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**International Transmission of US Monetary  
Policy Shocks: VAR Evidence  
from the Philippines**

*by*

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### **Abstract**

Based on Soyoung Kim's previous work for non-US G6 countries, I use evidence from recursive vector autoregressions (VARs) in order to analyze the international transmission mechanism of expansionary US monetary policy shocks to other countries. The method not only attempts to ascertain the workings of the mechanism itself, but it also tries to discern which theoretical model's predictions (Mundell-Fleming vs. the intertemporal model of Obstfeld and Rogoff) fit the data best. For the Philippines, at least, the initial evidence suggests that the transmission mechanism follows the traditional Mundell-Fleming model (a US monetary expansion is beggar-thy-neighbor and works primarily through exchange rate and trade balance effects).

# **International Transmission of US Monetary Policy Shocks: VAR Evidence from the Philippines**

**Renato E. Reside, Jr.<sup>1</sup>**

## **1. Introduction**

In a recent study, Soyoung Kim (2001) attempts to analyze the international monetary transmission mechanism of US monetary policy shocks in non-US G6 countries. Apart from ascertaining the workings of the transmission mechanism itself, Kim's study is an attempt to determine whether the pattern of responses to expansionary US monetary policy is consistent with the predictions of the traditional Mundell-Fleming model, or predictions of recent intertemporal models, such as Obstfeld and Rogoff (1995). Kim employs the empirical strategy of estimating vector autoregressions (VARs) containing US and aggregated international variables to achieve his objective, arguing that compared to other studies in the past which estimate structural models to analyze the transmission mechanism, the particular VAR model he uses "employs minimal identifying restrictions and does not depend much on a specific theoretical model."

In order to identify US monetary policy shocks, Kim estimates a VAR model with the policy shock identification method first introduced by Christiano, Eichenbaum and Evans (CEE) as a baseline. He then employs the "marginal" method and adds each international variable one by one to the baseline model, inferring the transmission mechanism of US monetary policy shocks through an analysis of the impulse responses from the resulting VAR estimates. In general, Kim finds that expansionary monetary shocks from the US lead to positive spillovers to output in non-US G-6 countries. He also finds that the US trade balance worsens after a shock, but then subsequently improves. After analyzing the pattern of impulse responses from the VARs, Kim concludes that extensions of traditional and intertemporal models need to be made in order to reconcile the data with the theoretical models.

This study employs Kim's techniques in an analysis of the impact of US monetary policy shocks on Asian countries. There is one important difference, however, and that is that the analysis is done one country at a time. Kim aggregates time series non-US G6 data in order to estimate his recursive vector autoregressions, while this study looks at disaggregated country-level data. This study therefore does not attempt to generalize the region's response to policy shocks, but rather tries to ascertain whether there are country-specific responses. One basic objective, however, remains the same – to determine whether the pattern of responses corresponds to the Mundell-Fleming model, or to new intertemporal and micro-founded sticky price models. Like Kim, an attempt is also made to identify non-recursive VARs of monetary policy.

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## **2. Traditional and Modern Models of the International Transmission Mechanism**

### **2.1 The Traditional Mundell-Fleming Model**

Until recently, the canonical model for analyzing international macroeconomic policy transmission in the presence of sticky prices has been the two-country version of the Mundell-Fleming model (MFD). The structure and implications of the 2-country MFD were first described in a static optimization problem in Mundell (1967). Since the MFD is too well-known to expound upon in detail here, it suffices to say that the two-country model essentially extended results from the one-country MFD into a two-country setting. Mundell's analysis focused on the international spillover effects of a monetary expansion in one country. The basic results are summarized succinctly as follows:

- 1) After a monetary expansion, the nominal interest rate falls in the expanding country;
- 2) This leads to a capital outflow, which then leads to an incipient depreciation of the currency of the expanding country;
- 3) In a two-country world, this means that the other country has undergone an incipient appreciation;
- 4) The depreciation leads to an increase in exports, a reduction in imports and an improvement in the trade balance of the expanding country (an expenditure-switching effect);
- 5) Conversely, the appreciation leads to a decrease in exports, an increase in imports and a deterioration in the trade balance of the other country;
- 6) The improvement in the trade balance, as well as the reduction in interest rate lead to a rise in the expanding country's output;
- 7) However, the other country's output has fallen because of the deterioration in its trade balance with the expanding country.

The implication of the foregoing is that a monetary expansion undertaken in one country is beggar-thy-neighbor. However, the result can be reversed if the monetary expansion in the home country increases income sufficiently to increase overall imports from the other country (an income absorption effect).<sup>2</sup> Note the prominence of the role of the exchange rate and its effect on the trade balance in the transmission mechanism.

In recent years, however, new microfounded and optimization-based models with nominal price rigidities have been developed to address the same questions. Such models bear little similarity in structure to the original MFD in that they rely on representative agent models typically solved by dynamic optimization. The latter models also come equipped with better-specified production and supply blocks which model nominal price rigidities as: a simple one-time price rigidity, or some form of price-staggering by producers.

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<sup>2</sup> See Betts and Devereux (2000) and Bergin (1996) for this possibility.

## 2.2 The Intertemporal Model

The publication of Obstfeld and Rogoff's (OR, 1995) paper represented an important shift in open economy model building. Prior to its publication, building general equilibrium open economy models was an elusive proposition, as researchers grappled with the complexities of putting together a complete optimization-based model which combined an intertemporal model of the current account, a well-specified production sector described by imperfect competition, and where pricing decisions by firms led to price rigidities, leading to monetary policy non-neutrality in the face of demand shocks.

It is important to note that Obstfeld and Rogoff's model is essentially an open economy version the sticky price closed economy model of Blanchard and Kiyotaki (1989). That model is one of monopolistically competitive firms. Initially the economy is at equilibrium, but this is disturbed by an unanticipated domestic money supply shock in one period. When the shock occurs, prices are assumed to be adjust and settled to their new equilibrium levels in only one period. Therefore, any real effects of monetary policy are felt within this period of adjustment. In this one period of interest, aggregate demand responds positively to a positive money shock. Since marginal revenue is above marginal cost for each imperfectly competitive firm, it pays for each of them to raise production in order to meet the increase in demand. Profits rise, but equally important, since firms are closer to the competitive level of output, the monopoly distortion is reduced and overall welfare has risen. What Obstfeld and Rogoff have done is to convert this into a two-country open economy model by adding a mechanism for foreign asset accumulation (a model of the current account), as well as assumptions regarding the exchange rate, interest rates, capital markets, and capital mobility.

In the pre-shock equilibrium in the intertemporal model, each agent must determine optimally:

- 1) Aggregate consumption dynamics (and thus asset holdings);
- 2) Relative demand for different goods (composition of aggregate demand); and
- 3) Production effort for own good

What are the effects of an unanticipated permanent shock to domestic money supply in the intertemporal model? Obstfeld and Rogoff assume that nominal prices in both countries are set one period in advance. After the monetary shock hits, prices adjust completely after one period. Thus, analysis covers just three periods: the initial steady state (time  $t - 1$ ), the period when the shock hits (time  $t$ ), and the next period, when the economy adjusts to the new steady state (time  $t + 1$ ).

A description of the international monetary transmission mechanism in the intertemporal model is available from different authors. Besides Obstfeld and Rogoff (1997), interpretations of the standard intertemporal model are available in Sarno (2000), Mark (2001), Lane (2001), Bowman and Doyle (2003), and Walsh (2003). In general, there are short-run effects (within the period the shock hits) and long-run effects (change in the steady state). Central for transmission of shock in short run is the nominal



exchange rate effect. Central for transmission of shock in long run is wealth redistribution between countries (i.e., if short-run effects imply current account imbalance, a country will accumulate claims of the other => permanent wealth effects).

### Short Run Impact

- 1) the real interest rate at home declines (with the size of the decline a function of the size of the home country), with several short-run effects:
  - a) nominal home currency depreciation (terms of trade of home country declines), but in a manner that is less than proportional to the change in money) and nominal foreign currency appreciation (terms of trade of home country rises) occur due to arbitrage because uncovered interest parity is assumed to hold
  - b) the home depreciation raises the domestic price level and thus reduces the real price of domestic goods. Thus, aggregate demand (AD) at home increases; home consumption and income rise (so money is non-neutral in the short-run)
  - c) AD in the foreign country increases; foreign consumption rises, but the effect on home income is ambiguous because effect of decline in world real interest rate is offset by effect of appreciation
- 2) From 1a, home consumption rises by less than the increase in home output (due to need to smooth consumption), so in the short-run, home runs a current account (CA) surplus; home net foreign assets (NFA) increase
- 3) From 1b, the nominal home depreciation translates into a nominal foreign appreciation, leading to expenditure-switching away from foreign goods. This, coupled with the fact that foreign consumption rises means that in the short-run, the foreign country runs a CA deficit; net foreign assets decline in the foreign country

### Long-run impact

- 4) Increased NFA due to the CA surplus generates a wealth effect at home in the long-run: domestic labor supply falls, and therefore the supply of domestic goods falls. In the steady state, this implies a domestic trade deficit, since a positive net investment income inflow allows consumption to remain permanently above domestic output. Terms of trade (TOT) at home rises in the long-run.
- 5) Reduced NFA due to the CA deficit generates a wealth effect in the foreign country in the long-run: foreign labor supply rises, supply of domestic goods rises. In the steady state, this implies a domestic trade surplus, since a net investment income outflow forces consumption to remain permanently below domestic output. TOT in the foreign country falls in the long-run.

At the initial stages, the intertemporal model has the same basic predictions compared to Mundell-Fleming. The domestic monetary expansion should lead to a fall in interest rates and a home currency depreciation and a temporary increase in home income. Because of consumption smoothing, home consumption rises by less than the increase in income, so the home current account improves. However, the home current account may worsen if the fall in the interest rates induces a sufficiently high increase in investment. The fall in the world interest rate, however, increases aggregate demand in both countries, so foreign output may grow.

The long-run effects of the monetary shock occur due to wealth redistribution via the CA. The Obstfeld-Rogoff model therefore predicts that money supply shocks can have real effects lasting beyond the time frame of the nominal rigidities because of the induced short-run wealth accumulation via the current account, providing a rationale for long-run non-neutrality of money.

### 3. Empirical Tests of the International Transmission Mechanism

#### 3.1 Recursive VAR Modeling

Consider an  $n \times 1$  vector of (endogenous) variables,  $y_t$ . From its name, a vector autoregression (VAR) is a vector of variables,  $y_t$ , regressed on time lags of itself:  $y_{t-1}, y_{t-2}, \dots, y_{t-p}$ , where  $p$  is the number of periods. In matrix notation, this is expressed as:

$$y_t = \mu + A_0 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t \quad (1)$$

$$y_t = A(L)y_{t-1} + \varepsilon_t$$

in matrix form, where  $\varepsilon_t$  is white noise and  $\text{cov}(\varepsilon_t) = \Omega$  and  $\mu$  is a vector of constants. Also,

$$A(L) = A_0 + A_1 L + A_2 L^2 + \dots + A_p L^p$$

$A(L)$  is an  $n \times n$  matrix polynomial in  $L$ , the lag operator,  $L = 0, 1, 2, \dots, p$ .

Since the VAR in (1) is a system of reduced form equations, the maximum likelihood estimate of the VAR (provided the disturbances are normally distributed and serially uncorrelated) is the same as OLS on each equation in the reduced form done separately. We therefore get consistent estimates of the coefficients of the VAR by implementing OLS on the RF equation by equation.

The standard approach taken is to examine pattern of responses to the vector of reduced form or structural form shocks (more on these later) to discern the time path of the effect of shocks on the endogenous variables over time.

If we ignore  $\mu$ , (1) implies that

$$\begin{aligned} [I - A(L)L]y_t &= \varepsilon_t \\ y_t &= [I - A(L)L]^{-1} \varepsilon_t \end{aligned} \quad (2)$$

where it is clear that the last equation above is the impulse-response function, or the vector moving average (VMA) form of the VAR, relating the vector of endogenous variables to the reduced-form shocks.

$$\begin{aligned} y_t &= C(L)\varepsilon_t \\ y_t &= \varepsilon_t + C_1\varepsilon_{t-1} + C_2\varepsilon_{t-2} + C_3\varepsilon_{t-3} + \dots \end{aligned} \quad (3)$$

Since (3) is a reduced form, it follows that the VMA is a series of responses of  $y_t$  to the reduced form shocks comprising  $\varepsilon_t$ . However, economists are usually more interested in determining the VMA and variance decomposition with respect to structural shocks, which we assume to be a linear function of the reduced form shocks:

$$u_t = F\varepsilon_t, \text{ with } \text{var}(u_t) = D \quad (4)$$

where  $F$  is an invertible  $n \times n$  matrix containing the coefficients of  $\varepsilon_t$ . The variance of the structural shocks is  $D$ . Usually,  $D$  is assumed to be diagonal. Using (4), we can rewrite the VMA in (3) as

$$y_t = F^{-1}u_t + C_1F^{-1}u_{t-1} + C_2F^{-1}u_{t-2} + C_3F^{-1}u_{t-3} + \dots \quad (5)$$

and the forecast error variance may be rewritten as:

$$E(y_{t+s} - E_t y_{t+s})(y_{t+s} - E_t y_{t+s})' = F^{-1}D(F^{-1})' + C_1F^{-1}D(F^{-1})'C_1' + \dots + C_{s-1}F^{-1}D(F^{-1})'C_{s-1}' \quad (6)$$

Both (4) and (5) have more profound economic interpretations than (1) and (3), respectively. However for us to be able to estimate (4) and (5), we need to be able to identify the structural parameters of the structural form of the model. Since  $D$  is usually taken to be equal to  $I$ , then this usually amounts to choosing an appropriate form for  $F$  that allows us to achieve exact- or over-identification.



Suppose economic theory suggests that the structural form of a model is:

$$Fy_t = \alpha + B_1 y_{t-1} + \dots + B_p y_{t-p} + u_t, \quad u_t \text{ is white noise, } \text{cov}(u_t) = D \quad (7)$$

then, since  $F$  is invertible, then we could rewrite (7) as

$$y_t = F^{-1}\alpha + F^{-1}B_1 y_{t-1} + \dots + F^{-1}B_p y_{t-p} + F^{-1}u_t \quad (8)$$

$$= \mu + A_1 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t \quad (9)$$

These imply that

$$\mu = F^{-1}\alpha, \quad A_k = F^{-1}B_k, \text{ and } \varepsilon_t = F^{-1}u_t, \text{ so that } \Omega = F^{-1}D(F^{-1})' \quad (10)$$

where  $\varepsilon_t$  is white noise and  $\text{cov}(\varepsilon_t) = \Omega$

The  $\varepsilon_t$  terms are called orthogonalized innovations, since when multiplied by the matrix  $F$ , they are orthogonal to the reduced form innovations  $u_t$ . Note that (8) and (9) are VAR forms, which are really reduced form models, since each variable is regressed against its own lags and lags of other variables, so therefore, all regressors are predetermined.

Since the reduced form (RF) in (8) and (9) may be estimated directly from time series data, it is possible to recover the structural parameters in the structural form (SF) in (7) provided we impose enough restrictions on the structural parameters  $F$ ,  $B_s$ ,  $\alpha$ , and  $D$ . The table below shows that we need to impose at least  $n^2$  additional restrictions on the RF to achieve identification of all of the structural parameters.

Almost all VAR studies impose enough restrictions on the RF to just-identify the model.<sup>3</sup> For structural VARs, the most common identifying restrictions are those that impose zero restrictions on  $F$  and normalize the elements in the  $D$  matrix. Assume  $F$  is lower triangular ( $n(n-1)/2$  restrictions), and that  $D = I$  ( $n(n+1)/2$ ). This identification scheme yields just enough restrictions ( $n^2$ ) to exactly identify the model. Normalizing the variances of the SF shocks to unity means that the impulse response of  $y$  generated by setting  $u$  to unity is the effect of a structural shock on  $y$  of the size of one standard deviation.

Note that a lower triangular  $F$  implies that the first variable can react to its own lags and the first shock, the second variable to its own lags and the first two shocks, etc. This identification pattern means that this is a recursive simultaneous equations model, so we have to be careful in ordering the variables in this VAR. In order to actually

<sup>3</sup> The possible exception is the VAR study by Bernanke and Mihov (1997). They impose over-identifying restrictions on monetary policy, and conduct tests of these restrictions.

implement this identification pattern, a Cholesky decomposition is applied to the covariance matrix of RF shocks,  $\Omega$ . This will (automatically) yield a lower triangular  $F$  matrix and restrict  $D = I$ . The Cholesky decomposition is carried out as follows: since  $\Omega$  is symmetric, it follows by definition that it can be decomposed into two lower triangular matrices,  $X$  and  $X'$  with 1's on their main diagonal.

If  $\Omega$  is a symmetric positive definite matrix, then there exists a lower triangular matrix  $X$  such that

$$\Omega = XX' \quad (11) \quad \text{so that}$$

$$\text{chol}(\Omega) = X \quad (12)$$

However,

$$\Omega = F^{-1}D(F^{-1})', \quad \text{so to pattern this after (11), let } D = I \text{ to get}$$

$$\Omega = F^{-1}(F^{-1})' \quad (13) \quad \text{and so,}$$

$$\text{chol}(\Omega) = F^{-1} \quad (14)$$

Since  $F^{-1}$  is lower triangular, it follows that its inverse,  $F$ , will also be lower triangular.  $F$  will have 1's on its main diagonal, zero's above the main diagonal, and unrestricted parameters elsewhere. Thus, it follows that applying the  $F$  derived from the Cholesky decomposition on the SF in (7) yields a fully recursive system of equations (which, as is well known, is exactly-identified). Any time the  $D = I$  restriction is imposed, structural shocks are assumed to be of the magnitude of one standard deviation (or have unit variance). Signs of the elements in  $F$  may be chosen freely.

### **3.2 Methodology in Identifying the International Transmission Mechanism of US Monetary Policy Shocks**

#### **3.2.1 Identifying the Recursive Baseline VAR Model of US Monetary Policy Shocks**

Soyoung Kim follows the “marginal” procedure when examining the transmission mechanism of US monetary policy shocks into the aggregate non-US G6 economy. A prerequisite for implementing the “marginal” procedure is the development of a baseline model to identify US monetary policy shocks. He develops two baseline recursive VAR models of monetary policy for the USA. Based on the structure of successfully estimated recursive VARs in previous studies (notably, Christiano, Eichenbaum and Evans – referred to as CEE in the balance of this paper), Kim estimates two baseline VARs in three or four variables, placing enough restrictions on the model in order to reasonably



identify US monetary policy shocks. These restrictions come in the form of zero restrictions implied from the recursive structure of the structural model. The ordering of the variables in the structural model then reflects assumptions regarding the information set the Federal Reserve uses when formulating US monetary policy, as well as assumptions regarding which variables are affected contemporaneously (or not) by monetary policy actions of the Fed.

CEE's two basic monetary VAR models are exactly identified because of their recursive structure. In general Kim's baseline VAR models utilize the following sequence of variables:

- 1) (model CEE-R) real GDP, price level, commodity prices, federal funds rate; and
- 2) (model CEE-X) real GDP, price level, commodity prices, a measure of nonborrowed reserves and the federal funds rate.

The instrument or indicator of the stance of monetary policy specified in the first baseline model (CEE-R) is the federal funds rate, while the instrument or indicator specified in the second baseline model (CEE-X) is non-borrowed reserves. These indicator variables come after the information set in the VAR sequence. This reflects the assumption that the Fed uses the information to determine the stance of monetary policy.

The inclusion of commodity prices is necessitated by the well-known price puzzle in many VAR studies of monetary policy (when commodity prices are not included in the VAR, prices respond negatively to an expansionary money shock).

What does the recursive nature of the monetary policy VAR used by CEE and Kim imply? In the baseline model, this means that the federal funds rate reacts to its own lags and contemporaneous shocks to real GDP, the price level and commodity prices in the CEE-R model, and to real GDP, the price level, commodity prices, and a measure of nonborrowed reserves in the CEE-X model. In the augmented model, Asian variables are assumed to react to own lags and to contemporaneous shocks to real GDP, the price level, commodity prices and to the federal funds rate in the CEE-R model, and to real GDP, the price level, commodity prices, a measure of nonborrowed reserves, and the federal funds rate in the CEE-X model. The information set of the Federal Reserve is assumed to be comprised of real GDP, the GDP deflator (to capture current prices), as well as the producer price index (to capture inflation expectations).

Using aggregate non-US G6 data for different economic variables, Kim adds non-US G6 variables one at a time and estimates one VAR for each added variable. The baseline VARs are augmented one non-US G6 variable at a time and then estimated. When the federal funds rate is specified as the policy indicator

After identifying the baseline VARs, Kim analyzes more identifying restrictions for the added variables: he estimates a VAR where US monetary policy affects the additional variable contemporaneously (and the additional variable does not affect US monetary policy contemporaneously) (C), and another VAR where US monetary policy



has no contemporaneous effect on the additional variable (N). In the former (C), the additional variable is ordered *before* the monetary policy instrument. In the latter (N), the additional variable is ordered *after* the monetary policy instrument. The international transmission mechanism of US monetary policy shocks is inferred from an examination of the impulse responses from the estimated augmented VARs.

### 3.2.2 Results of Baseline Model Identification

The research conducted for this study uses the same methodology, but uses disaggregated Asian national data in order to capture differences in the way individual countries respond to US monetary policy shocks. Wherever possible, the data utilized for the study uses quarterly data from the first quarter of 1980 to the fourth quarter of 2003. Because the time periods for the studies are different, the pattern of impulse responses yielded by the baseline model used in this study may differ from that of Kim's.<sup>4</sup> Kim concludes that his two baseline VAR models reasonably identify US monetary policy shocks because they produce impulse response functions which are similar in shape to those produced by other studies, and because these responses are generally consistent with predictions made by economic theory.

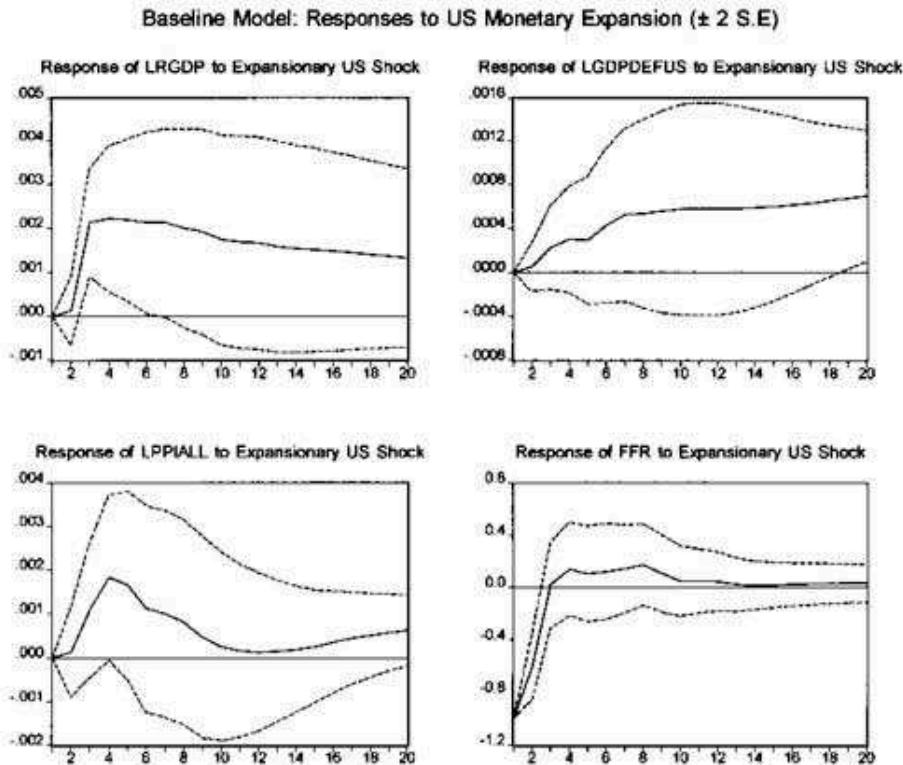
After estimating VARs using different variables and using different assumptions regarding the appropriate indicator of the stance of monetary policy for the period 1980 to 2003, the following CEE-R identification scheme was chosen as the baseline model for this study: log of US real GDP (LRGDP), log of US GDP deflator (LGDPDEFUS), log of US producer price index for all goods (LPPIALL) and the federal funds rate (FFR).<sup>5</sup> A US monetary expansion is defined as a negative unit shock to the federal funds rate. The impulse response function produced by the baseline VAR is displayed in Figure 1. Dotted lines are two standard error bands. All non-US data comes from *International Financial Statistics* of the International Monetary Fund. I downloaded all US data from the *Economagic* website at <http://www.economagic.com>.

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<sup>4</sup> Kim uses data from 1974 to 1996. This study uses data from 1980 to 2000. The difference in time periods was also necessitated by the dearth of quarterly data for many Asian countries in the 1970's.

<sup>5</sup> We did not consider the log of the federal funds rate in order to be consistent with the studies of CEE and Kim.

**Figure 1**



Note that a US monetary expansion (a fall in the federal funds rate) leads to a persistent increase in output (even after 5 years, the effect remains positive), a persistent increase in prices, a rise, then fall in producer prices. The result is slightly different from Kim's baseline CEE-R, in which the response of output to an expansionary shock does not display persistence (the shock dies down eventually within the relevant horizon). We may attribute this difference to a change in the time horizon for the US sample data. At any rate, the results of the baseline model seem to suggest that price flexibility is playing a greater role in influencing the response of output to a monetary shock.

Unfortunately, VAR estimates using non-borrowed reserves as an indicator of the stance of monetary policy (the CEE-X identification scheme) did not yield good results, as the pattern of impulse responses generated by this identification scheme did not appear to be consistent with predictions made by economic theory (the price level stayed flat and did not experience a sustained rise in response to expansionary monetary policy). Thus, we have decided to consider results from just one specification of the monetary instrument or policy indicator.

### **3.3 Using the Marginal Method to Identify the Extended Model and to Test Theories of the International Monetary Transmission Mechanism**

In order to test the Mundell-Fleming model for each country, the following variables (for the Philippines) are added to this baseline VAR of US monetary policy one at a time (with name of variable in parentheses):

- 1) nominal exchange rate (LMEXR)
- 2) real exchange rate (LREER)
- 3) real exports (LREXP)
- 4) real imports (LRIMP)
- 5) real trade balance (LRTBRP)
- 6) current account (LCA)
- 7) exports to the US (LEXPORTSUSA)
- 8) imports from the US (LIMPORTSUSA)
- 9) trade balance with the US (LTBRPUSA)
- 10) GDP (LRGDP)

Variables will be added to this benchmark model one at a time and each resulting VAR model will be estimated to allow a determination of the implied transmission mechanism.

Kim (2001) examines the responses of consumption, saving, investment and interest rates to a monetary expansion in order to test the implications of the intertemporal model for non-US G6 countries. In order to test the intertemporal model for the Philippines, the following variables (for the Philippines) are added to this baseline VAR of US monetary policy one at a time:

- 1) nominal interest rate (the nominal lending rate)
- 2) real consumption (LRCONS)
- 3) investment (LRGFCF)
- 4) price level (LCPIRP)

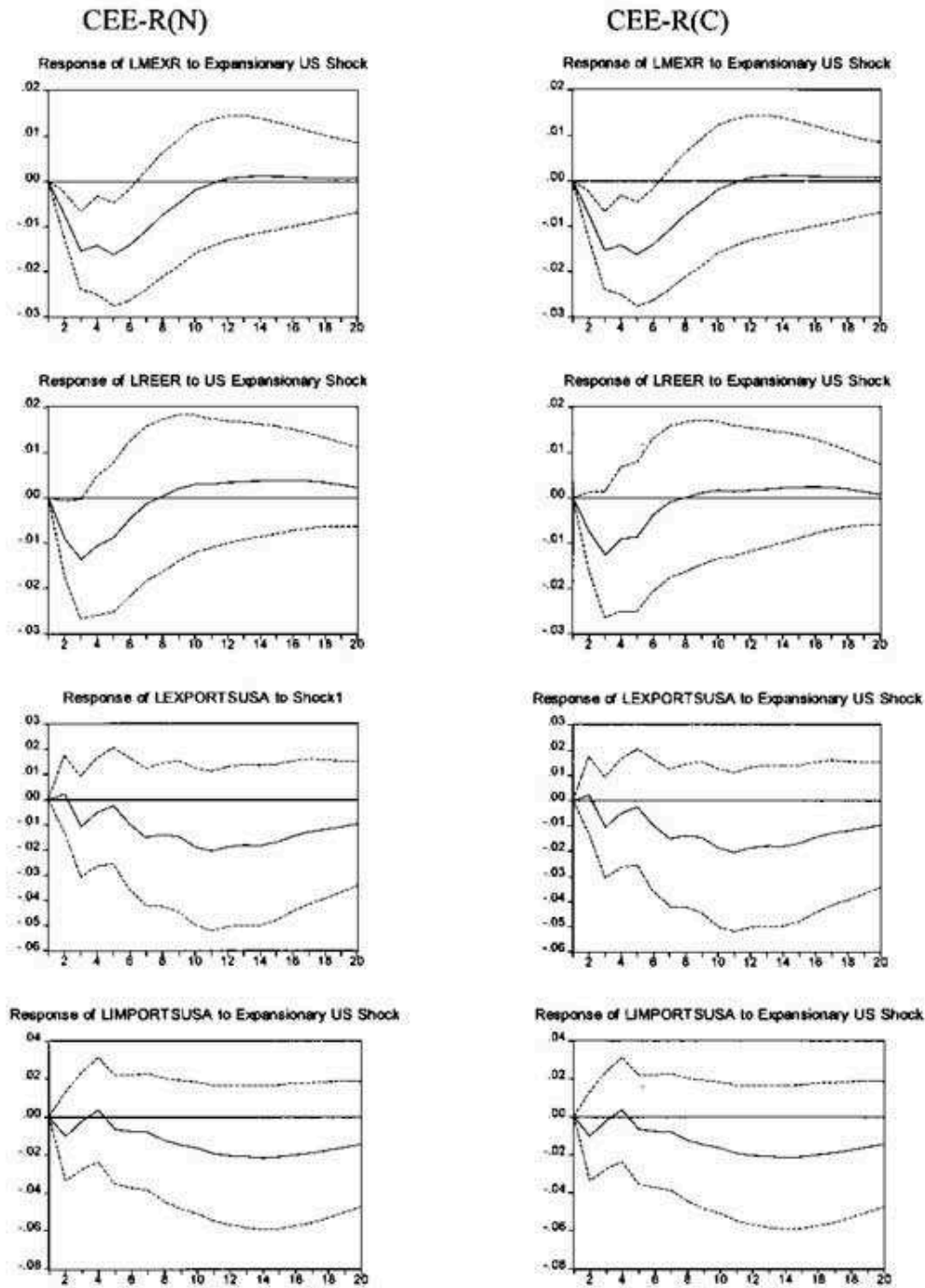
The following represents results of the exercise for the Philippines.

#### **3.3.1 Results for the Philippines**

Figure 2 displays the results of the marginal procedure for the Philippines for testing the Mundell-Fleming model. The model corresponds to the two specifications where US monetary policy through the federal funds rate has (has no) contemporaneous effect on the additional variable - CEE-R(C) (CEE-R(N)).

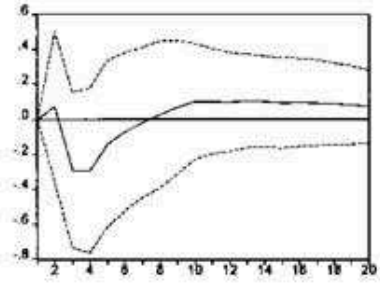


**Figure 2: Testing the Mundell-Fleming Model - Results of the marginal procedure**



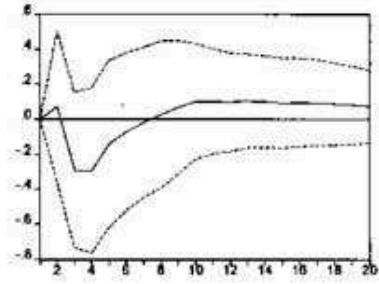
### CEE-R(N)

Response of LTBRPUSA to Expansionary US Shock

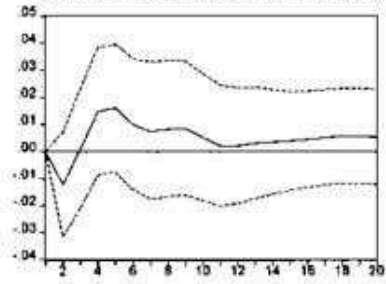


### CEE-R(C)

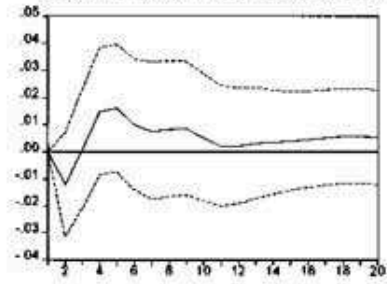
Response of LTBRPUSA to Expansionary US Shock



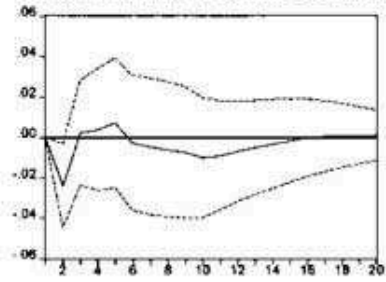
Response of LREXP to Expansionary US Shock



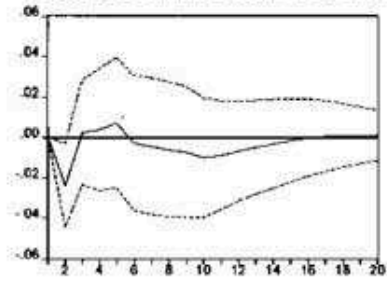
Response of LREXP to Expansionary US Shock



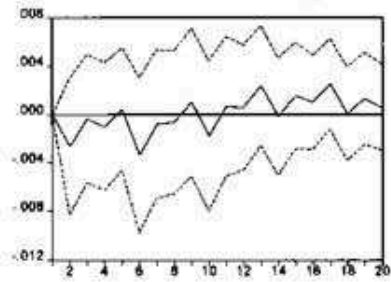
Response of LRIMP to Expansionary US Shock



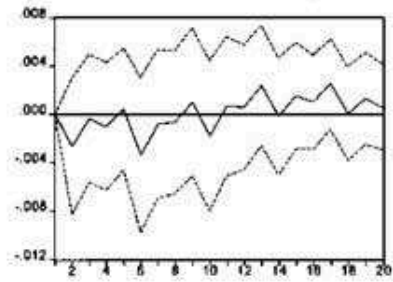
Response of LRIMP to Expansionary US Shock

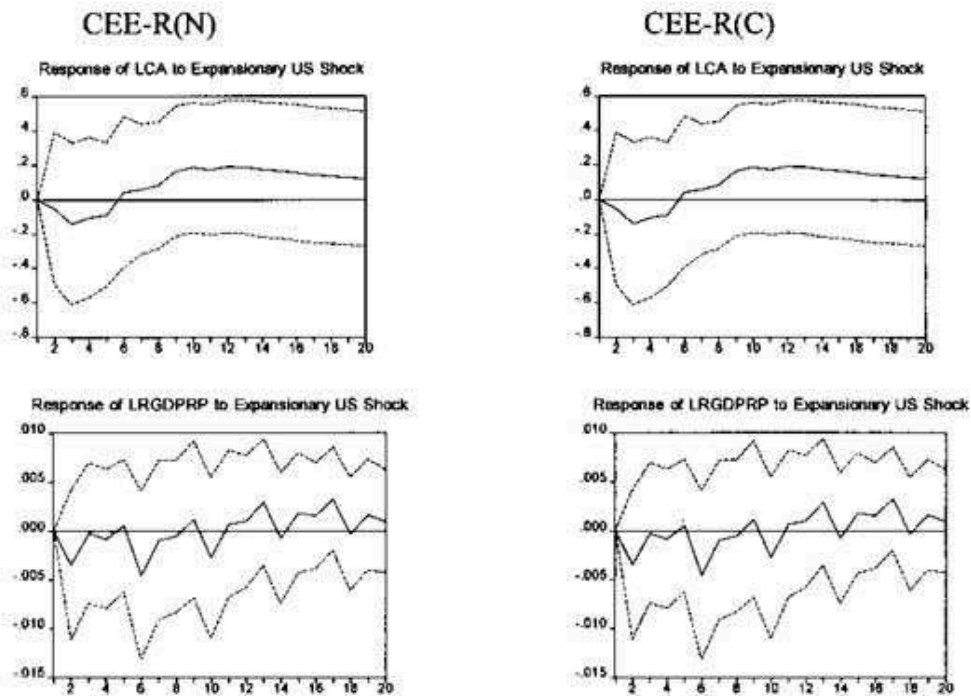


Response of LRTBRP to Expansionary US Shock



Response of LRTBRP to Expansionary US Shock





Based on the impulse responses of Philippine variables to a unit shock to the monetary policy instrument, an expansionary US monetary policy shock leads to the following effects on Philippine variables:

- 1) an appreciation of the nominal exchange rate, which persists for three years following the initial shock;
- 2) an appreciation of the real exchange rate, which persists for almost two years following the initial shock, followed by a real depreciation;
- 3) after a small initial rise, a persistent drop in exports to the USA;
- 4) a persistent drop in imports from the USA;
- 5) after an initial increase, a sharp fall in the trade balance between the Philippines and the US;
- 6) a general fall in the overall Philippine trade balance for about two years;
- 7) a fall in the current account for about a year and a half, followed by a long-term improvement; and
- 8) a fall in Philippine real GDP for about three years after the initial shock;



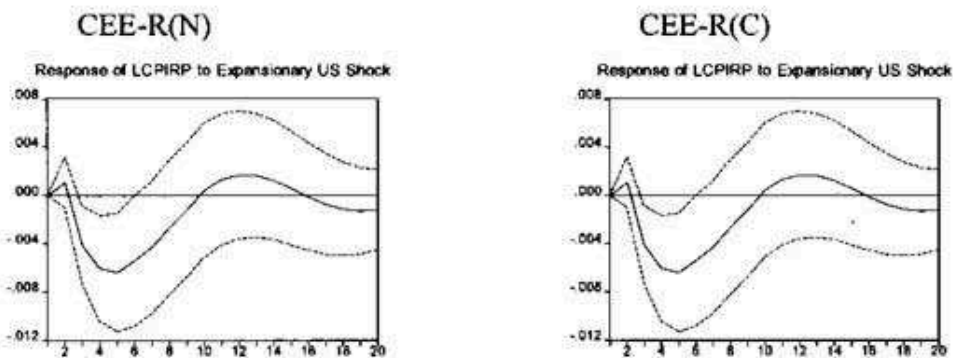
In response to an expansionary US shock, the Philippines' overall trade balance and current account both improve after initially deteriorating. This perhaps can be attributed to the reversal of the path of the real exchange rate (from appreciation to depreciation).

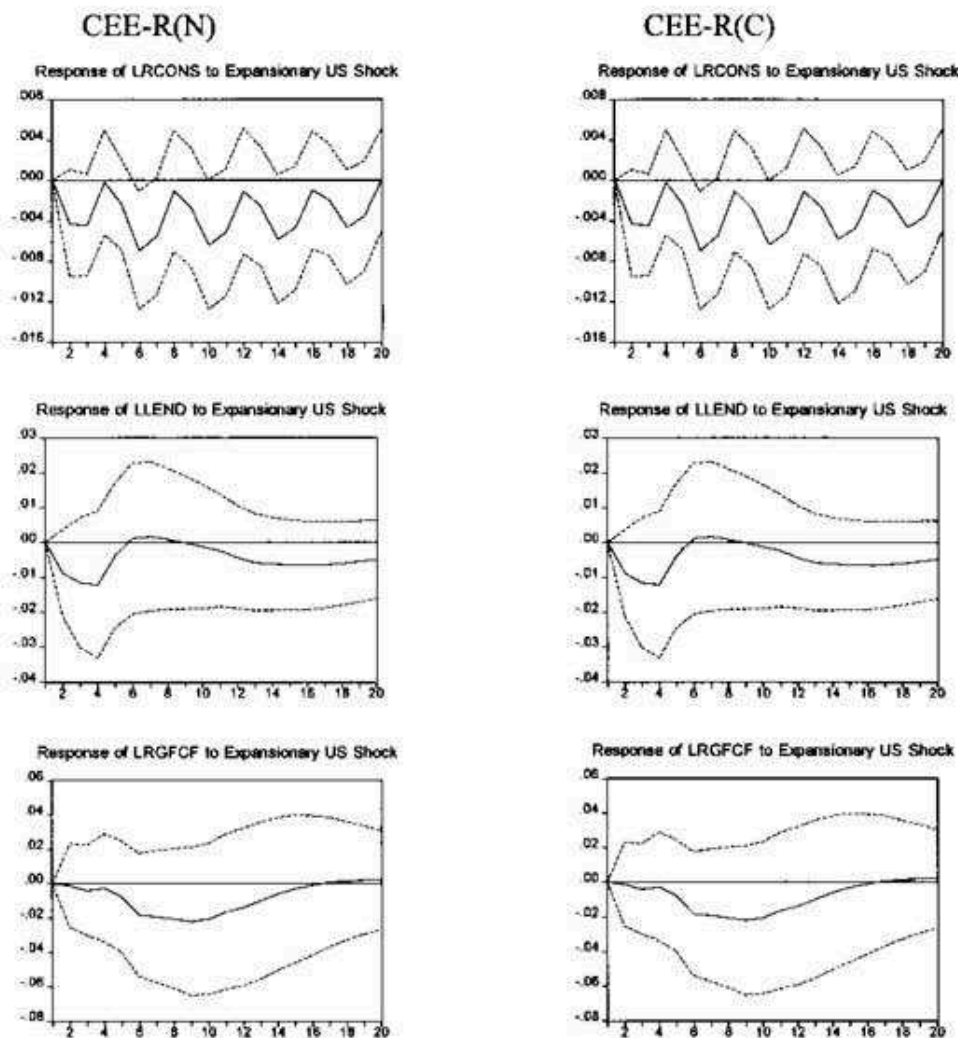
Figure 3 displays the results of using the marginal procedure using additional variables for the Philippines in testing the implications of the intertemporal model. The intertemporal model initially predicts that a home monetary expansion leads to an appreciation of the foreign real exchange rate and subsequent deterioration in the foreign trade balance and current account. These have been confirmed by our earlier results. However, the intertemporal model emphasizes the forward-looking behavior of agents, and predicts that aggregate demand should be stimulated by the fall in the world interest rate, so that consumption and investments should rise in the foreign country. Previous results have already confirmed the deterioration in the foreign current account. What remains to be tested are the implications of the intertemporal model for variables related to consumption and investment.

Based on impulse responses, an expansionary US monetary policy shock leads to the following changes in Philippine variables:

- 1) a drop in the Philippine price variable from the middle of the first year to about the middle of the second year after the shock initially hits;
- 2) a drop in the Philippine lending rate;
- 3) a persistent fall in Philippine aggregate real consumption; and
- 4) a persistent fall in Philippine real investment.

**Figure 3: Testing the Intertemporal Model - Results of the marginal procedure**





#### 4. Initial Conclusions

These initial results suggest that the transmission mechanism of US monetary policy shocks to the Philippines very closely follows the pattern predicted by the Mundell-Fleming model. US monetary policy appears to have beggar-thy-neighbor effects as the impact of the exchange rate on bilateral and overall Philippine trade balance appears to be negative, pulling down Philippine income.

In the short-run, at least, there is not much initial evidence to support the implications of the intertemporal model for the Philippines. In response to a US monetary expansion, real consumption and investment both fall in spite of a decline in interest rates.

Additional recursive and non-recursive VARs will be estimated for the Philippines and other Asian countries in extensions of this study.

## Bibliography

Bowman, David and Brian Doyle (2003), "New Keynesian, Open-Economy Models and their Implications for Monetary Policy," in *Price Adjustment and Monetary Policy*, proceedings of a conference held by the Bank of Canada, November 2002. Ottawa: Bank of Canada.

Christiano, Lawrence J., Martin Eichenbaum and Charles Evans 1996. "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds" *Review of Economics and Statistics* 78, 16-34.

Christiano, Lawrence, Martin Eichenbaum and Charles Evans (2000), "Monetary Policy Shocks: what have we Learned and to what End?", in J.Taylor and M.Woodford (eds.), *Handbook of Macroeconomics*.

Eichenbaum, Martin. 1992. "Comments on "Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy." By C. Sims. *European Economic Review* 36: 1001-11.

\_\_\_\_\_, and Charles Evans. 1995. "Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates." *Quarterly Journal of Economics*.

Kim, Soyoung. 2001. "International Transmission of U.S. Monetary Policy Shocks: Evidence from VARs" *Journal of Monetary Economics* 48, 339-372.

Lane, P. (2001) "The New Open Economy Macroeconomics: A Survey" *Journal of International Economics* 54, 235-266.

Mark, Nelson C. 2001, "International Macroeconomics and Finance: Theory and Empirical Methods", Blackwell Publishers.

Obstfeld, Maurice and Rogoff, K., 1995. "Exchange Rate Dynamics Redux" *Journal of Political Economy* 103, 624-660.

Obstfeld, Maurice, and Kenneth Rogoff, 1997, *Foundations of International Macroeconomics*, MIT Press.

Sarno, Lucio (2000), "Towards a New Paradigm in Open Economy Modeling: Where do we Stand?" mimeo, St. Louis FRB. (technical version of Federal Reserve Bank of St. Louis Review 83(3): 21-26.)

Walsh, Carl E., 2003: *Monetary Theory and Policy*, Cambridge: MIT Press.