E C O N O M I C S B U L L E T I N

Sources of Real and Nominal Exchange Rate Movements for the Euro

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Abstract

We conducted an analysis on the sources of real and nominal exchange rate movements for the Euro, applying the SVAR methods of Enders and Lee (1997). In particular, our analysis focused on the robustness of the results by considering different combinations of data on nominal exchange rates and price indices. Our results showed that the shape of the impulse response function differs substantially depending on the case. In particular, we found that the important issue of whether the real exchange rate and nominal exchange rate overshoot depends on the index selected.

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1 Introduction

In January 1999, a single currency (the Euro) was introduced in 11 member nations (currently 13 nations) of the European Union (EU). The Euro was introduced for the following reasons:

(1) Establishment of a single market in the EU: The EU has aimed to achieve intra-regional market integration enabling the free movement of people, goods, capital and services. The stabilization of EU currencies was essential for that purpose.

(2) Success of the European Monetary System (EMS): EMS was launched in 1979 (after the "snake in the tunnel" in 1972) in a bid to realize a fixed exchange rate system among the various EU currencies. As a result, the exchange rate fluctuation seen between 1975 and 1979 was halved between 1979 and 1985, then halved again between 1986 and 1989.

(3) Realization of sound fundamentals in the EU economy: EU nations strengthened their economic policy coordination and worked to improve the fundamentals required for participation in currency integration, which resulted in the achievement of a stable economic environment marked by such factors as low inflation, sound public finances, and low interest rates. This also raised hopes for the promotion of structural reform in such areas as pension and taxation systems, which had failed to materialize at the level of each individual nation.

This paper empirically analyzes the sources of movement in the Euro, which was introduced in 1999, by using structural VAR (SVAR). Analysis on sources of exchange rate movements using SVAR methods has been vigorously researched to date. Such research includes Lastrapes, 1992; Clarida and Gali, 1994; Enders and Lee, 1997; Rogers, 1999; Dibooglu and Kutan, 2001; and Wang, 2004. Enders and Lee (1997), among others, used the methods of Blanchard and Quah (1989) to decompose movements in the real exchange rate and nominal exchange rate into the portions caused by real shocks and the portions caused by nominal shocks, and analyzed the impact of each on those rates.

This paper uses the SVAR method to analyze the sources of movements in the Euro. The Euro, which was introduced in January 1999, is now the leading international settlement currency following the US dollar, and its movement impacts substantially on trends in the global economy. It is therefore highly important to analyze the sources of movements in the Euro.

This paper has two special characteristics, as follows:

(1) It conducts an analysis on the sources of real and nominal exchange rate movements for the Euro, which was introduced in January 1999, applying the SVAR methods of Enders and Lee (1997).

(2) The analysis focuses on the robustness of the results by considering different combinations of data on nominal exchange rates and price indices. For the exchange rate, there is a choice between using monthly averages or end-of-month levels. For price levels, there is a choice between using the consumer price index (CPI) or using the producer price index (PPI). This paper examines how these choices impact on the results. To our knowledge, this paper is the first attempt to analyze the robustness of the results based on such alternative indices.

2. Empirical Techniques

Following Enders and Lee (1997), we represent the real and nominal exchange rates as being characterized by unit root processes. Let $u_{re,t}$ and $u_{n,t}$ be the zero-mean mutually uncorrelated real and nominal shocks, respectively. Formally, a 2×1 vector of the first differences in real and nominal exchange rates, $z_t = [\Delta re_t, \Delta e_t]'$, can be represented by the following vector moving average (VMA) representation.

(1) $$z_t = [\Delta re_t, \Delta e_t]' = C(L)u_t,$$

Or

(2) $$\begin{bmatrix} \Delta re_t \\ \Delta e_t \end{bmatrix} = \begin{bmatrix} C_{11}(L) & C_{12}(L) \\ C_{21}(L) & C_{22}(L) \end{bmatrix} \begin{bmatrix} u_{re,t} \\ u_{e,t} \end{bmatrix},$$

where re_t is the real exchange rate at time t; e_t is the nominal exchange rate at time t, $u_t = [u_{re,t}, u_{e,t}]'$; $C_{ij}(L)$ is an infinite-order polynomial in the lag operator L; Δ is the first-difference operator; and the innovations are normalized such that $E(u_t u_t') = I$.

Following Enders and Lee (1997), we assume as follows:

Assumption: Real shock has permanent effect on the real exchange rate, whereas nominal shock has only temporal effect on real exchange rate.

This assumption implies that if domestic money supply becomes twice, then domestic price level and nominal exchange rate also becomes twice in the long-run, and as a result, the real exchange rate does not change.

The time paths of the effects of the various shocks on the real and nominal exchange rates are implied by the coefficients of the polynomials $C_{ij}(L)$. The above assumption implies as follows:

(3) $$C_{12}(L) = \sum_{j=0}^{\infty} c_{12}(j)L^j; \qquad \sum_{j=0}^{\infty} c_{12}(j) = C_{12}(1) = 0.$$

Since $c_{12}(j)$ is the effect of $u_{e,t}$ on Δre_t after j periods, $\sum_{j=0}^{\infty} c_{12}(j)$ is the cumulative effect of $u_{e,t}$ on Δre_t over time. Consequently, the restriction that $\sum_{j=0}^{\infty} c_{12}(j) = C_{12}(1) = 0$ implies that the cumulative effect of $u_{e,t}$ on Δre_t over time is zero, and that the long-run effect of $u_{e,t}$ on re_t is zero. Put another way, the nominal shock has only short-run effects on real exchange rate, whereas the real shock may have long-run effects.

3. Data

The data are taken from the *International Financial Statistics* (IFS) of International Monetary Fund (IFM). The empirical analysis is carried out using the monthly observations from January 1999 to April 2006. Nominal exchange rates considered are end-of-period rates and monthly average. They are expressed as national currency units per US dollar. The log-level real exchange rate, re_t, may be expressed as follows:

(4) $$re_t = e_t + p_t^f - p_t,$$

where e_t denotes the logarithm of the nominal exchange rate; p_t is the logarithm of domestic price level; p_t^f is the logarithm of foreign price level (i.e., US price level). Real exchange rates are generated using the producer's price level (PPI) or the consumer's price level (CPI). The real exchange rtes thus measures the relative price of goods in Euro area in terms of US goods.

Thus, we have following four cases in empirical analysis:

Case 1: (Price Level, Exchange Rate) = (CPI, Monthly Average),

Case 2: (Price Level, Exchange Rate) = (PPI, Monthly Average),

Case 3: (Price Level, Exchange Rate) = (CPI, End-of-Month),

Case 4: (Price Level, Exchange Rate) = (PPI, End-of-Month).

As a preliminary exercise, the presence of a unit root in the univariate representations of the real and nominal exchange rates are tested for by using the augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1979). For the log-level of all real and nominal exchange rates, the null hypothesis of a unit root is not rejected at conventional significance levels. For the first differenced real and nominal exchange rates, the null hypothesis of a unit root is rejected at conventional significance level. Thus, both of real and nominal exchange rates are found to be I(1) series. Then, we carry out cointegration tests between the real and nominal exchange rates. We apply the Johansen tests to the two variables and found that the two series are not cointegrated at the conventional significance levels for most of the cases (Johansen, 1991; Johansen and Juselius, 1990). This implies that there is no long-run equilibrium relationship between real and nominal exchange rates over the period considered.

4. Empirical Results

We estimate the VAR model under the restriction of $\sum_{j=0}^{\infty} c_{12}(j) = C_{12}(1) = 0$ and evaluate the effect of each shock on real and nominal exchange rates using the impulse response function and variance decomposition. In empirical analysis, we use the AIC, SBIC and HQ to choose the optimal lag length of VAR, and found that VAR(1) model is the most appropriate.

Table 1 indicates the results of variance decomposition. First, we examined the impact on real exchange rates. We found that the contribution of real shocks to real exchange rates was 97.70% in case 1, 99.58% in case 2, 99.10% in case 3, and 99.55% in case 4. Enders and Lee (1997) showed that real shocks contributed 97.0% to the forecast error variance of German-US real exchange rates. Our results were consistent with the results of Enders and Lee (1997).

Next, we examined the impact on nominal exchange rates. Table 1 shows that the contribution of nominal shocks to nominal exchange rates differs depending on the case: 7.13% in case 1, 16.09% in case 2, 2.64% in case 3 and 11.46% in case 4. Enders and Lee (1997) showed that nominal shocks contributed 12.9% to the forecast error variance of German-US nominal exchange rates. In our analysis, it was clear that different results were obtained depending on the selection of price level and selection of exchange rate timing.

Figures 1, 2, 3 and 4 show the impulse response functions corresponding with cases 1, 2, 3 and 4. The upper figures show the accumulated response of real exchange rates to real and nominal shocks, and the lower figures show the accumulated response of nominal exchange rate to real and nominal shocks.

First, we looked at the impact of real shocks on real exchange rates. In cases 1, 2 and 3, when a real shock occurs, real exchange rates immediately rise, then eventually converge smoothly to their new long-run levels. In case 4, by contrast, when a real shock occurs, real exchange rates overshoot. In other words, real exchange rates temporarily rise, but eventually fall and converge to their new long-run levels. Hence, it became clear that whether or not real exchange rates overshoot differs depending on the case.

Next, we looked at the impact of nominal shocks on real exchange rates. Consistent with our identification assumption, the impact of nominal shocks on real exchange rates was temporary and zero over the long term. This was a common result in all cases.

Third, we looked at the impact of real shocks on nominal exchange rates. As evident from each of the figures, the results differed depending on the case. In cases 1, 2 and 3, when a real shock occurs, nominal exchange rates immediately rise, then eventually converge smoothly to their new long-run levels. In case 4, by contrast, when a real shock occurs, nominal exchange rates overshoot. In other words, nominal exchange rates temporarily rise, but eventually fall and converge to their new long-run levels. Hence, it became clear that whether or not nominal exchange rates overshoot differs depending on the case.

Finally, we looked at the impact of nominal shocks on nominal exchange rates. When a nominal shock occurs, nominal exchange rates fall and eventually converge to their new long-run levels. However, as evident from the figure, the path differs sharply in each case.

5. Concluding Remarks

We conducted an analysis on the sources of real and nominal exchange rate movements for the Euro, applying the SVAR methods of Enders and Lee (1997). In particular, our analysis focused on the robustness of the results by considering different combinations of data on nominal exchange rates and price indices. For the exchange rate, there is a choice between using monthly averages or end-of-month levels. For price levels, there is a choice between using the consumer price index (CPI) or using the producer price index (PPI). This paper examines how these choices impact on the results.

On the sources of exchange rate movement, the following points became clear.

First, real shocks raise real exchange rates and nominal exchange rates over the long term. Next, nominal shocks do not impact on real exchange rates over the long term, but do lower nominal exchange rates.

On the robustness of analysis results due to differences in index selection, the following points became clear. The shape of the impulse response function differs substantially depending on the case. In particular, it became clear that the important issue of whether or not real exchange rates and nominal exchange rates overshoot depends on the selection of the index. This means that it is necessary to pay more attention than previously to the selection of data used when analyzing sources of exchange rate movement. This is likely to serve as a word of caution to researchers in this field.

References

Blanchard, O. and Quah, D., (1989), The dynamic effects of aggregate demand and supply disturbances, American Economic Review, **79**, 655-673.

Clarida, R. and Gali, J., (1994), Sources of real exchange rate fluctuations: how important are nominal shocks? National Bureau of Economic Research Working Paper No. 4658.

Dibooglu, S and Kutan, A (2001), Sources of real exchange rate fluctuations in transition economies: the case of Poland and Hungry, Journal of Comparative Economics, **29**, 257– 275.

Dickey, D.A. and Fuller, W.A., (1979), Distribution of the estimators for autoregressive time series with a unit root, Journal of the American Statistical Association, **74**, 427–431.

Enders, W. and Lee, B.-S., (1997), Accounting for real and nominal exchange rate movements in the post-Bretton Woods period, Journal of International Money and Finance, **16**, 233-254.

Lastrapes, W.D., (1992), Sources of fluctuations in real and nominal exchange rates Review of Economics & Statistics, **74**, 530-9.

Rogers, J.H., (1999), Monetary shocks and real exchange rates,, Journal of International Economics, **49**, 269-88.

Johansen, S., (1991), Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, Econometrica, **59**, 1551–1580.

Johansen, S. and Juselius, K., (1990), Maximum likelihood estimation and inferences on cointegration—with applications to the demand for money, Oxford Bulletin of Economics and Statistics, **52**, 169–210.

Wang, T (2004) “China: Sources of Real Exchange Rate Fluctuations”, International Monetary Fund Working Paper No. 04/18.

Table 1 Variance Decomposition

(Percentage of forecast error variance accounted for by real shocks)

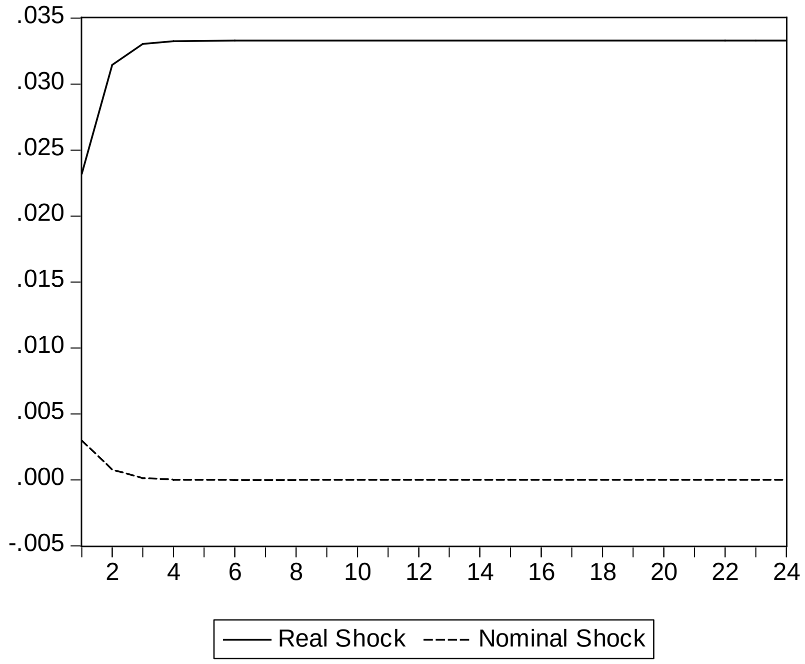
Horizon	Δre	Δe
(Case 1)		
1-month	98.37	92.69
3-month	97.70	92.88
6-month	97.70	92.87
12-month	97.70	92.87
24-month	97.70	92.87
(Case 2)		
1-month	99.67	81.40
3-month	99.58	83.89
6-month	99.58	83.91
12-month	99.58	83.91
24-month	99.58	83.91
(Case 3)		
1-month	99.84	97.50
3-month	99.69	97.30
6-month	99.69	97.36
12-month	99.69	97.36
24-month	99.10	97.36
(Case 4)		
1-month	99.73	88.31
3-month	99.55	88.54
6-month	99.55	88.54
12-month	99.55	88.54
24-month	99.55	88.54

Note:

Δre : first difference of real exchange rate; Δe : first difference of nominal exchange rate.

Figure 1 (Case 1)

Accumulated Response of Real Exchange Rate to Real and Nominal Shocks



Accumulated Response of Nominal Exchange Rate to Real and Nominal Shocks

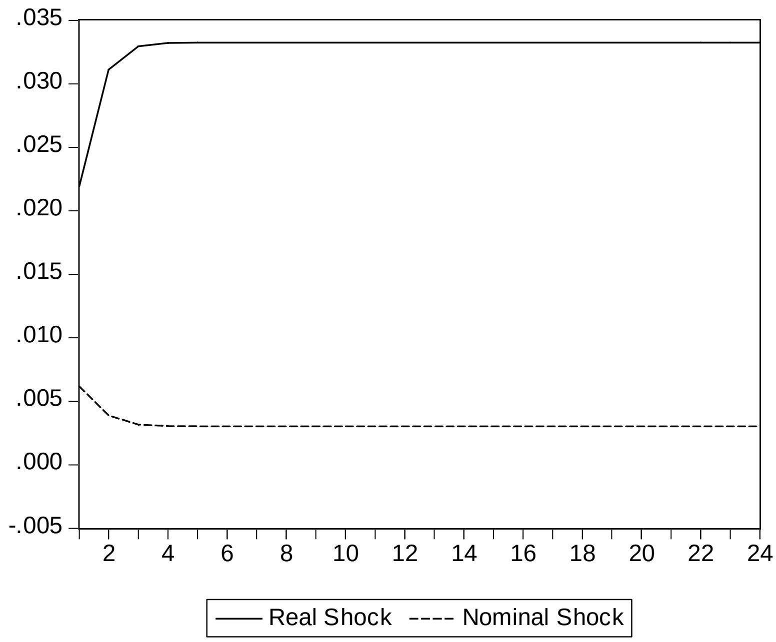
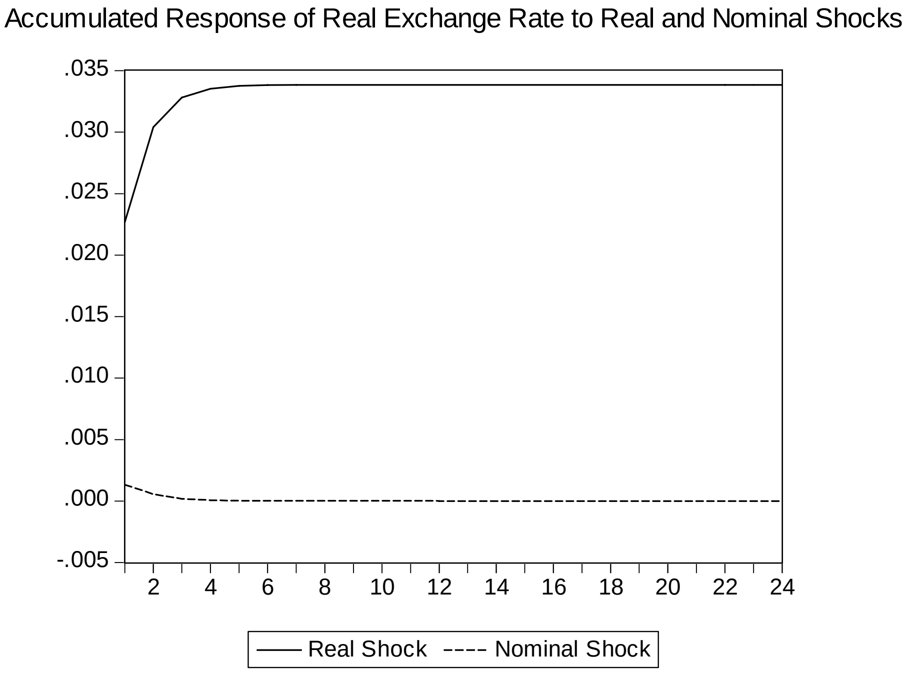


Figure 2 (Case 2)



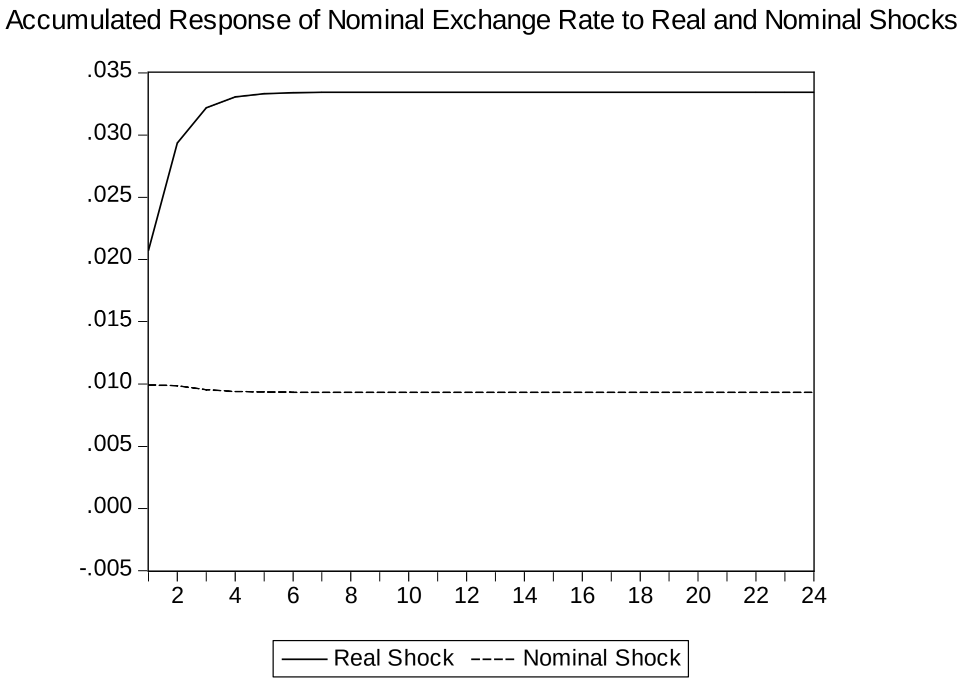
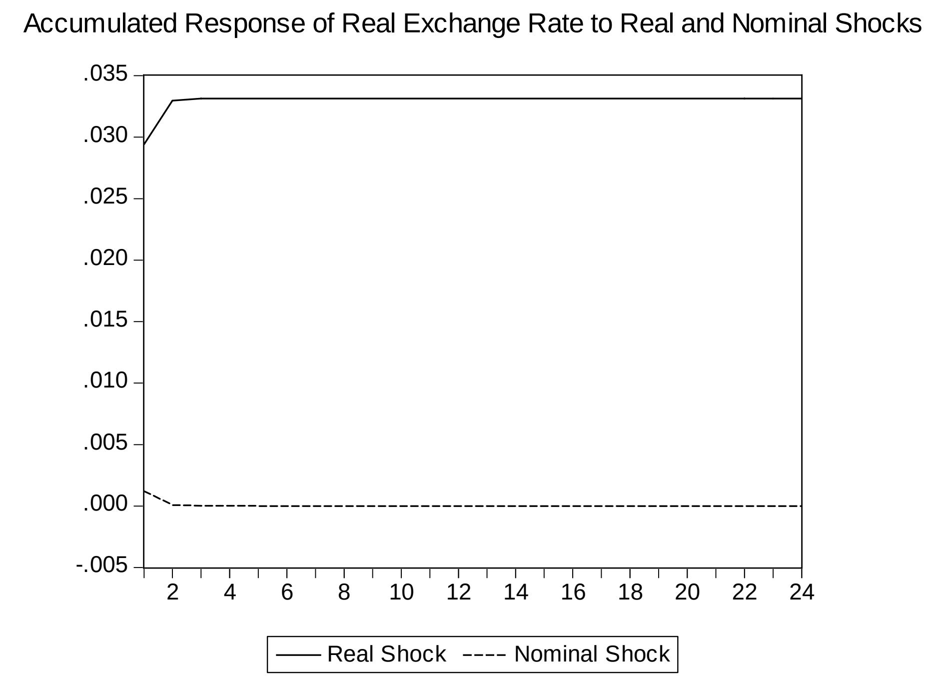


Figure 3 (Case 3)



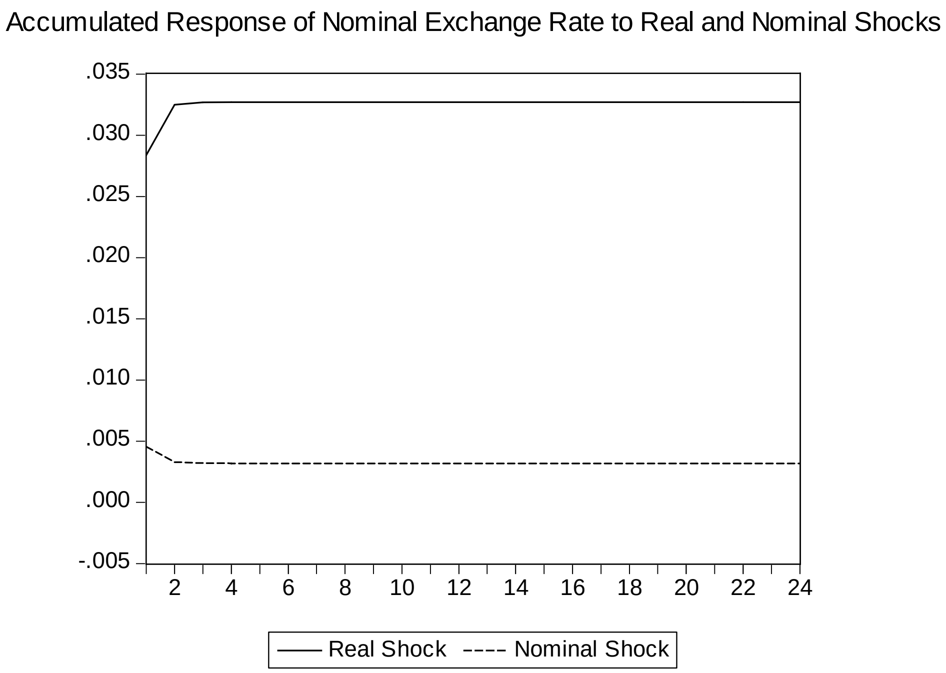


Figure 4 (Case 4)