Impacts of Japanese and the US monetary policies on Asian economies

Lixing Sun*

and

Makoto Ohta**

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* Lixing Sun, Foreign Researcher, Institute of Policy and Planning Sciences, University of Tsukuba.
** Makoto Ohta, Professor, Institute of Policy and Planning Sciences, University of Tsukuba.
Corresponding to Lixing Sun: Institute of Policy and Planning Sciences, University of Tsukuba, Tsukuba, Ibaraki, 305-8573, Japan.
E-mail: lixing@shako.sk.tsukuba.ac.jp.

Abstract

This study empirically examines the impacts of the US and Japanese monetary policies on the real and monetary markets in Korea, Malaysia, Indonesia, the Philippines and Thailand. We have employed a bivariate EGARCH model instead of VAR to explore not only mean but also volatility spillover effects. Our major findings indicate that both Japanese and the US monetary policies have affected Asian economies significantly. In particular, Japanese monetary policy has a powerful impact on Indonesian economies, whereas the US monetary policy has influenced Malaysian and Philippines' economies strongly.

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1 Introduction

Capital market liberalization was pursued in Asian developing countries since 1980. The liberal policies were motivated by the desire to rely on foreign capitals to promote domestic economic growth. Recent liberalization of restrictions on external and domestic financial transactions attracted a surge of capital inflows to Asian developing countries. Foreign capital inflows played an important role in financing domestic investment and stimulating economic growth in these countries. However, the integration of international capital markets made Asian economies more susceptible to foreign monetary shocks, since the risk of a sudden reversal in capital inflows increased over the process of capital market liberalization. In fact, Asian developing countries suffered sharp private capital outflows, which triggered the Asian currency crisis in mid-1997.

As the trade and financial linkage between Asian developing countries and foreign developed countries, especially the US and Japan, became closer over time, foreign monetary shocks, arising from the US and Japan, influenced Asian economies more significantly. In this sense, Asian developing countries have to monitor the US and Japanese monetary policy and enhance the policy coordination with the US and Japan. Asia Pacific Economic Cooperation (APEC) ministerial and summit meetings have created a forum to enhance economic cooperation among Asia and the Pacific region. So, Asian developing countries can use the regional meetings to strengthen the policy coordination with the US and Japan through policy dialogue.

Most recent researches have related economic fluctuations of Asian developing countries to foreign monetary shocks. Glick and Hutchison (1990), Awad and Goodwin (1998), Anoruo *et al* (2002) have found that Japanese and the US interest rates have influenced Asian interest rates significantly. Bekaert and Harvey (1997), Ng (2000) and Miyakoshi (2003) have shown that the fluctuations in Japanese and the US stock prices have a large impact on Asian stock markets. In addition, Fornari and Levy (2000), Kaminsky and Reinhart (2001), King (2001) and among others, have emphasized the non-trivial impact of Japanese monetary policy on Asian monetary markets.

So far, the above existing literature has examined spillover effects from Japan and the US to Asian developing countries. Nevertheless, few studies have focused on the spillover effects on both monetary and real markets, and compared the impact of Japanese monetary policy with that of the US one on Asian economies. It is vital importance of understanding comparative spillover effects of the US and Japanese monetary policies on Asian economies, in order to realize the policy coordination with the US or Japan in Asian developing countries.

The purpose of this study is to investigate how output and money supply in Asian developing countries are influenced by Japanese and the US monetary policies, and which of these two developed countries has a stronger policy impact on Asian economies. This study has paid particular attention to the comparative impacts of Japanese and the US monetary policies in each sample country. Therefore, our quantitative evidence provide important information for the individual authority of Asian developing countries to identify which is more significant on its monetary and real markets, the impact of Japanese monetary policy or that of the US one.

The transmission mechanism about how foreign interest rate influences domestic real economy is very complicated. Foreign monetary policy can affect domestic aggregate demand through a lot of channels, such as interest rate channel, exchange rate channel, bank lending channel and asset price channel. So the response of Asian economies to the change in foreign monetary policy incorporates the impacts of a variety of channels, since the aforementioned channels of monetary transmission are not mutually exclusive.

In this study, we focus on the time-series data analysis to examine the spillover effects of Japanese and the US monetary policies on Asian economies. Since bi-directional domestic causality effects between output and money supply should be taken into account in examining the impacts of foreign monetary policies on domestic output and money supply, a bivariate time-series model with both monetary and real variables is preferably applied to the empirical analysis. We use exponential generalized autoregressive conditional heteroscedasticity (EGARCH) model instead of the traditional vector autoregressive (VAR) model. The reasons are given as follows.

Much of private capital inflows to Asian developing countries have taken the form of short-term loans or portfolio investment. This portion of foreign capital inflows is particularly susceptible to the changes in foreign investors' sentiment and confidence. Since the changes in foreign interest rates influence the expectations of foreign investors about the future course of domestic economic indicators (e.g. exchange rate, inflation and economic growth, etc.), such changes will affect their investment behavior which leads to the fluctuation in short-term capital flows.[1]

Also, the presence of incomplete and asymmetric information can generate the volatility of foreign capital flows, thereby causing the unexpected fluctuation in domestic monetary and real markets. As Cheung and Fujii (2001) indicated, in the presence of imperfect information, output is affected by unexpected change in money supply, and subsequently,

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[1] The worst scenario was Asian currency crisis in the late 1997. Sudden shifts in market sentiment and confidence caused foreign investors to withdraw their funds en masse, and to refuse to roll over maturing short-term loans, which triggered Asian economic turmoil. For the detailed descriptions, see Chang and Velasco (1998), Furman and Stiglitz (1998), Radelet and Sachs (1998), and Corsetti, *et al* (1999).

output volatility is also related to monetary volatility. Since VAR model is based on the assumption of homoscedastic errors, the time-varying conditional variance will cause the estimator to be not inconsistent and efficient any longer.

Furthermore, the volatility of money supply and output, like the volatility of stock price, is not symmetric phenomenon. Nelson (1991), Engle and Ng (1993) and among others have indicated that larger volatility is associated with unexpected fall in the market return. In other words, negative shocks raise volatility more than positive shocks in the market. Since the GARCH volatility processes impose a symmetry constraint on the conditional variance function in past shocks, we examine volatility effects by using the bivariate extension of Nelson's (1991) EGARCH model, which is capable of explicitly capturing intrinsic asymmetry in the volatility spillover mechanism. Besides that, one more advantage of EGARCH model is that unlike GARCH model, there are no restrictions on the parameters to ensure non-negativity of the conditional variance, since EGARCH is a model of the logarithm of the conditional variance.

Therefore, the following analysis builds on a bivariate EGARCH model with not only money supply but also real output, including foreign-domestic interest rate differentials and foreign interest rate volatility as exogenous variables. Since short-term capital flows are sensitively affected by foreign-domestic interest rate differentials, we examine how real interest rate differentials affect real economies of Asian developing countries. In addition, the changes in foreign investors' sentiment and confidence may be related to the uncertainty about the changes in foreign monetary policies. Thus, we add the monthly variance of daily short-term foreign interest rate as a proxy for foreign interest rate volatility in the EGARCH model, which captures the unexpected fluctuation in foreign monetary policy.[2]

We examine Korea, Malaysia, Indonesia, the Philippines and Thailand, using monthly data during August 1985 and June 1997. Our major result is that Japanese and the US monetary policies have affected real and monetary markets of Asian sample countries significantly. Nonetheless, the impacts of Japanese and the US monetary policies on Asian economies are different from country to country. In particular, Japanese monetary policy has influenced Indonesian economies strongly, while the US monetary policy has affected Malaysian and the Philippines' economies significantly.

The remainder of this study is organized as follows. Section 2 presents a bivariate EGARCH model. Section 3 describes the data set and explains the testable hypotheses. Section 4 discusses the estimation results. Section 5 provides the concluding remarks.

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[2] Some previous studies have concerned the issue of interest rate volatility. For instance, Fung *et al* (1997) have studied the international interest rate transmission and volatility spillover effects; Kim and Sheen (2000) have examined the effects of monetary policy announcements on short-term interest rates and their volatility; Bo and Sterken (2002) have analyzed the impact of interest rate volatility on investment.

2 A Bivariate EGARCH Model

This paper presents a bivariate EGARCH (1,1) model modifying the framework of Miyakoshi (2003) to examine mean and volatility spillover effects of Japanese and the US monetary policies on Asian economies. Miyakoshi (2003) explores which is stronger on the stock returns in Asian developing countries, the spillover effect from Japanese stock market or that from the US stock market. We modify his framework by changing the focus from the spillover effects of the developed countries' stock markets on the stock return in Asian countries to the spillover effects on real as well as monetary variables. As an endogenous real variable, we consider real output Y, and as an endogenous monetary variable, we consider money supply M. Furthermore, we take call rate spread CS (to be defined later) as an exogenous monetary variable.

Specifically, our model is formulated as follows:

$$\begin{pmatrix} Y_t \\ M_t \end{pmatrix} = \begin{pmatrix} \alpha_Y \\ \alpha_M \end{pmatrix} + \sum_{i=1}^{m} \begin{pmatrix} \beta_{YY,t-i} & \beta_{YM,t-i} \\ \beta_{MY,t-i} & \beta_{MM,t-i} \end{pmatrix} \begin{pmatrix} Y_{t-i} \\ M_{t-i} \end{pmatrix}$$
$$+ \sum_{i=1}^{m} \begin{pmatrix} \gamma_{YJA,t-i} & \gamma_{YUS,t-i} \\ \gamma_{MJA,t-i} & \gamma_{MUS,t-i} \end{pmatrix} \begin{pmatrix} CS_{JA,t-i} \\ CS_{US,t-i} \end{pmatrix} + \begin{pmatrix} \varepsilon_{Y,t} \\ \varepsilon_{M,t} \end{pmatrix} \quad (1)$$

$$\varepsilon_t \mid I_{t-1} = \begin{pmatrix} \varepsilon_{Y,t} \\ \varepsilon_{M,t} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, H_t \right] \quad (2)$$

$$H_t = \begin{bmatrix} Var(\varepsilon_{Y,t}) & Cov(\varepsilon_{Y,t}\varepsilon_{M,t}) \\ Cov(\varepsilon_{M,t}\varepsilon_{Y,t}) \cdot & Var(\varepsilon_{M,t}) \end{bmatrix} = \begin{pmatrix} h_{YY,t} & h_{YM,t} \\ h_{MY,t} & h_{MM,t} \end{pmatrix} \quad (3)$$

$$\ln(h_{YY,t}) = \delta_{Y0} + \delta_{YY} \ln h_{YY,t-1} + \delta_{YM} \ln h_{MM,t-1} + \psi_Y (Z_{Y,t-1})$$
$$+ \sum_{i=1}^{m} \phi_{YJA,t-i} \ln \sigma^2_{JA,t-i} + \sum_{i=1}^{m} \phi_{YUS,t-i} \ln \sigma^2_{US,t-i} \quad (4)$$

$$\ln(h_{MM,t}) = \delta_{M0} + \delta_{MY} \ln h_{YY,t-1} + \delta_{MM} \ln h_{MM,t-1} + \psi_M (Z_{M,t-1})$$

$$+ \sum_{i=1}^{m} \phi_{MJA,t-i} \ln \sigma^2_{JA,t-i} + \sum_{i=1}^{m} \phi_{MUS,t-i} \ln \sigma^2_{US,t-i} \qquad (5)$$

$$\psi_i (Z_{i,t-1}) = \varphi_{1i} Z_{i,t-1} + \varphi_{2i} (|Z_{i,t-1}| - E|Z_{i,t-1}|) \qquad (6)$$

where $Z_{i,t} = \varepsilon_{i,t} / \sqrt{h_{i,t}} \sim N(0,1): \quad i = Y, M$

$$h_{YM,t} = h_{MY,t} = \rho \sqrt{h_{YY,t} h_{MM,t}} \qquad |\rho| < 1 \qquad (7)$$

In the above equations (1), (2) and (3), $CS_{JA,t}$ and $CS_{US,t}$ represent the monthly real call rate spreads (Japanese and the US one minus the Asian one, respectively) as a proxy for Japanese and the US monetary policy instruments, respectively. Y_t and M_t represent the real output and real money supply in Asian countries. $\varepsilon_{Y,t}$ and $\varepsilon_{M,t}$ are the error terms conditional on past information set I_{t-1}. H_t is a conditional matrix of the variance and covariance of the error terms, $\varepsilon_{Y,t}$ and $\varepsilon_{M,t}$. The (i,i)-element of H_t, $h_{ii,t}$ is the conditional variance of ε_{it} ($i = Y, M$). The (i,j)-element of H_t, $h_{ij,t}$, is the covariance between the output and money supply. $\beta_{YY,t-i}$ measures the own mean effect from Y_{t-i} to Y_t. $\beta_{MM,t-i}$ can be interpreted similarly. $\beta_{MY,t-i}$ measures the cross mean effect from Y_{t-i} to M_t. $\beta_{YM,t-i}$ can be interpreted similarly. $\gamma_{YJA,t-i}$ shows the mean spillover effect of Japanese monetary policy (i.e. $CS_{JA,t-i}$) in period $t-i$ on Asian real output in period t. (i.e. Y_t). $\gamma_{YUS,t-i}, \gamma_{MJA,t-i}$ and $\gamma_{MUS,t-i}$ can be interpreted similarly as mean spillover effects.

A priori, the mean spillover effects, γ_{YJA} and γ_{YUS}, can be negative or positive by following arguments, and so their signs are determined empirically. For example, we suppose that Japan raises its call rate. Then the capital moves from Asia (e.g. Korea) to Japan to seek a higher interest rate. This decreases the Korean GDP by the decrease of its money supply. So γ_{YJA} can be negative. On the other hand, this capital inflow to Japan will increase Japanese GDP by the increase of its money supply. The increase of Japanese GDP will increase Korean export to Japan, which increases Korean GDP. So γ_{YJA} can be positive.

Meanwhile, foreign volatility spillover effects are also estimated in the conditional variance equations (4) and (5). The $\sigma^2_{JA,t-i}$ and $\sigma^2_{US,t-i}$ denote the monthly variance of Japanese and the US call rates respectively, which capture the risk of fluctuations in foreign interest rates. $\phi_{YJA,t-i}$ measures the spillover effect of Japanese call rate volatility in period $t-i$ (i.e. $In\sigma^2_{JA,t-i}$) on the volatility of the real output in period t (i.e. $Inh_{YY,t}$). $\phi_{YUS,t-i}$, $\phi_{MJA,t-i}$ and $\phi_{MUS,t-i}$ can be interpreted similarly.

A priori, the volatility spillover effects, ϕ_{MJA} and ϕ_{MUS}, can be negative or positive by following arguments, and so their signs are determined empirically. For example, we suppose that Japan changes its call rate to a large extent. Then the change in capital flows to or from Asia (e.g. Korea) is large. In the case, the sharp reversal in capital flows will cause the large fluctuation in Korean money supply. Therefore, Korean authority is supposed to take the countermeasure in response to Japanese monetary shock. If Korean authority takes the countermeasure insufficiently, Japanese volatility spillover effect still remains. So ϕ_{MJA} can be positive. If the countermeasure has exactly offset Japanese volatility spillover effect, ϕ_{MJA} should be zero. If Korean authority takes the countermeasure excessively, then the volatility of its money supply possibly becomes even less than that in the case of no Japanese monetary shock. So ϕ_{MJA} can be negative.[3]

δ_{YY} measures the own effect of the volatility of Y_{t-1} {i.e. $In(h_{YY,t-1})$} on the volatility of Y_t {i.e. $In(h_{YY,t})$}. δ_{MM} can be interpreted similarly. δ_{MY} measures the cross effect of the

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[3] In the other case that Japan changes its call rate to a small extent, the change in capital flows to or from Korea is not large, and thus the fluctuation in Korean money supply from Japanese monetary shock is not severe. Therefore, Korean authority may allow this change in Japanese call rate. So ϕ_{MJA} should be positive.

volatility of Y_{t-1} {i.e. $In(h_{YY,t-1})$ } on the volatility of M_t {i.e. $In(h_{MM,t})$ }. δ_{YM} can be interpreted similarly.

Equation (6) describes the error terms of the equations (4) and (5), where z_{it} is a standardized innovation as shown in the second part of that equation. In equation (6), the right-hand side of $|z_{i,t-1}| - E|z_{i,t-1}|$ measures the magnitude effect, and the first term (i.e. $z_{i,t-1}$) measures the asymmetric effect.

In equation (7), the condition of $|\rho| < 1$ is needed to support the positive definiteness of the covariance matrix of normal distribution, and we assume the correlation coefficient ρ to be constant in the variance-covariance matrix H.

The bivariate EGARCH models are estimated by maximizing the following log-likelihood function.

$$L(\theta) = -T\ln(2\pi) - (1/2)\sum_{t=1}^{T}(\ln|H_t(\theta)| + \varepsilon_t(\theta)' H_t^{-1}(\theta)\varepsilon_t(\theta)) \qquad (8)$$

where θ is the parameter vector $\theta(\alpha,\beta,\gamma,\delta,\phi,\rho,\varphi)$ to be estimated. ε_t is the (1×2) vector of innovations given by equation (2). H_t is the (2×2) time-varying conditional variance-covariance matrix with diagonal elements given by equations (4) and (4.5), and cross-diagonal elements given by equation (7).

3 Sample Countries and Data Description

This paper investigates five Asian developing countries, Korea, Malaysia, Indonesia, the Philippines and Thailand. The data is monthly. All the data, except for Thailand's industrial production, are obtained from IMF's International Financial Statistics CD-ROM June 2002. Thailand's monthly industrial production index is available from the website of the Bank of Thailand. We use the seasonally adjusted industrial production index as the real output Y, and the seasonally adjusted money supply divided by the wholesale price index as the real money supply M. We use call rate as the interest rate. The expected inflation is defined as follows:

$$\pi_{i,t}^{e} \equiv \log p_{i,t+1}^{e} - \log p_t, \qquad i = JA, US \qquad (9)$$

Thus, the monthly real call rate spread $CS_{i,t}$ is defined by

$$CS_{i,t} = r_{i,t} - r_{A,t}; \qquad r_{i,t} = i_{i,t} - \pi^{e}_{i,t}, \qquad i = JA, US \tag{10}$$

where $r_{i,t}$ is a real call rate (a nominal call rate $i_{i,t}$ minus an expected inflation rate $\pi^{e}_{i,t}$) for the developed country i, ($i =$ Japan and the US). Likewise, $r_{A,t}$ is a real call rate in period t for the Asian sample country. In the following analysis, we follow the hypothesis of static expectation to calculate real interest rates.

In addition, we use real call rate spreads as proxies for foreign monetary policies to examine their spillover effects on Asian real output and money supply. The reasons are twofold. First, we choose Japanese and the US call rates (i.e. short-term interest rates), rather than long-term interest rates, respectively, since the government can control the short-term rates much more easily than the long-term rates. On the other hand, the Asian developing country is assumed to be so small that r_A is influenced by the interest rates of developed countries, and also it has no ability to influence the interest rates of developed countries. In this context, such a real interest rate spread will mainly reflect the fluctuation in the call rate of developed country.

Second, such a real call rate spread reflects not only nominal interest rate movements but also exchange rate and inflation rate movements, since it includes uncovered interest differential and the deviation from relative purchasing power parity.[4] Therefore, such a real call rate spread can influence dynamic international capital movements as well as real economic activities.

The σ^2_{JA} and σ^2_{US} are the monthly sample variance compiled by the daily call rates for Japan and the US: the daily call rate data is obtained from the Bank of Japan. The nominal call rates are uncollateralized overnight call rates for Japan and the federal fund rates for the US. The variance of foreign interest rates indicates their volatility, which will cause the unexpected changes in money supply and real output in these Asian sample countries.

The sample period ends in June 1997 for all the sample countries, but it starts from the different time points for different countries: August 1985 for Korea, January 1986 for

[4] The real interest rate spread can be decomposed into the following two terms. The former is the uncovered interest differential, while the latter is the deviation from relative purchasing power parity.

$$r_{i,t} - r_{A,t} \equiv (i_{i,t} + \Delta s^{e}_{A,t} - i_{A,t}) - (\pi^{e}_{i,t} + \Delta s^{e}_{A,t} - \pi^{e}_{A,t}) \qquad i = JA, US$$

Malaysia, May 1986 for Indonesia, December 1986 for Philippines, and January 1987 for Thailand.

The number of observations is approximately 140 on average for each country. The data for the whole period is illustrated in the Figure 1. The data exhibit large fluctuations over the whole period. The call rate spreads of Japan and the US behave similarly, but the variance of the nominal call rates of them behaves differently.

4 Empirical Results

In section 1, we have presented some plausible reasons why we use the EGARCH model instead of the traditional VAR model in the analysis. Besides the aforementioned reasons, one more reason, from the technical viewpoint, is that the volatility of monetary and real variables is conditional on the last one, possibly following autoregressive conditional heteroscedastic process. So, in the following analysis we check the statistical requirements to use our EGARCH model, firstly.[5]

Our procedure for choosing the best lag length of the variables in the EGARCH model is to test between one-order lag and a twelve-order lag, by using the minimum value of Schwarz Bayesian Information Criterion (SBIC). The squared residuals are then checked for the serial correlation by Ljung-Box Q test. If the serial correlation exists in the squared residuals, we sequentially choose the second-best lag structure until the squares residuals are not serially correlated. As a result, the optimal lag lengths of the variables for the five sample countries are all one. The results of Ljung-Box Q test for squared residuals are reported in Table 1. We compare the results of traditional bivariate VAR models with those of our bivariate EGARCH models.[6]

According to Table 1, the null hypothesis that the squared residuals are not serially correlated is rejected in the VAR model for Korea and Malaysia. In contrast, Q^2-statistics of our EGARCH model do not reject the null hypothesis for all the sample countries. Therefore, from the technical viewpoint, the VAR model is inadequate, whereas the EGARCH model is appropriate in the analysis.

Next, we report the maximum likelihood estimates of our bivariate EGARCH model in Table 2. The results show Japanese and the US spillover effects, as well as domestic

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5 The package used in the following analyses is RATS.

6 It should be noted that the statistics of Ljung-Box Q tests are based on the sum of squared residuals, which acts as a proxy of variance, so they may not fully illustrate the autocorrelation in variance. However, the estimates deriving from variance equations in EGARCH model, as will be shown in Table 2, indicate statistically significant autocorrelation in the variance of money supply or real output in most sample countries, except for Indonesia.

causality effects. As noted above, the purpose of this study is to compare spillover effects of Japanese and the US monetary policies on monetary and real markets in Asian developing country. Therefore, we compare the absolute values of Japanese and the US mean and volatility estimates respectively, and present the comparative results in Table 3. Table 3 illustrates the comparative impacts of Japanese and the US monetary polices on monetary and real markets in each sample country, respectively. We summarize the major findings and probable interpretations in each sample country as follows.

First, the mean spillover effects of Japanese monetary policy on Korean monetary and real markets are larger than those of the US ($|\hat{\gamma}_{YJA}| > |\hat{\gamma}_{YUS}|$ and $|\hat{\gamma}_{MJA}| > |\hat{\gamma}_{MUS}|$), whereas the volatility spillover effect of the US monetary policy on its monetary market is more significant than that of Japanese one ($|\hat{\phi}_{MUS}| > |\hat{\phi}_{MJA}|$).

The possible reason is that a vast amount of short-term foreign capital inflows take the form of bank credits (Table 4), and Japanese share is much larger than the US one (Table 5). In Korea, bank sectors appear to borrow large quantities of foreign funds, nonetheless, almost one-third foreign funds still flow into the non-bank private corporate (Table 5). So, Japanese monetary policy affects Korean monetary and real markets. On the other hand, the unexpected fluctuation in the US interest rate affects the volatility of short-term capital flows. Therefore, it causes the volatility of Korean money supply due to its de facto dollar-pegged exchange rate regime.

Second, the US monetary policy has played an important role in Malaysian real and monetary markets. In Malaysia, equity flows are much larger than bank credits (Table 4). At the end of 1994, Malaysian stock market capitalization amounted to 283 percent of GDP (Table 6), and over the period of 1990-96, the capitalized value of Malaysian equity market expanded from 48,611 to 309,179 millions (Table 7). The US investors hold larger quantities of foreign equities than Japanese investors (Table 8). Accordingly, the influence of the US monetary policy on Malaysian economies is remarkable.

Third, compared to the case of Malaysia, Japanese monetary policy has a predominant spillover effect on Indonesian real and monetary markets. In Indonesia, bank credits have become larger than equity flows over time (Table 4). Actually, bank assets grew to 57 percent of GDP at the end of 1994, while equities and bonds rose only to 30 and 6 percent, respectively (Table 6). The international bank loans from Japan to Indonesia are much larger than those from the US to Indonesia (Table 5). Furthermore, a large number of foreign credits are borrowed by private corporate. So we infer that Japanese monetary policy affects Indonesia economies more significantly than the US.

Fourth, the major finding of the Philippines is similar to the case of Malaysia. That is, the US monetary policy influences the Philippines' economies more significantly. In the Philippines, the amount of equity flows was overwhelming by the end of 1994, however, after 1995 the sharp increase of bank credits became considerable (Table 4). As for equity flows, net purchase of equities by the US investors is much larger than Japanese investors (Table 8). The role of equity investment in its economic growth is considerably important (Table 6). As for bank credits, the US share is also a little larger than Japanese one (Table 5). Overall, spillover effects of the US monetary policy are more significant than those of Japanese one on the Philippines' economies.

Fifth, the results of Thailand are opposite to the case of Korea. That is, the mean spillover effect of the US monetary policy on Thailand's real market is more significant than that of Japanese one ($|\hat{\gamma}_{YUS}| > |\hat{\gamma}_{YJA}|$), whereas the volatility effects of Japanese monetary policy on its real and monetary markets are larger than those of the US ($|\hat{\phi}_{YJA}| > |\hat{\phi}_{YUS}|$ and $|\hat{\phi}_{MJA}| > |\hat{\phi}_{MUS}|$).

The possible explanation is that short-term capital flows were dominated by bank credits (Table 4). Also, non-bank private corporate borrowed much more international loans than bank sectors, especially from Japanese banks (Table 5). However, most of foreign funds to non-bank sectors were used to volatile real estate investment, rather than equipment and plant investment.[7] So, Japanese monetary policy has larger volatility spillover effects on Thailand economies. On the other hand, stock market capitalization has a non-trivial position (Table 6), and the US investors' holdings of equities are larger than Japanese (Table 8). Therefore, the US monetary policy may affect Thailand's real market.

So far we have used a variety of statistical data to explain the empirical results, nonetheless, the above interpretation has its limitation since the statistical data is derived from different sources and its periods are also different each other. Thus, more convincible evidence and detailed discussion need to be done in the future research.

5 Concluding Remarks

This study has examined the spillover effects of Japanese and the US monetary policies

[7] For the detailed description of foreign capital investment in Thailand, see Radelet and Sachs (1998), Chang and Velasco (1998), and Corsetti, *et al* (1999).

on the five Asian developing countries by using a bivariate EGARCH model. As the international capital market becomes more integrated, the interdependence of national economies is growing. The global economic linkage may generate a speedy conduit for monetary shocks to be transmitted internationally. So an individual country may not be able to independently implement monetary policy any longer. Instead, the coordination of national policies is required. For the authorities of Asian developing countries, it is vital importance of identifying which is more significant on their monetary and real markets, the impact of Japanese monetary policy or that of the US one, since the trade and financial linkage between Asian developing countries and the two developed countries have increased sharply.

The results of this study indicate that both Japanese and the US monetary policies have affected Asian economies significantly. Nevertheless, impacts of Japanese and the US monetary policies on Asian economies are different from sample country to country. Specifically, Japanese monetary policy has influenced Indonesian economies strongly, while the US monetary policy has affected Malaysian and Philippines' economies significantly. Moreover, the spillover effects of Japanese and the US monetary policies on Korean economies is the exact opposite to the case of Thailand. In Korea, Japanese monetary policy has a large mean spillover effect, while the US monetary policy has a large volatility spillover effect. On the contrary, in Thailand, the US monetary policy has a large mean spillover effect, while Japanese monetary policy has a large volatility spillover effect.

We suggest some policy recommendation, based on the above results. Since Japanese and the US monetary policies have played an important role on Asian economies, Asian developing countries should strengthen the policy dialogue with Japan and the US. For example, Indonesia should strengthen the surveillance of Japanese economies and increase mutual consultation with Japan, while Malaysia and Philippines should reinforce the policy dialogue and coordination with the US.

Furthermore, in the study, we have employed EGARCH model to examine the influence of unexpected fluctuations in foreign monetary policies on the volatility of Asian monetary and real markets. For the objective of economic stabilization, Asian authorities need to pay a closer attention to the volatility spillover effect of foreign monetary policies than the mean spillover effect. Since we have shown a large volatility spillover effect of the US monetary policy in Korea and a large one of Japanese monetary policy in Thailand, Korea should keep a close eye on the US monetary policy, while Thailand should much concern Japanese monetary policy.

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Figure 1: Graphs of the Observed Data Series

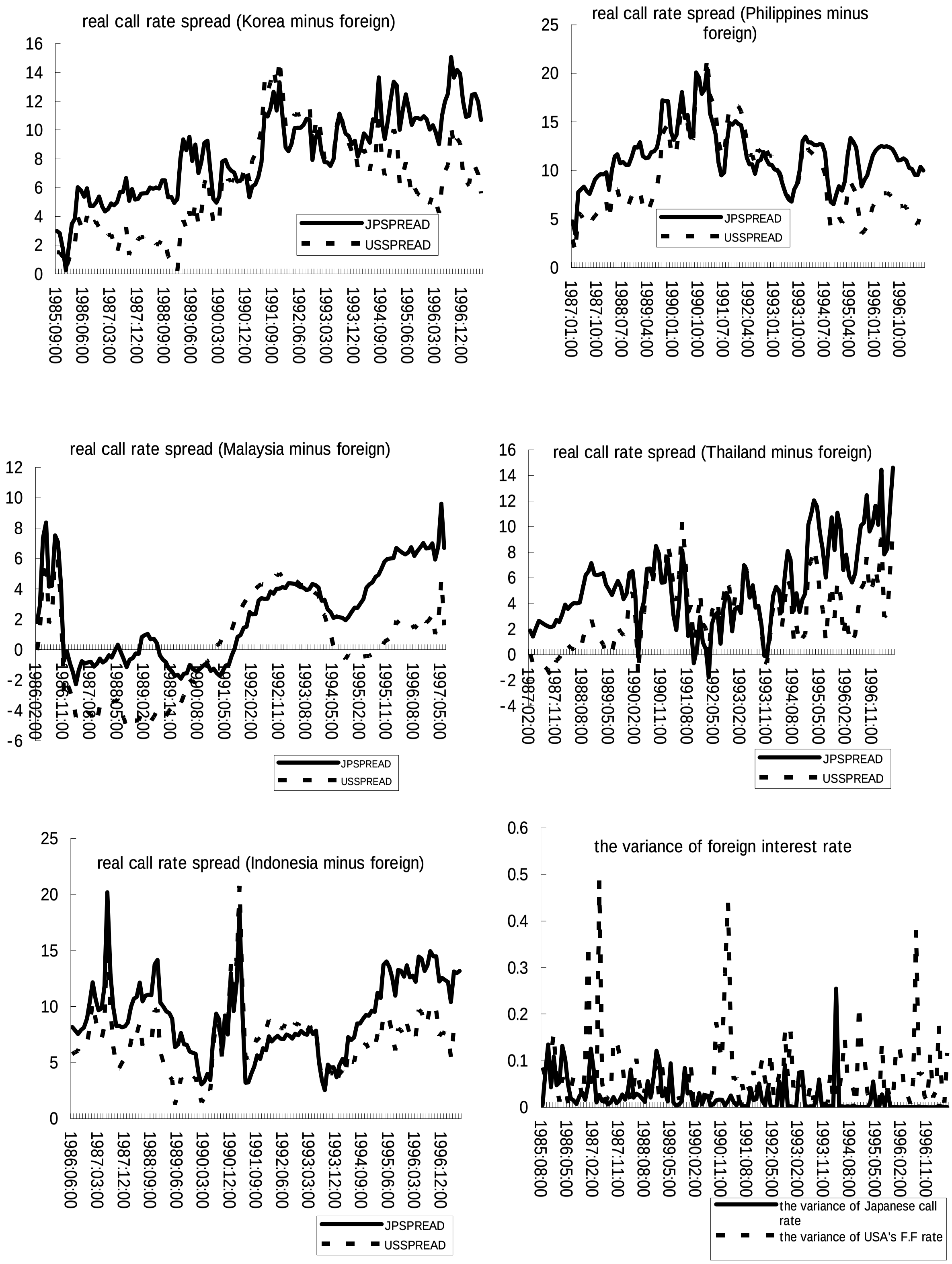

Table 1: Serial Correlation in Squared Residuals of VAR and EGARCH

Ljung-Box Q-statistic		$Q^2(6)$	$Q^2(12)$	$Q^2(18)$	$Q^2(24)$
VAR					
Korea	Y	19.53(0.00)	27.87(0.00)	33.86(0.01)	37.36(0.04)
	M	19.92(0.00)	22.32(0.03)	34.28(0.01)	41.78(0.01)
Malaysia	Y	12.33(0.05)	32.57(0.00)	38.41(0.00)	41.19(0.01)
	M	7.86(0.24)	24.49(0.02)	28.93(0.05)	35.30(0.06)
Indonesia	Y	12.59(0.05)	16.47(0.17)	22.06(0.23)	24.62(0.43)
	M	10.80(0.09)	14.02(0.30)	17.48(0.49)	18.89(0.76)
Philippines	Y	3.42(0.75)	7.90(0.79)	10.93(0.90)	16.31(0.88)
	M	3.66(0.72)	10.95(0.53)	18.75(0.41)	20.77(0.65)
Thailand	Y	8.96(0.17)	11.36(0.50)	17.66(0.48)	21.64(0.60)
	M	7.54(0.27)	10.87(0.54)	13.21(0.78)	15.61(0.90)
EGRACH					
Korea	Y	4.84(0.56)	11.56(0.48)	19.05(0.39)	25.28(0.39)
	M	5.43(0.49)	7.74(0.81)	16.07(0.59)	20.11(0.69)
Malaysia	Y	3.40(0.76)	9.35(0.67)	15.21(0.65)	20.98(0.64)
	M	4.75(0.57)	5.81(0.93)	8.22(0.98)	10.19(0.99)
Indonesia	Y	5.39(0.50)	8.52(0.74)	13.82(0.75)	27.37(0.29)
	M	11.90(0.06)	15.67(0.21)	18.14(0.45)	21.81(0.59)
Philippines	Y	2.90(0.82)	5.63(0.94)	9.04(0.96)	16.04(0.89)
	M	1.83(0.93)	6.87(0.87)	9.32(0.95)	13.33(0.96)
Thailand	Y	3.87(0.69)	8.08(0.78)	12.17(0.84)	16.66(0.86)
	M	3.89(0.69)	9.66(0.94)	11.13(0.89)	12.63(0.97)

Note: The numbers in parentheses after Q^2 are lag lengths. The numbers out of and in parentheses of the main body of the table are χ^2-statistics and p-values, respectively.

Table 2: Parameter Estimation of Bivariate EGARCH (1,1)

	Domestic Effects								Japan and the US Effects							
	Mean Equation ($\hat{\beta}$)				Variance Equations ($\hat{\delta}$)				Mean Equation ($\hat{\gamma}$)				Variance Equations ($\hat{\phi}$)			
	Y→Y	M→Y	Y→M	M→M	Y→Y	M→Y	Y→M	M→M	J→Y	U→Y	J→M	U→M	J→Y	U→Y	J→M	U→M
Korea	0.94	0.02	-0.04	0.99	-0.53	0.60	-0.46	-0.59	-0.30	0.19	-0.63	-0.11	0.06	0.13	-0.15	0.27
	(0.00)	(0.27)	(0.13)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.06)	(0.00)	(0.37)	(0.48)	(0.24)	(0.07)	(0.02)
Malaysia	-0.01	-0.17	-0.21	0.89	0.06	0.45	0.58	0.50	-0.21	0.32	-0.13	-0.11	0.09	-0.18	-0.07	0.25
	(0.89)	(0.00)	(0.00)	(0.00)	(0.84)	(0.08)	(0.13)	(0.07)	(0.16)	(0.00)	(0.28)	(0.27)	(0.42)	(0.30)	(0.36)	(0.08)
Indonesia	0.71	0.09	-0.01	0.79	-0.09	1.25	0.42	-0.13	-0.14	-0.09	-0.21	0.03	-0.23	0.14	0.21	0.11
	(0.00)	(0.00)	(0.93)	(0.00)	(0.67)	(0.01)	(0.01)	(0.58)	(0.06)	(0.38)	(0.17)	(0.89)	(0.00)	(0.28)	(0.01)	(0.09)
Philippines	0.67	-0.15	-0.04	0.70	0.03	-0.10	0.16	-0.80	0.50	-0.13	-0.17	0.25	-0.04	0.10	0.06	-0.62
	(0.00)	(0.07)	(0.14)	(0.00)	(0.87)	(0.35)	(0.00)	(0.00)	(0.01)	(0.28)	(0.00)	(0.00)	(0.42)	(0.21)	(0.35)	(0.00)
Thailand	0.72	0.07	0.06	0.85	-0.44	-0.77	0.00	0.18	0.16	-0.43	-0.10	-0.14	-0.27	0.10	0.01	-0.01
	(0.00)	(0.03)	(0.30)	(0.00)	(0.09)	(0.06)	(0.81)	(0.39)	(0.01)	(0.00)	(0.46)	(0.41)	(0.00)	(0.49)	(0.10)	(0.37)

Notes: P-values for the estimated parameters appear in parentheses. Mean equation is equation (1). Variance equations are equations (4) and (5).

Table 3: Comparative Impacts of Japanese and the US Monetary Policies on Asian Developing Countries

	Real Spillover Effects		Monetary Spillover Effects	
	Mean Spillover Effects	Volatility Spillover Effects	Mean Spillover Effects	Volatility Spillover Effects
Korea	J**	(U)	J**	U**
Malaysia	U**	(U)	(J)	U*
Indonesia	J*	J**	(J)	J**
Philippines	J**	(U)	U**	U**
Thailand	U**	J**	(U)	J*

Note: 1. J represents that Japanese spillover effect is larger than the US one by comparing the absolute values of their estimates. Similarly, U represents that the US spillover effect is larger than Japanese one.

2. ** indicates statistical significance at 5%; * indicates statistical significance at 10%.

3. The character in the parenthesis denotes that the estimate of foreign spillover effect is statistically insignificant.

Table 4: Net Short-term Capital Inflows (US$ millions)

	1992	1993	1994	1995	1996
Korea					
Equity flows	2,057	5,659	1,580	2,205	2,956
Bank credits	3,806	1,782	15,314	24,351	35,119
Malaysia					
Equity flows	5,439	11,664	8,986	4,604	5,361
Bank credits	2,001	4,518	-2,924	1,472	4,159
Indonesia					
Equity flows	1,947	2,692	2,573	4,285	5,195
Bank credits	663	1,573	2,030	8,021	12,602
Philippines					
Equity flows	268	812	1,558	1,609	3,517
Bank credits	302	-2,843	115	1,513	3,875
Thailand					
Equity flows	1,538	4,337	259	3,238	2,718
Bank credits	4,630	3,964	11,490	17,828	9,531

Source: Institute of International Finance, *Comparative Statistics for Emerging Market Economies*, 1998.

Table 5: International Bank Lending to Five Asian Developing Countries (US$ billions)

	Total outstanding	Short-term loans	Distribution by Sector			Japanese share	the US share
			Bank	Public	Non-bank		
End 1995							
Korea	77.5	54.3	50	6.2	21.4	21.5	7.6
Malaysia	16.8	7.9	4.4	2.1	10.1	7.3	1.5
Indonesia	44.5	27.6	8.9	6.7	28.8	21	2.8
Philippines	8.3	4.1	2.2	2.7	3.4	1	2.9
Thailand	62.8	43.6	25.8	2.3	34.7	36.9	4.1
End 1996							
Korea	100	67.5	65.9	5.7	28.3	24.3	9.4
Malaysia	22.2	11.2	6.5	2	13.7	8.2	2.3
Indonesia	55.5	34.2	11.7	6.9	36.8	22	5.3
Philippines	13.3	7.7	5.2	2.7	5.3	1.6	3.9
Thailand	70.2	45.7	25.9	2.3	41.9	37.5	5
Mid-1997							
Korea	103.4	70.2	67.3	4.4	31.7	23.7	10
Malaysia	28.8	16.3	10.5	1.9	16.5	10.5	2.4
Indonesia	58.7	34.7	12.4	6.5	39.7	23.2	4.6
Philippines	14.1	8.3	5.5	1.9	6.8	2.1	2.8
Thailand	69.4	45.6	26.1	2	41.3	37.7	4

Source: Radelet and Sachs (1998)

Table 6: Relative Position of Bank Assets, Equities and Bonds in 1994 (% GDP)

Country	Bank assets	Stock market capitalization	Bond market
Korea	75	51	43
Malaysia	100	283	56
Indonesia	57	30	6
Philippines	54	87	39
Thailand	110	94	10

Source: Dalla and Khatkhate (1996)

Table 7: Stock Market Capitalization, 1990-1996 (US$ millions)

Market	End 1990	End 1996	% Change in 1990-96
Korea	110,594	138,817	20.3
Malaysia	48,611	309,179	84.3
Indonesia	8,081	91,016	91.1
Philippines	5,927	80,649	92.7
Thailand	23,896	99,828	76.1

Source: International Finance Corporation, *Emerging Stock Markets Fact book*, 1996.

Table 8: Net Purchase of Foreign Securities by Japan and the US Investors (US $ billions)

	Equities		Bonds	
	Japan	the US	Japan	the US
1990	6.26	8.95	33.43	22.32
1991	3.63	31.19	70.68	15.65
1992	-3.01	32.21	37.37	18.60
1993	15.33	63.36	36.34	62.74
1994	14.06	47.13	69.55	11.58
1995	-0.16	50.28	93.76	48.29
1996	8.17	57.88	93.87	45.22

Source: IMF, *International Capital Market*, 1997.