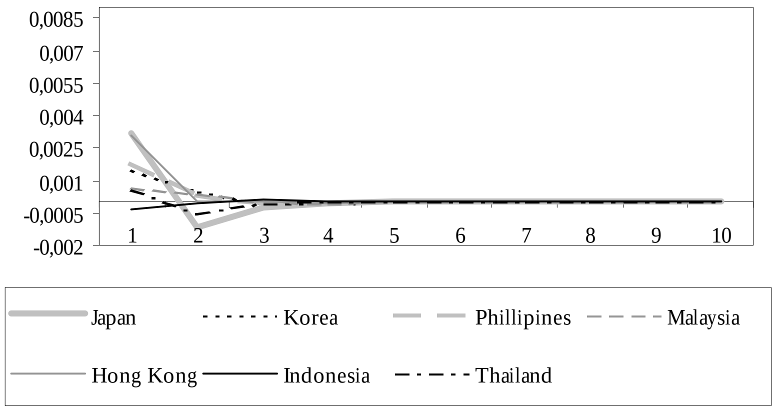


Graph 5.- Response of Eurozone to one standard error shock in the Asian markets

4/1/1995 - 1/7/1997

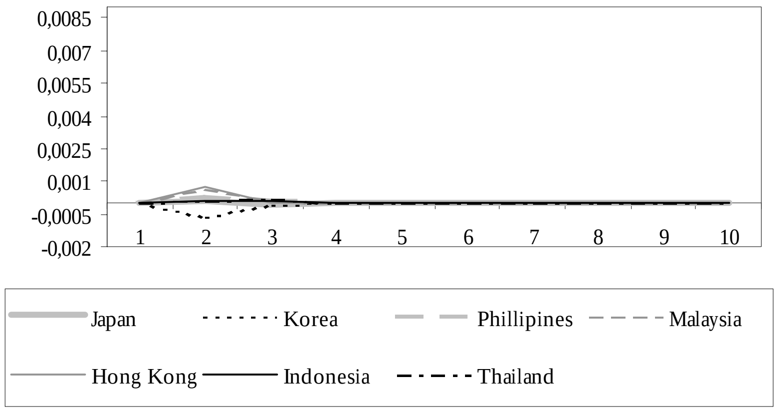


1/11/1997 – 15/5/2000

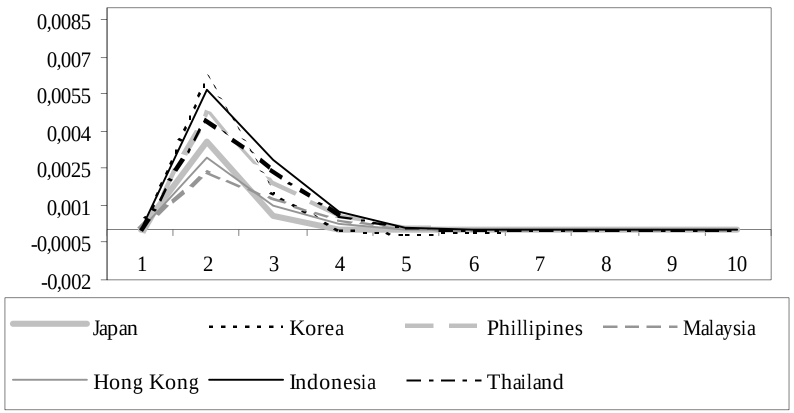


Graph 6.- Response of the Asian markets to one standard error shock in the Eurozone markets

4/1/1995 - 1/7/1997

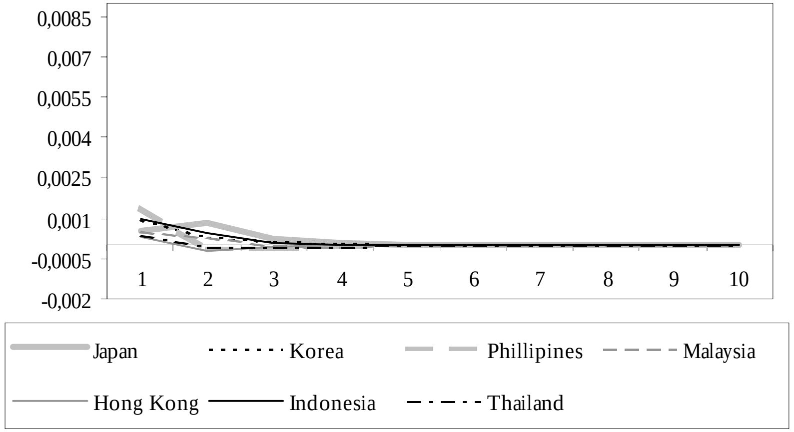


1/11/1997 – 15/5/2000

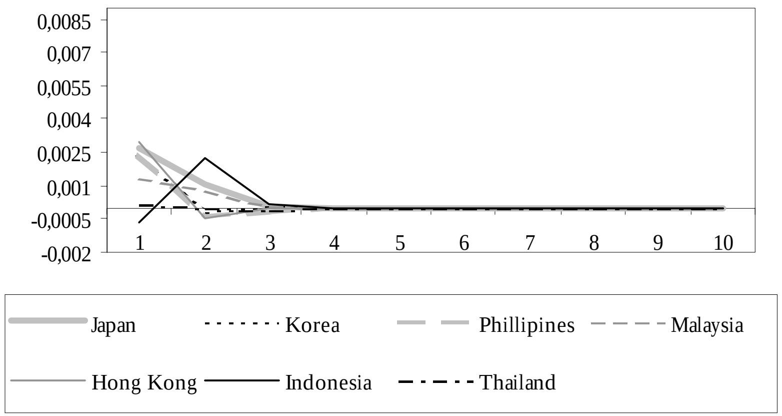


Graph 7.- Response of the Latin American markets to one standard error shock in the Asian markets

4/1/1995 - 1/7/1997

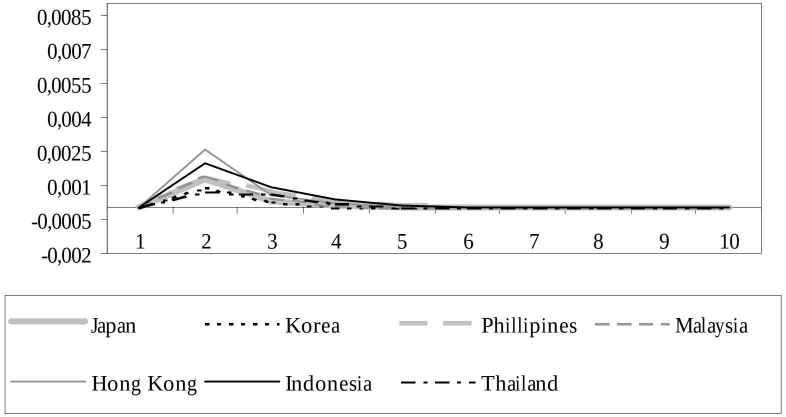


1/11/1997 – 15/5/2000



Graph 8.- Response of the Asian markets to one standard error shock in the Latin American markets

4/1/1995 - 1/7/1997



1/11/1997 – 15/5/2000