경제학박사학위논문

Effects of Monetary Policy Shocks on Farm Prices and Exchange Rate

통화 정책 충격이 농산물 가격과 환율에 미치는 효과

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Abstract

Effects of Monetary Policy Shocks on Farm Prices and Exchange Rate

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The farm financial crisis following the monetary regime change in the early 1980's of the U.S. was an important historical episode that made many economists reevaluate the effect of macroeconomic events such as monetary policy shocks on agricultural markets. From the experience of the farm financial crisis, many economists realized that farm prices are affected not only by shocks in agricultural markets but also by shocks in monetary policy and macroeconomic condition.

Since then, many researchers investigated the effects of monetary shocks on farm prices. In contrast with the traditional view based on neutrality of money and flexible prices, the "overshooting" theory is developed, which suggests that the short-run responses of farm prices overshoot the long run level in the presence of a sticky non-farm price under monetary policy shocks and thus the real farm or relative prices may change in the short-run in the presence of monetary policy shocks. Many empirical studies on the effects of monetary policy shocks on farm prices, especially in the U.S., were conducted but the empirical evidence was mixed. In addition, the studies on emerging/developing countries such as Korea are very rare.

To document further evidence and help to resolve the controversy in the literature, this study empirically analyzes the effects of monetary policy shocks on farm prices in the U.S and South Korea (for the post Asian crisis period in which many regulations in agricultural markets are deregulated.) by applying a recently developed empirical method in the VAR framework. This study identifies monetary policy shocks by imposing sign restrictions on impulse responses. Further, this study analyzes the effects on exchange rate and farm prices together, differently from past studies that focus on either exchange rate or farm prices.

The empirical model for the U.S. follows the detailed specifications of Uhlig (2005) that also analyzes the effects of monetary policy shocks in the U.S. In addition to farm prices and the exchange rate, the key macro variables such as product, non-borrowed reserves, the Federal Funds rate, the price level, and a price variable that is likely to reflect the expectation on the price level are included in the model. To identify negative interest shocks, we use the following sign restrictions on impulse responses. The Federal Funds rate increases, the price level and the price variable decrease, and non-borrowed reserves decrease. The predictions of most theories on the effects of monetary policy shocks are consistent with these effects.

The empirical model for Korea incorporates small open economy features, as suggested by Kim and Lim (2015). The key macro variables such as production, the price level, the short-term interest rate, and monetary base are included in addition the exchange rate and to farm prices. Furthermore, the U.S. Federal Funds rate, the U.S. output, the U.S. price level, and VIX are included as exogenous variables in the empirical model to reflect the small open economy feature in which US macroeconomic condition and international financial market condition are important factors. The following sign restrictions, that are similar to those used in the U.S. model, are imposed. The short-term rate increases, the price level and monetary base decrease.

The main empirical results for the U.S. can be described as follows. First, contractionary monetary policy shocks have significant negative effects on real farm prices, which suggest that farm prices respond to monetary policy shocks more than the general price level. This is against the traditional view based on the neutrality of money assumption.

Second, the effects of monetary policy shocks on farm prices are stronger than the effects of monetary policy shocks on exchange rate. The former is as large as or greater than the latter even in the floating exchange rate regime period. The result is interesting since exchange rate is often thought of as a variable that is substantially affected by monetary policy shocks.

Third, farm price dynamics under monetary policy shocks show "delayed overshooting" as exchange rate dynamics under monetary policy shocks do. These results imply that the equilibrium condition between the interest rate and the expected return on holding farm products and the uncovered interest parity (UIP) condition do not hold conditional on monetary policy shocks.

The main empirical results for Korea are as follows. First, (contractionary) monetary policy shocks have significant negative effects on real farm prices, which suggest that farm prices respond to monetary policy shocks more than the general price level. This is against the traditional view based on the neutrality of money. The effect on real farm prices in Korea is less persistent than in the U.S. This result may be explained by farm price stabilization policy and strong regulation in farm prices in Korea.

Second, the effects of monetary policy shocks on farm prices are far stronger than the effects of monetary shocks on exchange rate. This tendency is even more clear in Korea than in the United States. This result may be explained by the fact that exchange rate is less flexible in Korea than in the United States.

Farm price responses are short-lived and not inconsistent with the overshooting theory.

The results in this study suggest that macroeconomic shocks such as monetary policy shocks can affect farm prices significantly and generate volatility in farm prices, not only in the U.S. but also in Korea. Although micro factors mostly explain farm price dynamics, considering macro factors can also helpful in understanding farm price dynamics and implementing farm price stabilization policies. However, the current study has a limitation in that it does not explicitly consider various important factors of farm price determination, such as weather and micro factors.

Keywords: VAR, Farm Price, Exchange Rate, Monetary Policy Shocks, Overshooting

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Chapter 1

Introduction

The farm financial crisis following the monetary regime change in the early 1980's of the U.S. was an important historical episode that made many economists reevaluate the effect of macroeconomic events such as monetary policy shocks on agricultural markets. From the experience of the farm financial crisis, many economists realized that farm prices are affected not only by shocks in agricultural markets but also by shocks to monetary policy and macroeconomic condition.

The traditional theory based on the neutrality of money (e.g., Belongia and King, 1983) suggests that monetary policy shocks affect all the nominal variables proportionately. Therefore, the relative or real farm prices are not affected by monetary policy shocks. However, alternative views emerged especially after the farm financial crisis. Frankel (1986) and Stamoulis and Rausser (1988) suggested an "overshooting" model in which the short-run responses of farm prices overshoot the long run level in the presence of a sticky non-farm price under monetary policy shocks. As a result, the relative or real farm price may change in the short-run. These theories can be viewed as an extension from the "overshooting" theory of exchange rate developed by Dornbusch (1976). In fact, subsequent studies such as Saghaian, Reed, and Marchant (2002) developed an open economy model in which both exchange rate and farm prices may overshoot in the presence of monetary policy shocks.

From the 1980s, there have been many empirical studies on the effects of monetary policy shocks on farm price in the U.S., for example, Chambers and Just (1982), Chambers (1984), Devadoss and Meyers (1987), Lapp (1990), Han, Jansen, and Penson (1990), Belongia (1991), Dorfman and Lastrapes (1996), Issac and Rapach (1997), Han and Kim (2005), Saghaian et al. (2002), and Kwon and Koo (2009). Most of these studies employed VAR (Vector Auto-Regression) models to identify monetary policy shocks and analyze the effects of monetary policy on farm prices. However, the issue is still controversial. The empirical evidence in these studies is mixed; some studies (e.g., Han and Kim, 2005, Saghaian, Reed, and Marchant, 2002, Dorfman and Lastrapes, 1996) found statistically significant effects of monetary policy shocks on the real or the relative farm price while others (e.g., Lapp, 1990, Belongia, 1991, and Issac and Rapach, 1997) found that the effects are not significant.

On the other hand, the studies on emerging/developing countries such as Korea are very rare.[1] One of the reasons is that emerging/developing countries have a different agricultural market structure. Emerging/developing countries often severely regulate agricultural markets to stabilize farm. In such an environment, the study on the effects of monetary shocks on farm prices would not be much interesting since farm prices would be stable anyway. Traditionally, various severe policy regulations were imposed to protect agriculture and to stabilize farm prices also in Korea. Since 1980s, Korea started to decrease trade barriers on agricultural products and deregulate agricultural markets. As a result, farm prices become more flexible than before, and it's more likely that macroeconomic events like monetary policy shocks can affect farm prices in recent years.

To document further evidence and help to resolve the controversy in the literature, this study empirically analyzes the effects of monetary policy shocks on farm prices in the U.S and Korea (for the post Asian crisis period in which many regulations in agricultural markets are abolished and weakened.) by applying a recently developed empirical method. Most of past studies employed VAR (Vector Auto-Regression) models to identify monetary policy explicitly and analyze the effects of the monetary policy shocks on farm prices. However, as reviewed in

[1] There are some exceptions. Saghaian, Hasan and Reed (2002) that analyze the effects of monetary policy on farm prices in four Asian economies using VECM models. Lee and Jung (1994) analyze the relation between money and farm prices in Korea using the Granger-Causality test. Lee (1995) investigate the issue for Korea using simple VAR model. Compared to these studies, current paper employs an improved empirical methodology for a recent sample period with deregulated agricultural markets and compares the effects on farm prices with those on exchange rates.

many studies on the effects of monetary policy shocks using VAR models (e.g., Christiano, Eichenbaum, and Evans, 1999, Kim, 2013), past studies often suffered from the identification problem, revealed as various puzzles such as the price and the liquidity puzzles.[2] To resolve these puzzles, Uhlig (2005) suggested to identify monetary policy shocks by imposing sign restrictions on impulse responses. This study applies the method introduced by Uhlig (2005), which was not used in past studies on monetary policy shocks and farm prices.

Using the empirical method, we focus on the following questions. First, do monetary policy shocks affect farm prices more than other prices (or general price level)? In other words, do monetary policy shocks affect real (or relative) farm prices? The traditional theory based on the hypothesis of neutral money suggests that monetary shocks affect all the nominal variables proportionately and thus monetary policy shocks do not affect real (or relative) farm prices. Therefore, the validity of the traditional theory based on the monetary neutrality can be inferred.

Second, do farm prices overshoot as predicted by the overshooting theory? The overshooting theory predicts that in response to monetary policy shocks, the short-run response is larger than the long-run response. In addition, the overshooting theory predicts that the maximum effect is found immediately after the monetary policy shocks. We test the validity of the overshooting theory by examining dynamic response of farm prices to interest rate shocks,.

[2] In Chapter 2, we explain these puzzles and Uhlig (2005)'s method in more details.

Third, this paper analyzes the effects of monetary policy shocks on farm prices, in comparison with the effects on exchange rate. The comparison is natural since overshooting theory of farm prices was originated from overshooting theory of exchange rate. The reason that farm prices can overshoot is similar to the reason that exchange rate can overshoot. Farm prices and exchange rates are regarded as more flexible than other prices. In this study, we analyze whether the effects of monetary policy shocks on farm prices are as large as the effects on exchange rate and whether farm prices overshoot as much as exchange rate does. Our empirical analysis considering both exchange rate and farm prices may be viewed as an empirical counter part of some studies like Saghaian, Reed, and Marchant (2002) that analyzed the effects of monetary policy shocks on both variables theoretically. The theory suggests that farm prices can overshoot more when exchange rate is relatively less flexible (and overshoot less).

Finally, this study also compares the results of South Korea with those of the U.S. From this comparison, we would like to answer the following questions. Are the effects of interest rate shocks on real farm prices in emerging countries like Korea as large as those in advanced countries like the U.S.? Do we observe overshooting in Korea as in the U.S.? Are the relative effects of monetary shocks on farm prices and exchange rate in Korea similar to those in the U.S.? In Korea, severe regulations on farm prices were imposed in old days but agricultural markets have been deregulated in recent years. We investigate the issue for Korea in recent years, and compare the results with those of the U.S., which can be regarded as a benchmark case.

In Chapter 2, the empirical method and the data to investigate the effects of monetary policy on farm prices and exchange rates are explained. In Chapter 3, the empirical results for the U.S. and Korea are presented. In Chapter 4, we conclude with a summary of the empirical findings and draw implications from the findings.

Chapter 2

Methodology

2.1. VAR models

2.1.1. VAR Models on Monetary Policy

Past studies suggest that identifying exogenous shocks to monetary policy is important. Economic condition can affect monetary policy actions. For example, monetary policy may take expansion to overcome the recession. To measure the true effects of monetary policy actions, it is necessary to identify exogenous part of monetary policy actions. However, it has not been so easy to disentangle the effects of exogenous policy actions on the economy and the changes of economic condition to which monetary policy reacts. Such problems are found even in old studies. Friedman and Schwartz (1963) show the leading properties of monetary aggregate to real activities to monetarist view. However, Tobin (1970) suggests that such timing relation can be generated in a theoretical model in which monetary policy responds to real activities but has no effects on real economy.

Sims (1980) suggested using VAR models for macroeconomic analysis. Since then, the effects of monetary policy have been frequently analyzed by using VAR models because VAR models are intended to extract surprise changes or shocks. The initial VAR analysis used the VAR models with recursive short-run zero restrictions, introduced by Sims (1980). These initial studies identified monetary policy shocks with innovations in broad monetary aggregates. However, the liquidity puzzle appears when such models are used.[3] Standard theory predicts that monetary contraction (expansion) increase (decrease) interest rate and decrease (increase) price levels and monetary aggregates if monetary contraction (or expansion) is exogenous. In the VAR model, however when innovations in broad monetary aggregate are used as monetary policy, interest rates and monetary aggregates both rise. These responses are called the "liquidity puzzle". Past studies frequently suggested these puzzles appeared because the model cannot properly identified exogenous shocks to monetary policy. Changes in broad monetary aggregates usually respond to non-policy shocks, such as money demand shocks, endogenously. Thus, innovations in broad monetary aggregates are not likely to represent exogenous shocks to monetary policy.

[3] Refer to Reichenstein (1987) and Leeper and Gordon (1992).

Studies such as Sims (1992) and Bernanke and Blinder (1991) identified monetary policy shocks with innovations in short-term interest rate, in order to solve the liquidity puzzle. In recent years, the monetary authority has used the short-term interest rate, instead of broad monetary aggregates as the monetary policy instrument. However, the "price puzzle" is found when monetary policy shocks are identified as short-term interest rate in the model that includes traditional macro variables such as money, the interest rate, price level, and output. Standard theory predicts that monetary contraction (expansion) increase (decrease) interest rate and decrease (increase) price levels if monetary contraction (or expansion) is exogenous. In the model, however, when innovations in interest rates are used as monetary policy, price levels and interest rates both rise. These responses called the "price puzzle." Similar to the liquidity puzzle, the price puzzle is commonly interpreted as an indication that the exogenous interest rate shocks to monetary policy are not properly identified in the model. Sims (1992) propose the following explanations. The monetary authority responds to inflationary pressure (even without actual changes in inflation rate), but the traditional model does not include any variables reflecting inflation expectation. Therefore, the traditional model does not identify exogenous monetary policy shocks by not properly taking into account the variables to which the monetary authority endogenously respond. By additionally including commodity price index in addition to the traditional macro variables in the model, Sims (1992) mitigated the price puzzle.

2.1.2. SVAR with Sign Restrictions

As discussed, Past studies frequently employed structural VAR (Vector Auto-Regression) models to analyze the effects of monetary policy since exogenous monetary policy shocks can be identified by using structural VAR models. However, these studies are faced with various puzzles, such as the price and the liquidity puzzles.

Uhlig (2005) developed a method to resolve these problems. By using sign restrictions properly on impulse responses, the puzzles can disappear by construction. Puzzling responses are frequently thought of as failures in identifying exogenous monetary policy shocks. Therefore, imposing sign restrictions to resolve those puzzles is an appealing method. Using this methodology suggested by Uhlig (2005), we identify interest rate shocks explicitly and examine the effects of the shocks on farm prices and exchange rate in this paper. The methodology of the structural VAR model with sign restrictions is briefly described below.

A reduced form of the VAR model is considered:

$$Y_t = B(L)Y_{t-1} + C(L)X_t + u_t, \tag{2.1}$$

where Y_t is an $l \times 1$ vector of endogenous variables, X_t is an $m \times 1$ vector of exogenous variables, u_t is an $l \times 1$ residual vector, $E(u_t) = 0$, $E(u_t u_t^{'}) = \Sigma$, and *B(L)* and *C(L)* are $l \times l$ and $l \times m$ matrix polynomials in lag operator *L*.

In general, reduced-form residuals (elements of u_t) can be written as the linear combinations of structural shocks (elements of v_t) as follows:

$$u_t = Av_t, \qquad (2.2)$$

where *A* is an $l \times l$ matrix, v_t is an $l \times 1$ vector of structural shocks, $E(v_t) = 0$, and $E(v_t v_t^{'}) = 1$. past studies allowed orthogonal structural errors to recover from the residuals of reduced-form by determining *A*, One method to recover the structural shocks is the the recursive identification strategy, for example, resolving *A* as lower triangularity by imposing Cholesky decomposition on Σ, (Sims, (1980)).

Uhlig (2005) has estimated restricting the signs of impulse responses to identify the monetary shock. In particular, he has estimated to identifying not several types of structural shock and only identified monetary shock, one type of shock, which amounts to identifying a single column $a \in R^m$ of the matrix *A*. The impulse vector has been defined as follows.

Definition 1. The vector $a \in R^m$ is called an impulse vector if matrix A exists; hence, $AA' = \Sigma$ and a is a column of A.

Uhlig (2005) suggested that $a = \tilde{A}\alpha$ can characterize any impulse vector a, where α is an l-dimensional vector of unit length and $\tilde{A}\tilde{A}' = \Sigma$ is a Cholesky decomposition of Σ. Hence, the impulse response vector $r_a(k)$ for a can be expressed as follows. $r_a(k) = \sum_{j=1}^{l} \alpha_j r_j(k)$, where $r_j(k) \in R^l$ is the vector response to the jth variable in a Cholesky decomposition of Σ at horizon k. A list of sign restrictions at various horizons k on the entries of the vector impulse response $r_a(k)$ is imposed.

Uhlig (2005) assumed α as an independent uniform prior and the VAR parameters (B, Σ) as a Bayesian prior. The draws that meet the conditions are only kept and calculated in this simulation following pure sign restriction approach. Based on 5,000 of such draws, the error bands are generated. Because we follow the Bayesian perspective, our statistical analysis is not problematic per se. Sims (1988) and Sims and Uhlig (1991) introduced Bayesian analysis in the presence of cointegrating relations and unit root in general discussion.

2.2. Model Specification and Data: U.S.

In the baseline model for the U.S., we used the following eight endogenous variables: the federal funds rate (FFR), non-borrowed reserves (NBR), total reserves (TR), industrial production (IP), consumer price index (CPI), crude material price in production price index (CMP), real farm price (RFP) and real exchange rate (RER). Exogenous variables are not introduced in the U.S. model, following Uhlig (2005). Therefore, the reduced form of the VAR model in equation (2.1) is expressed as follows.

$$Y_t = \mathrm{B}(L)\, Y_{t-1} + U_t$$

$$\begin{pmatrix} FFR_t \\ NBR_t \\ TR_t \\ IP_t \\ CPI_t \\ CMP_t \\ RFP_t \\ RER_t \end{pmatrix} = \begin{pmatrix} B_{11}(L) B_{12}(L) & & B_{18}(L) \\ B_{21}(L) B_{22}(L) & \cdots & B_{28}(L) \\ B_{31}(L) B_{32}(L) & \cdots & B_{38}(L) \\ B_{41}(L) B_{42}(L) & \cdots & B_{48}(L) \\ B_{51}(L) B_{52}(L) & \cdots & B_{58}(L) \\ B_{61}(L) B_{62}(L) & \cdots & B_{68}(L) \\ B_{71}(L) B_{72}(L) & & B_{78}(L) \\ B_{81}(L) B_{82}(L) & & B_{88}(L) \end{pmatrix} \begin{pmatrix} FFR_{t-1} \\ NBR_{t-1} \\ TR_{t-1} \\ IP_{t-1} \\ CPI_{t-1} \\ CMP_{t-1} \\ RFP_{t-1} \\ RER_{t-1} \end{pmatrix} + \begin{pmatrix} U^{FFR}{}_t \\ U^{NBR}{}_t \\ U^{TR}{}_t \\ U^{IP}{}_t \\ U^{CPI}{}_t \\ U^{CMP}{}_t \\ U^{RFP}{}_t \\ U^{RER}{}_t \end{pmatrix}$$

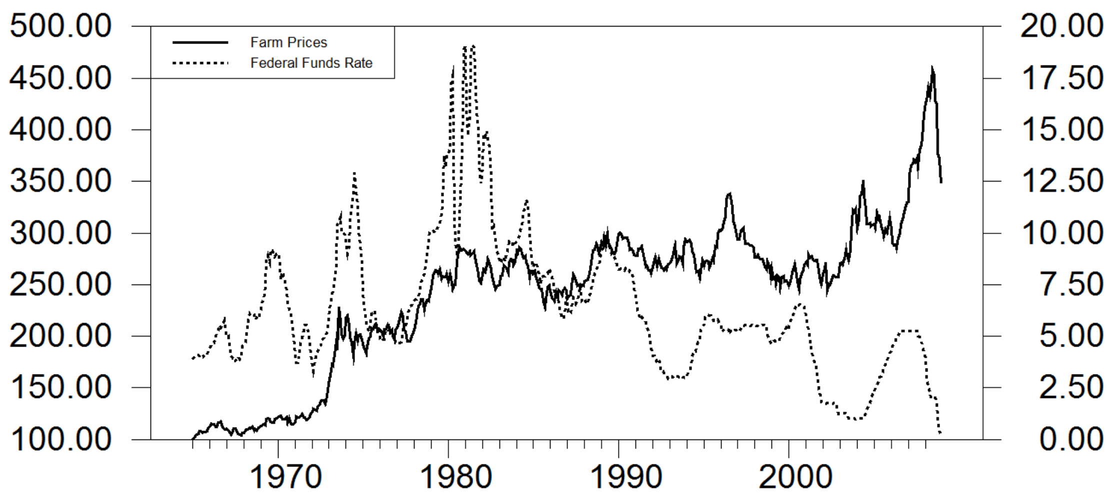
The first three variables are the same as those used in Uhlig (2005). FFR and NBR are included to identify monetary policy actions. For example, in monetary contraction, the Fed decreases NBR to increase FFR when open market operation is used. TR is also included since it is an important indicator of monetary condition. The next three variables are similar to those used in Uhlig (2005). Uhlig (2005) used real GDP and GDP deflator, but monthly data on real GDP and GDP deflator are not readily available. Therefore, we use IP to represent general economic activity and CPI to represent the general price level. Both variables are the objective of monetary policy so it is crucial to include these variables in the model. In addition, CPI needs to be included in the model since Uhlig (2005) identification scheme imposes restrictions on impulse responses of the price level as will be explained. Uhlig (2005) included commodity price index that is likely to reflect inflation expectation that monetary policy often reacts to. The same commodity price index is not available for the recent period, so we use CMP as a proxy.[4] Finally, we include RFP and RER since we are interested in the effects of monetary policy shocks on those variables.

In addition, we construct an additional model by replacing real farm price (RFP) and real exchange rate (RER) with nominal farm price (NFP) and nominal exchange rate (NER). The baseline model is useful to address whether real farm price and real exchange rate are affected significantly while this model is useful to see the dynamics of nominal farm price and nominal exchange rate and to check the overshooting hypothesis.

[4] We experiment with various proxy variables, but the results are similar.

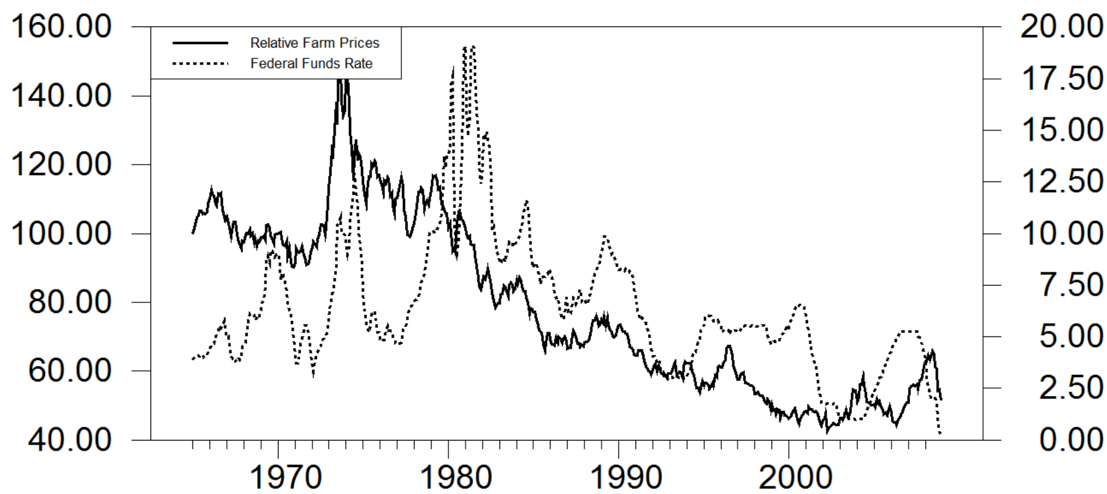
Following Uhlig (2005), the sign restrictions are imposed up to six months after the shock to identify (contractionary) monetary policy shocks. The sign restrictions are as follows. The federal funds rate increases, but the non-borrowed reserves, commodity price index, and consumer price index decrease. This methodology avoids the puzzles (liquidity and price puzzles) by construction. Therefore, the effects of interest rate shocks on very basic variables such as the interest rate, monetary aggregate, and the price level are consistent with the predictions of the standard theory. Twelve lags are included in the model following Uhlig (2005). Monthly data from 1965 to 2008 are used. We did not

Figure 2.2.1. Nominal Farm Price and Federal Funds Rate in the United States, 1965-2008



Note: This graph shows the nominal farm price and the Federal Funds rate in the U.S. for the period of 1965-2008. The nominal farm price is normalized as 100 at the initial date. The left scale is for the nominal farm price while the right scale is for the Federal Funds rate.

Figure 2.2.2. Relative Farm Price and Federal Funds Rate in the United States, 1965-2008



Note: This graph shows the relative farm price and the Federal Funds rate in the U.S. for the period of 1965-2008. The relative farm price is normalized as 100 at the initial date. The left scale is for the relative farm price while the right scale is for the Federal Funds rate.

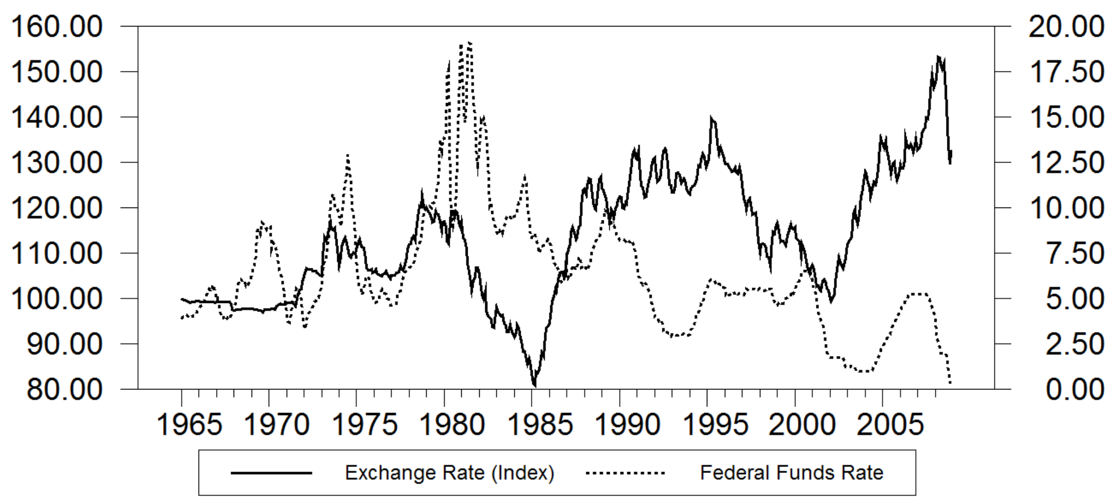
include the sample after 2008 since the Federal Funds rate reaches to zero and unconventional monetary policy is used, and thus, identifying monetary policy shocks using the restrictions on FFR and NBR responses is meaningless. The details on data sources are reported in the Table 2.2.1.

Figures 2.2.1 and 2.2.2 show the Federal Funds rate and nominal and real farm prices of the United States. The nominal and real farm prices are normalized as 100 at the initial date. In each graph, the left scale is for farm prices while the right scale is for the Federal Funds rate. Nominal farm prices tend to increase over time, but real farm prices tend to decrease over time. We can find a few episodes in which monetary tightening and real farm price falls are observed. In the early

1980's, the Federal Funds rate increased sharply while real farm prices fall. From the late 1990's to the early 2000's, the Federal Funds rate stays at a relatively high level but real farm prices fell over time. In addition, in the mid 2000's, a rising Federal Funds rate is associated with a falling farm price. This may suggest that a monetary tightening leads to a fall in real farm prices.

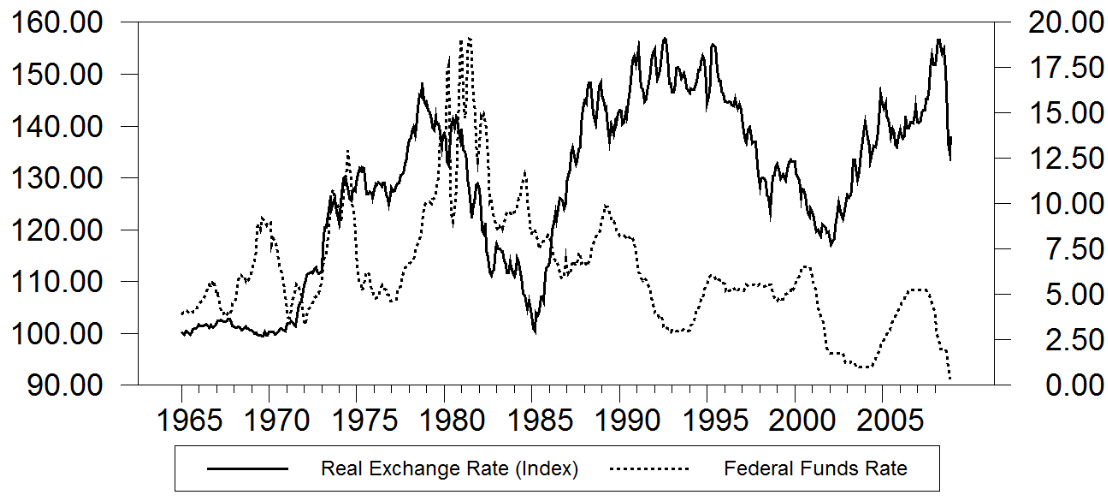
Figures 2.2.3 and 2.2.4 show nominal and real exchange rates and the Federal Funds rate in the United States. An increase (or a decrease) in exchange rate implies a depreciation (or an appreciation) of the U.S. dollars. We can see that the Federal Funds rate is often negatively associated with exchange rates. From

Figure 2.2.3. Nominal Exchange Rate and Federal Funds Rate in the United States, 1965-2008



Note: This graph shows the nominal exchange rate and the Federal Funds rate in the U.S. for the period of 1965-2008. The nominal exchange rate is normalized as 100 at the initial date. The left scale is for the nominal exchange rate while the right scale is for the Federal Funds rate.

Figure 2.2.4. Real Exchange Rate and Federal Funds Rate in the United States, 1965-2008



Note: This graph shows the real exchange rate and the Federal Funds rate in the U.S. for the period of 1965-2008. The real exchange rate is normalized as 100 at the initial date. The left scale is for the real exchange rate while the right scale is for the Federal Funds rate.

the mid 1980's to the early 1990's, nominal and real exchange rate increased over time, but the Federal Funds rate decreased over time. From the mid 1990's to the early 2000's, nominal and real exchange rate falls but the Federal Funds rate rises. From the early to the mid 2000's, rises in real and nominal exchange rates and falls in the Federal Funds rate are observed. This may suggest that a monetary expansion (or contraction) leads to depreciation (or appreciation) of nominal and real exchange rates.

Table 2.2.1. Data Sources for the U.S. Model

Variable	Description	Sources and Notes
CPI	consumer price index, seasonally adjusted	Federal Reserve Bank of St. Louis Macro Database
IP	industrial production index, seasonally adjusted	Federal Reserve Bank of St. Louis Macro Database
CMP	producer price index by commodity for intermediate & crude materials , seasonally adjusted	Federal Reserve Bank of St. Louis Macro Database
FFR	Federal Funds rate	Federal Reserve Bank of St. Louis Macro Database
NER	BIS nominal effective exchange rate (narrow)	BIS (Bank for International Settlement)
RER	BIS real effective exchange rate (narrow)	BIS (Bank for International Settlement)
NBR	non-borrowed reserves of depository institutions, seasonally adjusted	Federal Reserve Bank of St. Louis Macro Database
TR	total reserves of depository institutions	Federal Reserve Bank of St. Louis Macro Database
NFP	producer price index by commodity for farm products	Federal Reserve Bank of St. Louis Macro Database
RFP	real farm price	NFP/CPI

Note: This table shows the data sources for the U.S. model.

2.3. Model Specification and Data: Korea

The model aims to identify monetary policy shocks and analyze the effects on farm prices and exchange rate in Korea. The model is modified from Kim and Lim (2015) that developed an empirical model that can identify monetary shocks on exchange rate in small open economies including Korea.

We include 6 variables, monetary base (MB), call rate (CR), consumer price index (CPI), industrial production (IP), relative farm prices (RFP) and real exchange rate of Korea against the US (RER) as endogenous variables in the baseline model. The first 4 (MB, CR, IP, CPI) are key monetary and macroeconomic variables that are included to identify interest rate shocks. RER and RFP are included since we are interested in the effects on these variables.

In addition, we construct an additional model by replacing real farm price (RFP) and real exchange rate (RER) with nominal farm price (NFP) and nominal exchange rate (NER). The baseline model is useful to address whether real farm price and real exchange rate are affected significantly while this model is useful to see the dynamics of nominal farm price and nominal exchange rate and to check the overshooting hypothesis.

We also include 4, the federal funds rate (FFR), the CPI of the US (CPIUS), IP of the US (IPUS), and VIX as exogenous variables in the model. The U.S. monetary policy is likely to affect the exchange rate of Korea again the U.S., so the U.S. monetary policy is controlled by including FFR. Macro fundamentals like IPUS and CPIUS are likely important in explaining the exchange rate movements, so IPUS and CPIUS are included in the model. VIX represents the perception on riskiness in the international financial markets, which often affect the exchange rate substantially in recent years. No Restrictions are not imposed on exogenous variables regarding their contemporaneous reactions to endogenous variables in the model, as shown in Equation (2.1).

Now the reduced form of VAR model, as shown in equation (2.1), is expressed as follows.

$$Y_t = \mathrm{B}(L)\, Y_{t-1} + \mathrm{C}(L)\, X_t + U_t$$

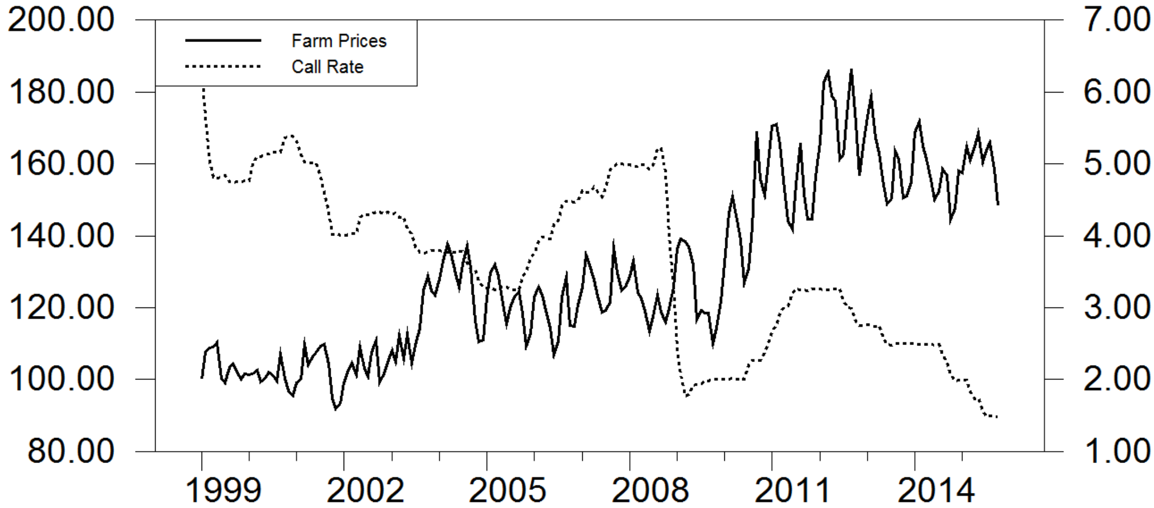
$$\begin{pmatrix} CR_t \\ MB_t \\ CPI_t \\ IP_t \\ RER_t \\ RFP_t \end{pmatrix} = \begin{pmatrix} B_{11}(L) B_{12}(L) \dots B_{16}(L) \\ B_{21}(L) B_{22}(L) \cdots B_{26}(L) \\ B_{31}(L) B_{32}(L) \cdots B_{36}(L) \\ B_{41}(L) B_{42}(L) \cdots B_{46}(L) \\ B_{51}(L) B_{52}(L) \dots B_{56}(L) \\ B_{61}(L) B_{62}(L) \quad B_{66}(L) \end{pmatrix} \begin{pmatrix} CR_{t-1} \\ MB_{t-1} \\ CPI_{t-1} \\ IP_{t-1} \\ RER_{t-1} \\ RFP_{t-1} \end{pmatrix}$$

$$+ \begin{pmatrix} C_{11}(L) C_{12}(L) \dots C_{14}(L) \\ C_{21}(L) C_{22}(L) \cdots C_{24}(L) \\ C_{31}(L) C_{32}(L) \cdots C_{34}(L) \\ C_{41}(L) C_{42}(L) \cdots C_{44}(L) \\ C_{51}(L) C_{52}(L) \dots C_{54}(L) \\ C_{61}(L) C_{62}(L) \quad C_{64}(L) \end{pmatrix} \begin{pmatrix} FFR_t \\ IPUS_t \\ CPIUS_t \\ VIX_t \end{pmatrix} + \begin{pmatrix} U^{CR}{}_t \\ U^{MB}{}_t \\ U^{CPI}{}_t \\ U^{IP}{}_t \\ U^{RER}{}_t \\ U^{RFP}{}_t \end{pmatrix}$$

To identify contractionary monetary shocks, we impose the following restrictions on impulse responses: (1) monetary base decreases, (2) call rate increases, and (3) CPI declines. By employing such restrictions, price and liquidity puzzles disappear by construction. Hence, these responses of basic macro parameters to interest rate shocks are consistent with the predictions of the standard economic view on the effects of monetary policy. Uhlig (2005) and many following studies such as Scholl and Uhlig (2008) used such restrictions. Following this methodology, we use these restrictions for the first 12 months after a shock.

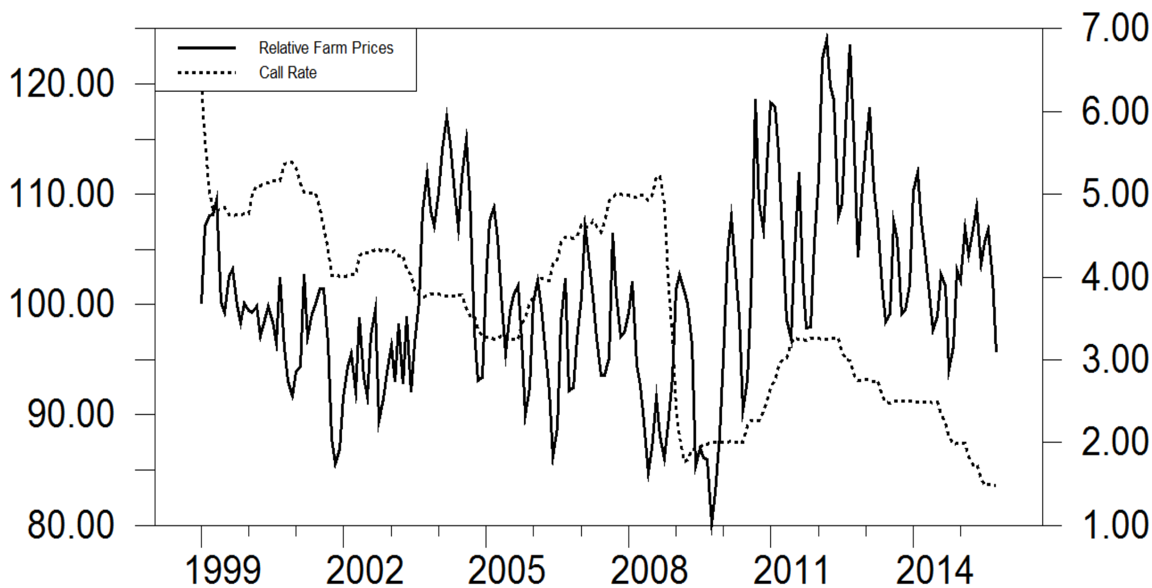
Monthly data are used. Details on data definitions and sources are found in the Table 2.3.1. Six lags for endogenous variables are allowed. Lags are not allowed for exogenous variables in the baseline model to secure the degree of freedom. To verify the robustness of the results, however, another number of lags is considered in the extended experiments (in Chapter 3.2.2). The period of 1999:1-2015:10 is considered. We consider this post Asian financial crisis period for various reasons. First, agricultural markets were more tightly regulated before Asian financial crisis. Second, monetary policy operating procedure changed substantially after Asian financial crisis. Inflation targeting was introduced and the interest rate instruments (instead of monetary aggregate) was introduced (see Kim and Park, 2006). Third, after Asian financial crisis, capital account was more liberalized and floating exchange rate regime was adopted (see Kim and Yang, 2012)

Figure 2.3.1. Nominal Farm Price and Call Rate in Korea, 1999-2015



Note: This graph shows the nominal farm price and the call rate in Korea for the period of 1999-2015. The nominal farm price is normalized as 100 at the initial date. The left scale is for the nominal farm price while the right scale is for the call rate.

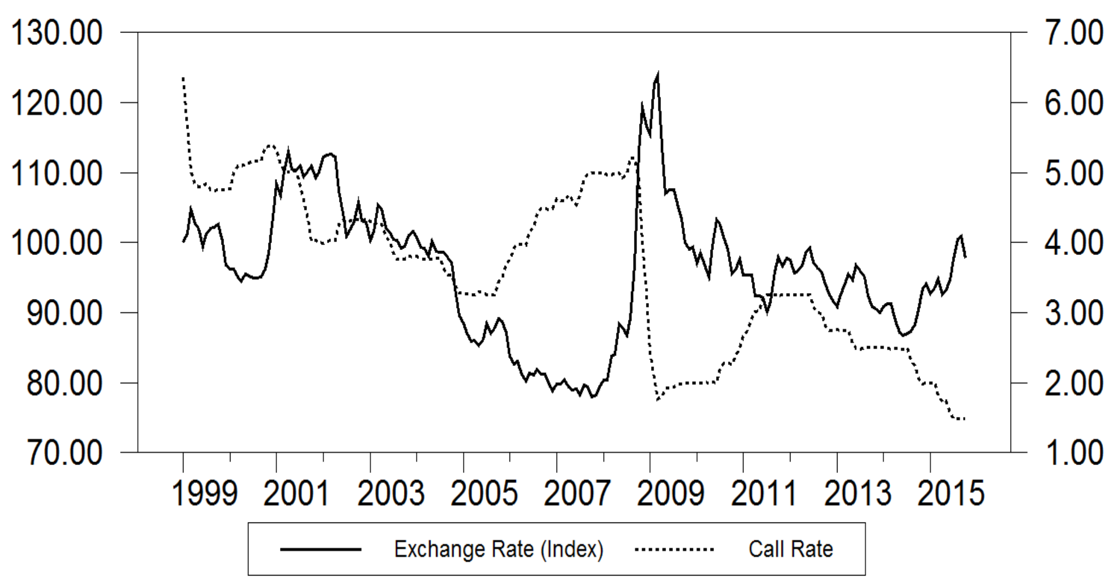
Figure 2.3.2. Relative Farm Price and Call Rate in Korea, 1999-2015



Note: This graph shows the relative farm price and the call rate in Korea for the period of 1999-2015. The relative farm price is normalized as 100 at the initial date. The left scale is for the relative farm price while the right scale is for the call rate.

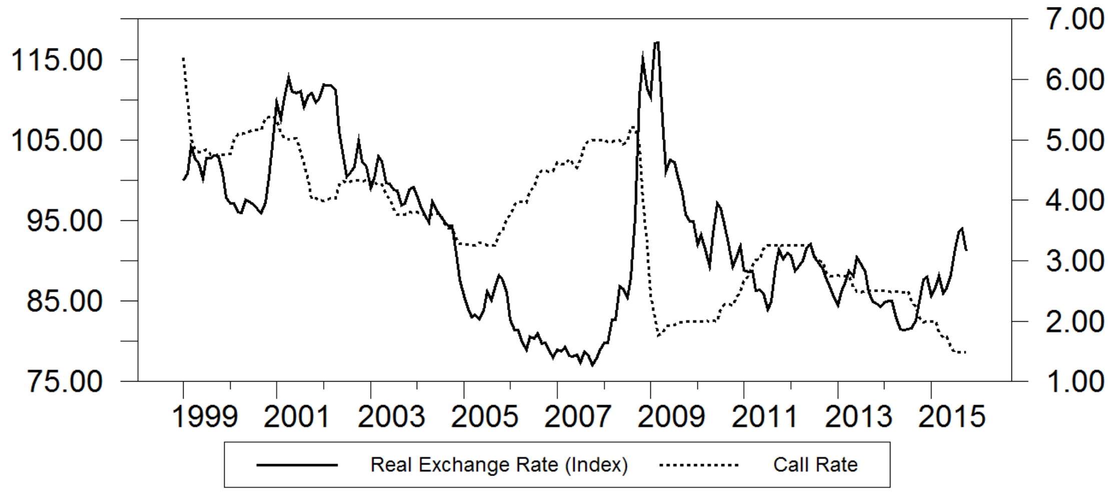
Figures 2.3.1 and 2.3.2 show the call rate and nominal and real farm prices of Korea. The nominal and real farm prices are normalized as 100 at the initial date. In each graph, the left scale is for farm prices or exchange rates while the right scale is for the Federal Funds rate. Nominal farm prices tend to increase over time, but there is no clear long run trend in real farm prices. We can find a few episodes in which the call rate is negatively associated with farm prices. In the early 2000's, rises in real and nominal farm prices and falls in the call rate are observed. This may suggest that a decrease in call rate leads to increases in real and nominal farm prices.

Figure 2.3.3. Nominal Exchange Rate and Call Rate in Korea, 1999-2005



Note: This graph shows the nominal exchange rate and the call rate in Korea for the period of 1999-2015. The nominal exchange rate is normalized as 100 at the initial date. The left scale is for the nominal exchange rate while the right scale is for the call rate.

Figure 2.3.4. Real Exchange Rate and Call Rate in Korea, 1999-2015



Note: This graph shows the real exchange rate and the call rate in Korea for the period of 1999-2015. The real exchange rate is normalized as 100 at the initial date. The left scale is for the real exchange rate while the right scale is for the call rate.

Figures 2.3.3 and 2.3.4 show call rate and exchange rates of Korea. An increase (or a decrease) in exchange rate implies a depreciation (or an appreciation) of the Korean Won. We can see that call rate is often negatively associated with exchange rates. From the late 1999s to the early 2000s, both nominal and real exchange rate increased over time, but the call rate decreased over time. From 2005 to 2007, call rate increases but exchange rate decreases. Around 2009, a sharp increase in exchange rates and a sharp fall in call rate are observed. From 2009 to 2012, exchange rates decrease over time but call rate increases over time. From 2014, exchange rate increases but call rate falls. This observation partly reflects that a monetary expansion (or contraction) leads to depreciation (or appreciation) of nominal and real exchange rates.

Table 2.3.1. Data Sources for Korean Model

Variable	Description	Sources and Notes
CR	money market rate	*Bank of Korea Economic Statistics*
MB	monetary base, seasonally adjusted	*Bank of Korea Economic Statistics*
CPI	consumer price index, seasonally adjusted	*Bank of Korea Economic Statistics*
IP	industrial production index, seasonally adjusted	*Bank of Korea Economic Statistics*
NER	nominal exchange rate of Korea against U.S.	*Bank of Korea Economic Statistics*
RER	real exchange rate of Korea against U.S.	NER*CPIUS/CPI
NFP	producer price index by commodity for farm products	*Bank of Korea Economic Statistics*
RFP	real farm price	NFP/CPI
FFR	Federal Funds rate	*Federal Reserve Bank of St. Louis Macro Database*.
CPIUS	US consumer price index, seasonally adjusted	*Federal Reserve Bank of St. Louis Macro Database.*
IPUS	US industrial production index, seasonally adjusted	*Federal Reserve Bank of St. Louis Macro Database*.
VIX	volatility Index	*Federal Reserve Bank of St. Louis Macro Database*

Note: This table shows the data sources for the Korea model.

Chapter 3

Empirical Results

3.1. U.S.

3.1.1. Baseline Model

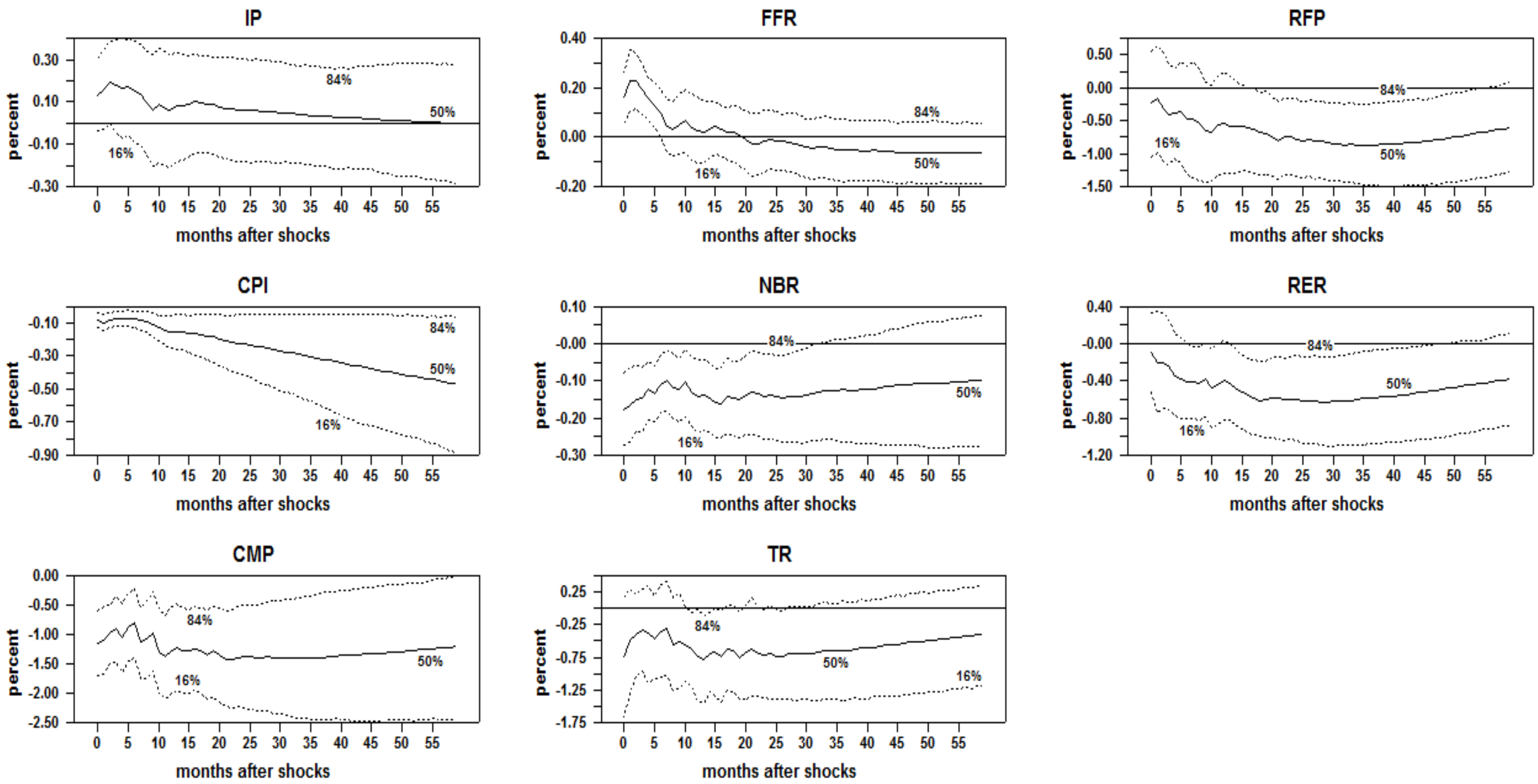
Figure 3.1.1 and Table A.1.1 (in Appendix) report the median impulse responses to monetary policy shocks over five and four year horizons, respectively, with 68% probability bands in the baseline model. FFR increases in the short run, NBR declines, and the CPI decreases. By using sign restrictions to impulse responses, the puzzles disappear by construction.

To infer the nature of the shock, we examine the responses in more details. FFR increase sharply on impact by 0.15%, which is significantly different from zero with more than 84% probability. FFR returns to the initial value in approximately eighteen months after the shock. NBR declines sharply on impact, by about 0.17%, and then rises to the initial value over time. The declines in NBR for one to thirty five month horizons are different from zero with more than 84% probability. TR also declines. The decline in TR at around twelve month horizon is different from zero with more than 84% probability. CPI declines on impact by approximately 0.08% on impact and further declines over time, reaching to approximately 0.39% decline at four-year horizon. The declines in CPI at almost all horizons are differ from zero with higher than 84% probability. CMP falls on impact, by 1.17%, and stays at a similar level for a long time. The declines in CMP are also differ from zero with higher than 84% probability, up to 4 year horizons.

Then we discuss the responses of RFP which is of our main interests. Real farm price declines. Based on median response, RFP declines approximately 0.25% on impact. It further declines over time, and in 37 months after the shock is the peak. The peak decline of 0.78% is observed. Then, it tends to move up to initial level slowly. The decrease in RFP from 21 months to more than 48 months horizons is different from zero with 84% probability. This result suggest that the farm price responds more than the general price level under monetary policy shocks. The result is not consistent with the traditional view based on the neutrality of money, but supports alternative views such as overshooting theory.

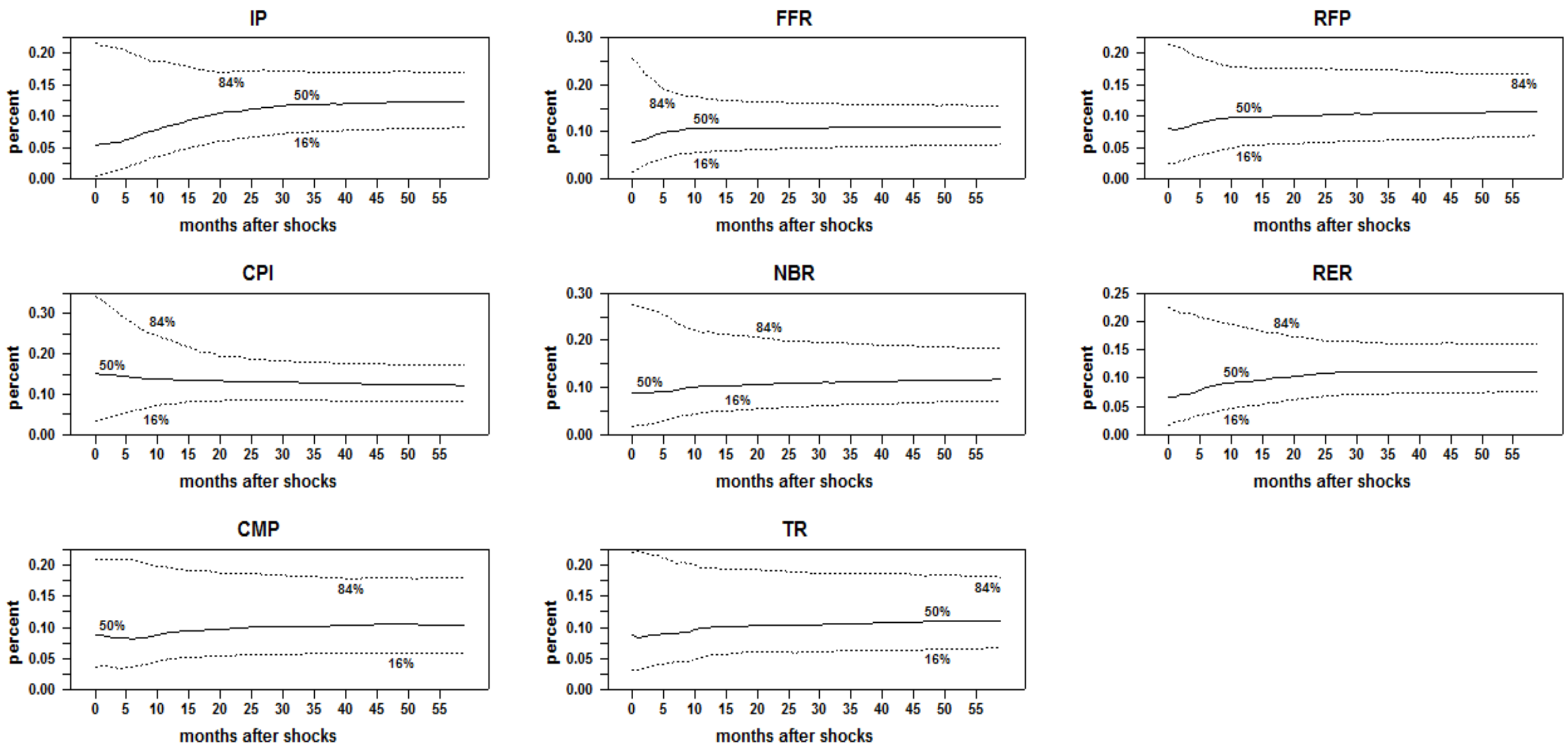
On the other hand, the real exchange rate also tends to decrease but error bands are wide. Based on the median estimate, RER does not change much on

Figure 3.1.1. Impulse Responses to Contractionary Monetary Policy Shocks in the Baseline Model for the U.S.



Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value)..

Figure 3.1.2. Forecast Error Variance Decomposition for Monetary Policy Shocks in the Baseline Model for the U.S.



Note: These graphs show forecast error variance decomposition of each variable (as percentages, in y-axis) due to monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted and 68% error bands were employed.

impact, but declines over time, and in 30 months after the shock reach to the peak. The peak decline of approximately 0.58%. And then it increases to the initial level. However, all these changes are not different from zero with 84% probability. Overall, it is interesting that the effects on real farm price is larger and more significant than the effects on real exchange rate.

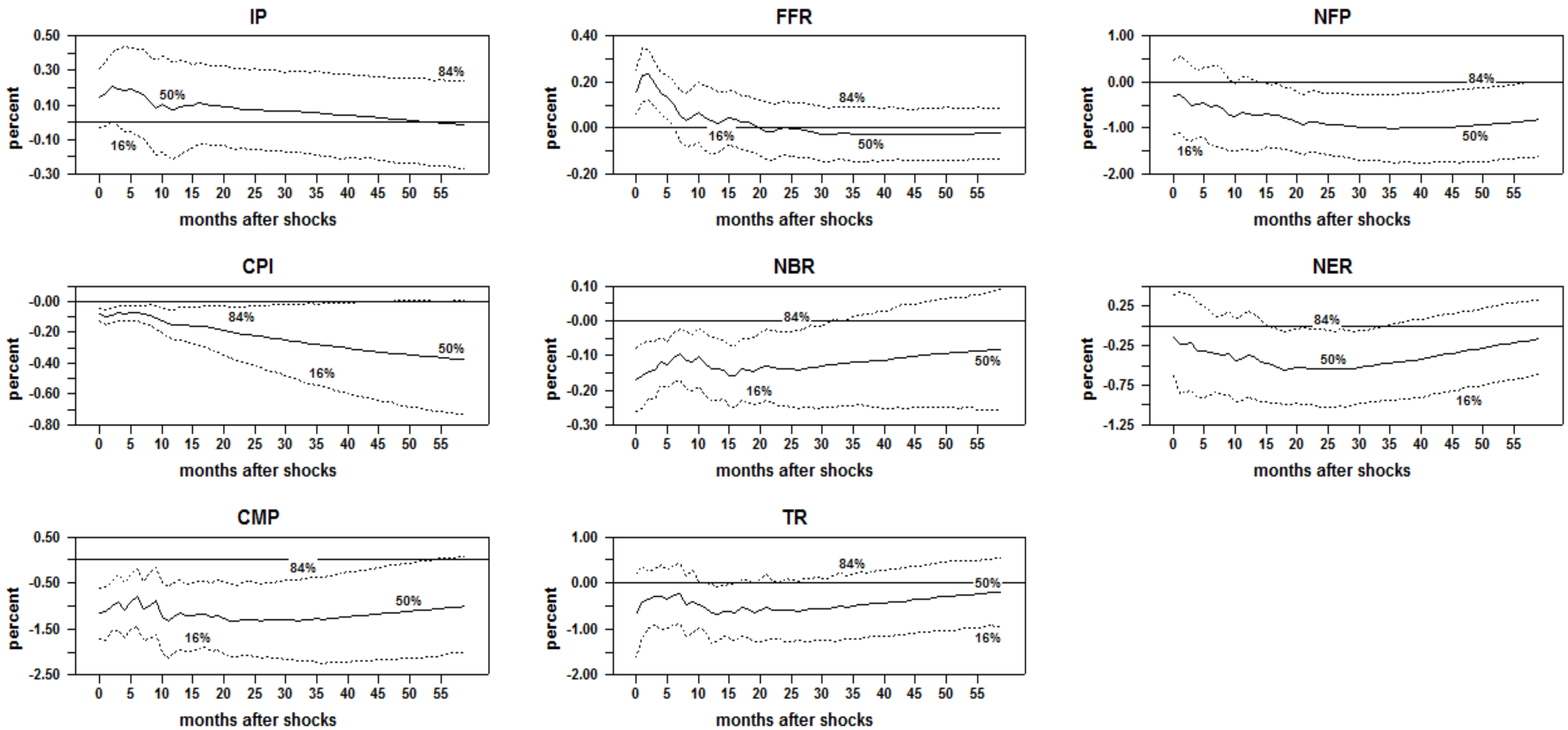
Figure 3.1.2 and Table A.1.2 (in Appendix) report the role of monetary policy shocks in analyzing fluctuation level of each variable at various horizons with 68% probability bands in the baseline model based on forecast error variance decomposition. The monetary policy shocks explain approximately 10 % of fluctuations in real farm prices. The monetary policy shocks also explain a similar magnitude of fluctuations in real exchange rate.

Figure 3.1.3 and Table A.1.3 (in Appendix) report the median impulse responses of each variable including nominal farm prices and nominal exchange rate to monetary policy shocks over 5 and 4 year horizons with 68% probability bands in the model. The responses of IP, CPI, FFR, TR, NBR, and CMP are very similar to those in the baseline model.

Based on median responses, NFP declines on impact by 0.31%, further decline over time, and the peck decline of 0.98% is observed in 36 and 37 months after the shock. Then, it tends to increase back. The peak response seems larger than the long run level, so ”overshooting” is observed. However, the dynamics is not fully consistent with theoretical prediction. Theory implies that the peak effect is found on impact but the peak effect is found with a long delay of 36-37 months in the empirical results. In fact, It is called the "delayed" overshooting puzzle and such results are often obtained in the studies on monetary policy shocks and exchange rate (e.g., Eichenbaum and Evans, 1995). In our results, we also found the delayed overshooting puzzle for exchange rate. NER declines on impact by 0.13%, further declines over time, and the peak decline of 0.55% is found in about 25-27 months after the shock. Then, the exchange rate increases back to the initial level over time. This shape of exchange rate responses shows the "delayed" overshooting. The delay in peak response is about 25-27 months for exchange rate. The "delayed overshooting" found in NFP and NER implies the failure of the equilibrium condition between the interest rate and expected return from holding farm products and the uncovered interest parity (UIP) condition, respectively, conditional on monetary policy shocks.

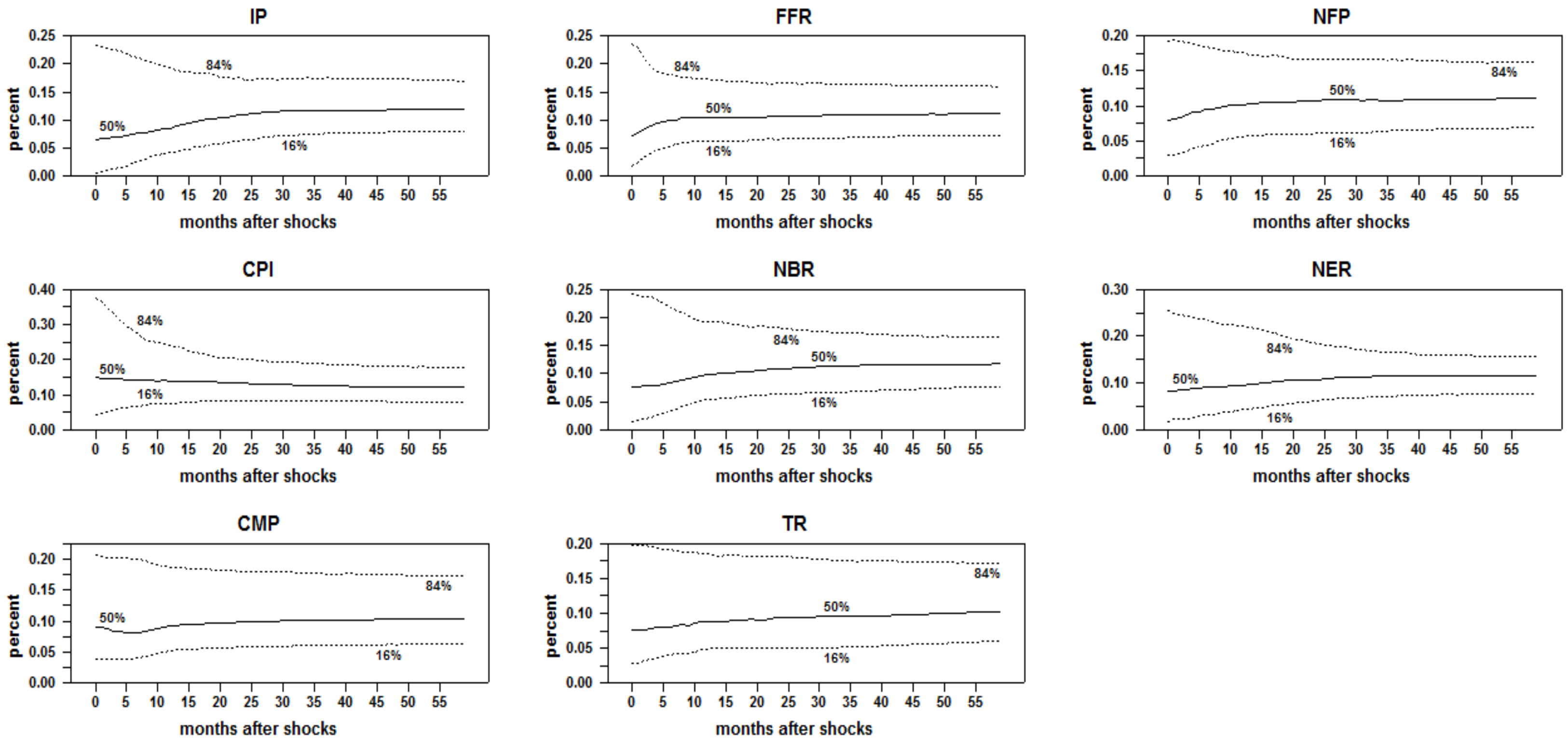
When we compare the results for NFP and NER, we can easily confirm that agricultural price responds more strongly to monetary policy shocks than nominal exchange rate does. Based on the median estimate, the impact effect on NFP (0.31%) is stronger than that on NER (0.13%). In addition, the peak effect on NFP (0.98%) is also larger than that on NER (0.55%). When we compare the responses for RFP and RER in Figure 3.1.1 and Table A.1.1 (in Appendix), the conclusion is the same. This result that the effect of monetary policy shocks on farm prices are stronger than that on exchange rate is quite interesting since monetary policy shocks are often thought of as having substantial effects on exchange rate.

Figure 3.1.3. Impulse Responses in the Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.



Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure 3.1.4. Forecast Error Variance Decomposition for Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.



Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure 3.1.4 and Table A.1.4 (in Appendix) report the role of monetary policy shocks in explaining fluctuations at various horizons with 68% probability bands in each variable in the model with NFP and NER. The results are not much different from those in the baseline model. The monetary policy shocks explain approximately 10 % of fluctuations in NFP and NER.

3.1.2. Extended Experiments

In this section, we extended the baseline model in a variety of ways to test the robustness of our results. First, alternative lag lengths are considered. In the baseline model, twelve lags are allowed, but six lags are considered. Figures A.1.1, A.1.2., A.1.3 and A.1.4 (in Appendix) report the results. The results are not much different from those under the baseline model. Second, alternative restriction horizons are considered. In the baseline model, six month restrictions are imposed but now twelve month restrictions are imposed. Figures A.1.5, A.1.6, A.1.7, and A.1.8 (in Appendix) report the results. The main results do not change.

Third, the data from Uhlig (2005) is used. The original model of Uhlig (2005) used commodity price index and monthly (interpolated) real GDP and GDP deflator, but we used intermediate material price of PPI, industrial production and CPI because the data is not available in recent years. Now we used the original data from Uhlig (2005) but the sample period covers only 1995-2003 as in Uhlig (2005). Figures A.1.9, A.1.10, A.1.11, and A.1.12 (in Appendix) report the results. The results are not much different from those of the baseline model.

Fourth, alternative sample periods are considered. In the baseline model, we use the data only up to 2008 because the Federal Funds rate reached to the zero lower bound. We consider the sample period for the flexible exchange rate regime (1974-2008) since the exchange rate behavior under the flexible exchange rate regime is likely to be different from those under the flexible exchange rate regime. Figures A.1.13, A.1.14, A.1.15, and A.1.16 (in Appendix) report the results. In Figure A.1.13 (in Appendix), we can see that the results are still not much different from the main results even when we consider the flexible exchange rate regime period. However, the nominal exchange rate depreciation becomes larger than the deprecation in the baseline model, although the nominal exchange rate changes are still smaller than the farm price changes as in the baseline model.

3.2. Korea

3.2.1. Baseline Model

Figure 3.2.1 and Table A.2.1 (in Appendix) report the median impulse responses of each variable to monetary policy shocks over four year horizons with 68% probability bands in the baseline model. CR increases in the short run, MB declines, and the CPI decreases. By using sign restriction, the liquidity and price puzzles disappear by construction.

To infer the nature of the shock, we examine the responses in more details. CR increase sharply on impact by approximately 0.03% and it is significantly not the same to zero with more than 84% confidence level. CR further increases up to 0.05% in three months, and then decreases to the initial value in the long run. Monetary base and CPI decreases, which is significant in many horizons. The industrial production response is not the same to zero with 84% confidence level.

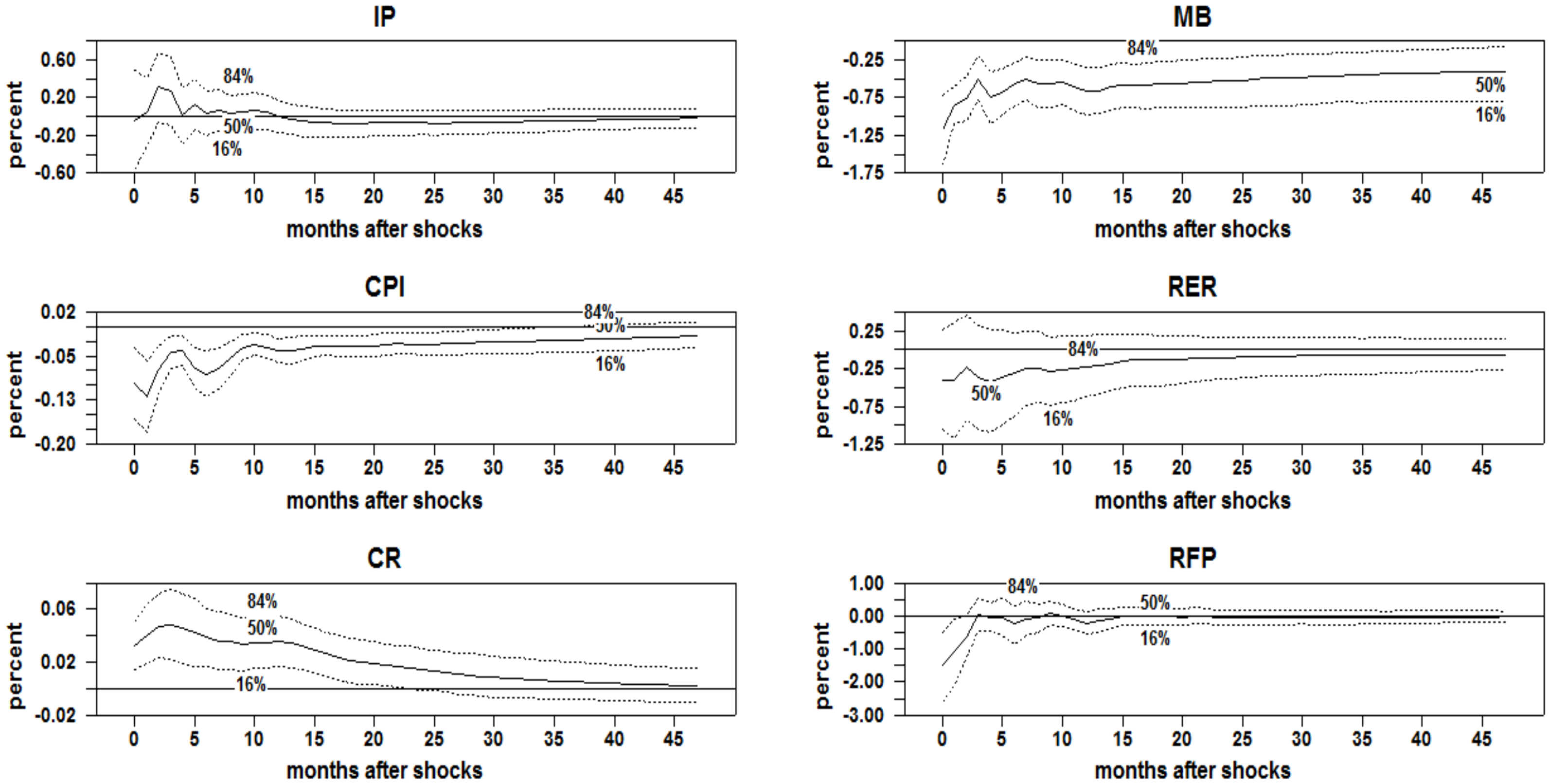
Then, we discuss the responses of RFP, which is of our main interests. Real farm price declines in the short run. Based on median response, RFP declines 1.51% on impact, and then increase to the initial value shortly. The decline in the first two months is different from zero with 84% probability. This result suggests that the farm price responds more than the general price level under monetary policy shocks. The result is not consistent with the traditional view based on the neutrality of money, but support alternative views such as overshooting theory.

The size of the maximum change in farm prices is huge, compared to the results in the U.S. For example, the maximum effect of monetary policy shocks on RFP is approximately 0.78% with even larger changes in the short- term interest rate in the U.S. as reported in Chapter 3.1.1. However, RFP changes far more persistently in the U.S. than in Korea. While RFP changes back to the initial value in a few months in Korea, RFP declines persistently in the U.S. as reported in Chapter 3.1.1. Farm price stabilization policy and regulation in farm prices may explain why the effects are short-lived in Korea.

On the other hand, the real exchange rate also tends to decrease but error bands are wide. Based on the median estimate, RER decreases by 0.45% on impact and increases back to the initial value over time. However all these changes are not different from zero with 84% probability. Overall, it is interesting that the effects of monetary policy shocks on real farm price is much larger and more significant than the effects on real exchange rate.

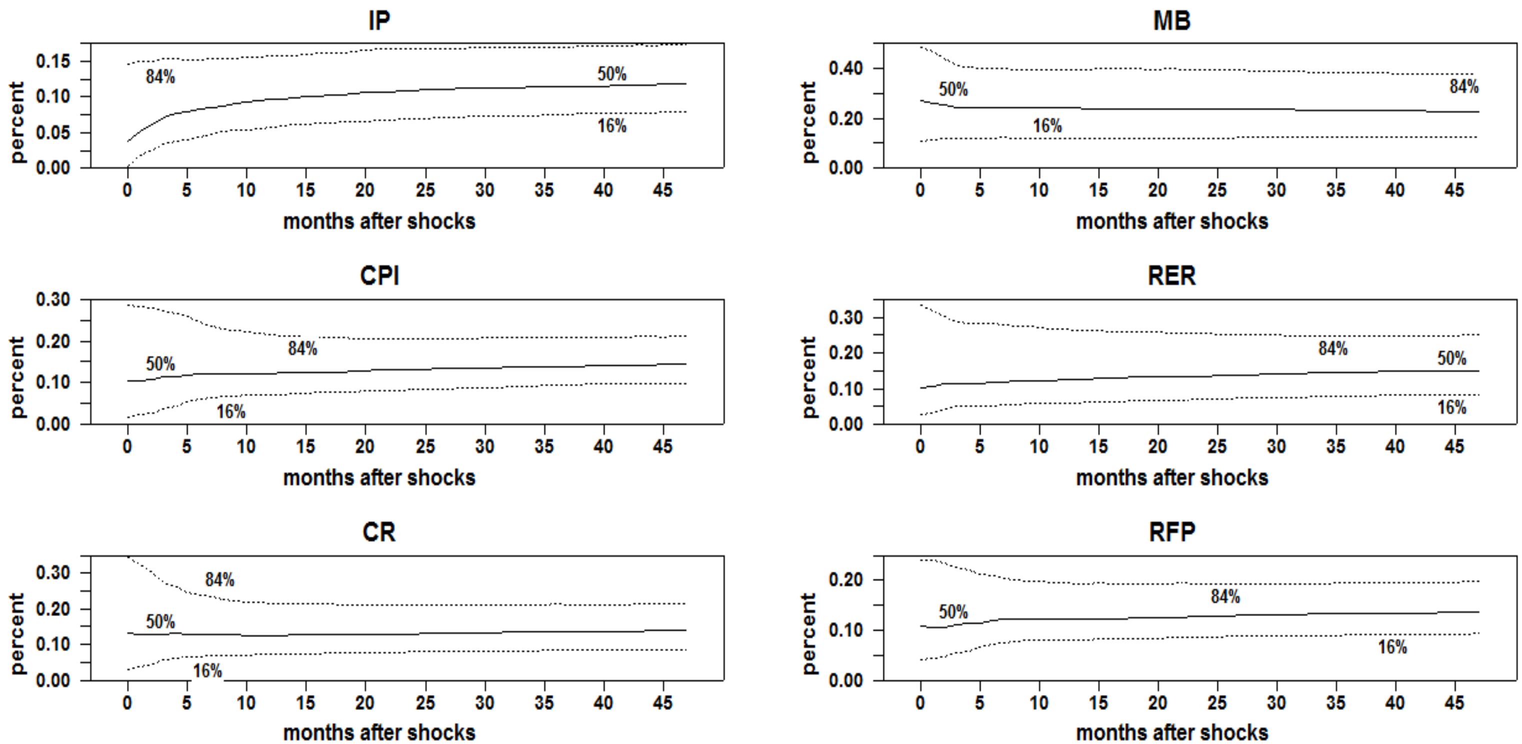
Figure 3.2.2 and Table A.2.2. (in Appendix) report the role of monetary policy shocks in explaining fluctuations of each variable at various horizons with 68% probability bands in the baseline model based on forecast error variance decomposition. The monetary policy shocks explain approximately 11 % - 14% of fluc tuations in real farm prices. It is not really huge, but it is slightly larger than the role found in the U.S. For example, monetary policy shocks explain

Figure 3.2.1. Impulse Responses to Contractionary Monetary Policy Shocks in the Baseline Model for Korea



Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure 3.2.2. Forecast Error Variance Decomposition for Monetary Policy Shocks in the Baseline Model for Korea



Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

approximately 10% fluctuations in real farm prices for the U.S. as reported in Chapter 3.1.1. The monetary policy shocks also explain a similar magnitude (11-16%) of fluctuations in real exchange rate.

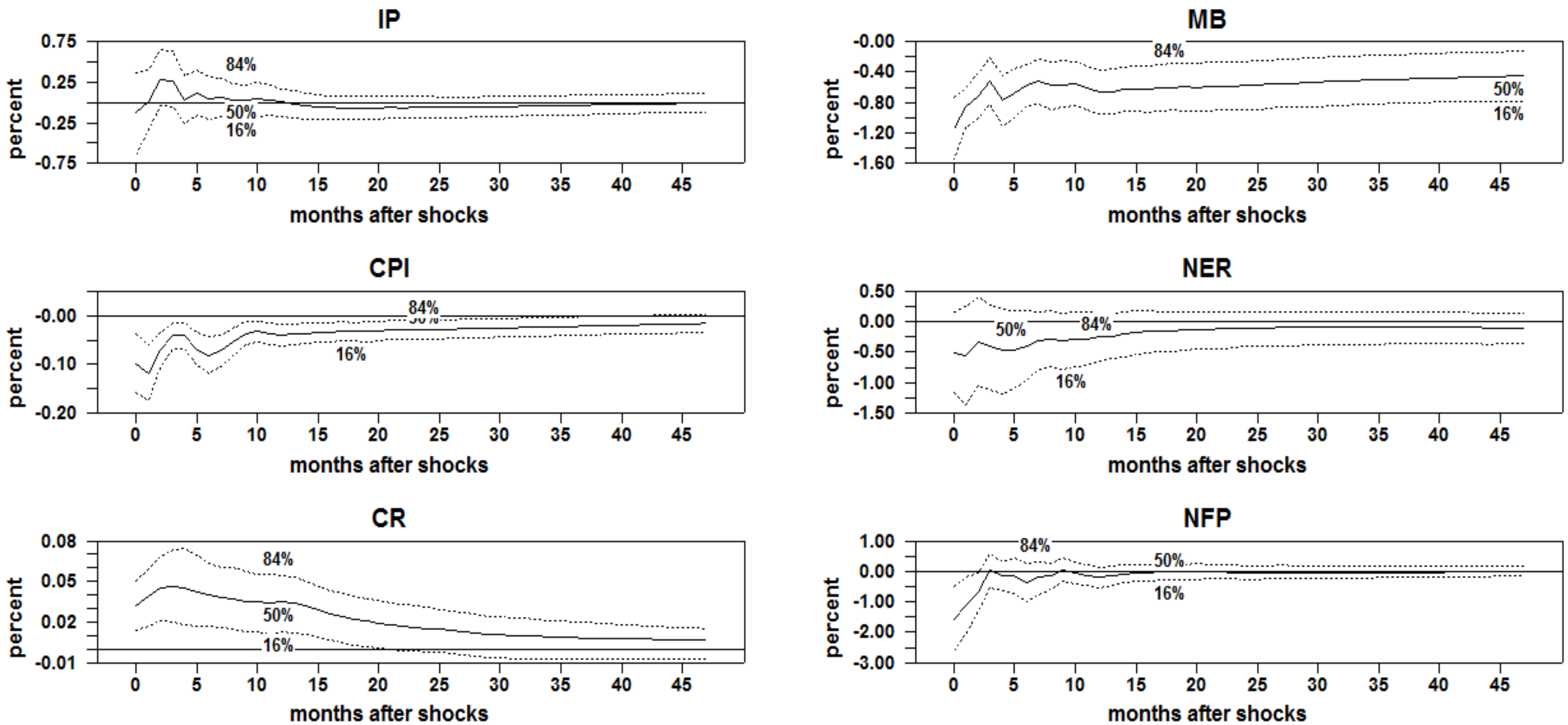
Figure 3.2.3 and Table A.2.3 (in Appendix) report the median impulse responses to monetary policy shocks over four year horizons with 68% probability bands in the model with nominal farm price and nominal exchange rate. The responses of IP, CPI, CR and MB are very similar to those in the baseline model.

Based on median responses, NFP declines on impact by approximately 1.59%, but increase back to the initial level shortly. The decline in agricultural price is different from zero for the first two months. Here we observe an immediate overshooting, without any delays, which is consistent with the overshooting theory. Then, NER also declines by 0.55% on impact, by 0.62% in the next month, and then increases back to the initial level over time, although the depreciation of nominal exchange rate is not significant in any horizons with 84% probability. Therefore, based on median response, the delay in overshooting of NER responses is only one month. Some previous studies documented “delayed overshooting” of exchange rate for the U.S. (see Eichenbaum and Evans, 1995 and Scholl and Uhlig, 2008) and “delayed overshooting” of farm prices for the U.S. was documented in Han and Kim (2005). However, we do not find such puzzling responses. This result may be partly due to the proper identifying assumptions as emphasized Kim and Lim (2015).

When we compare the results for NFP and NER, we can easily confirm that agricultural price responds to monetary policy shocks more strongly than nominal exchange rate. Based on the median estimate, the impact effect on NFP (1.59%) is stronger than that on NER (0.55%). When we compare the responses for RFP and RER in Figure 3.2.1, the conclusion is the same. This result that the effects of monetary policy shocks on farm prices are stronger than those on exchange rate is quite interesting since monetary policy shocks are often thought of as having substantial effects on exchange rate. On the other hand, this result might be due to severe foreign exchange intervention which may lead to low volatility of exchange rate in Korea.

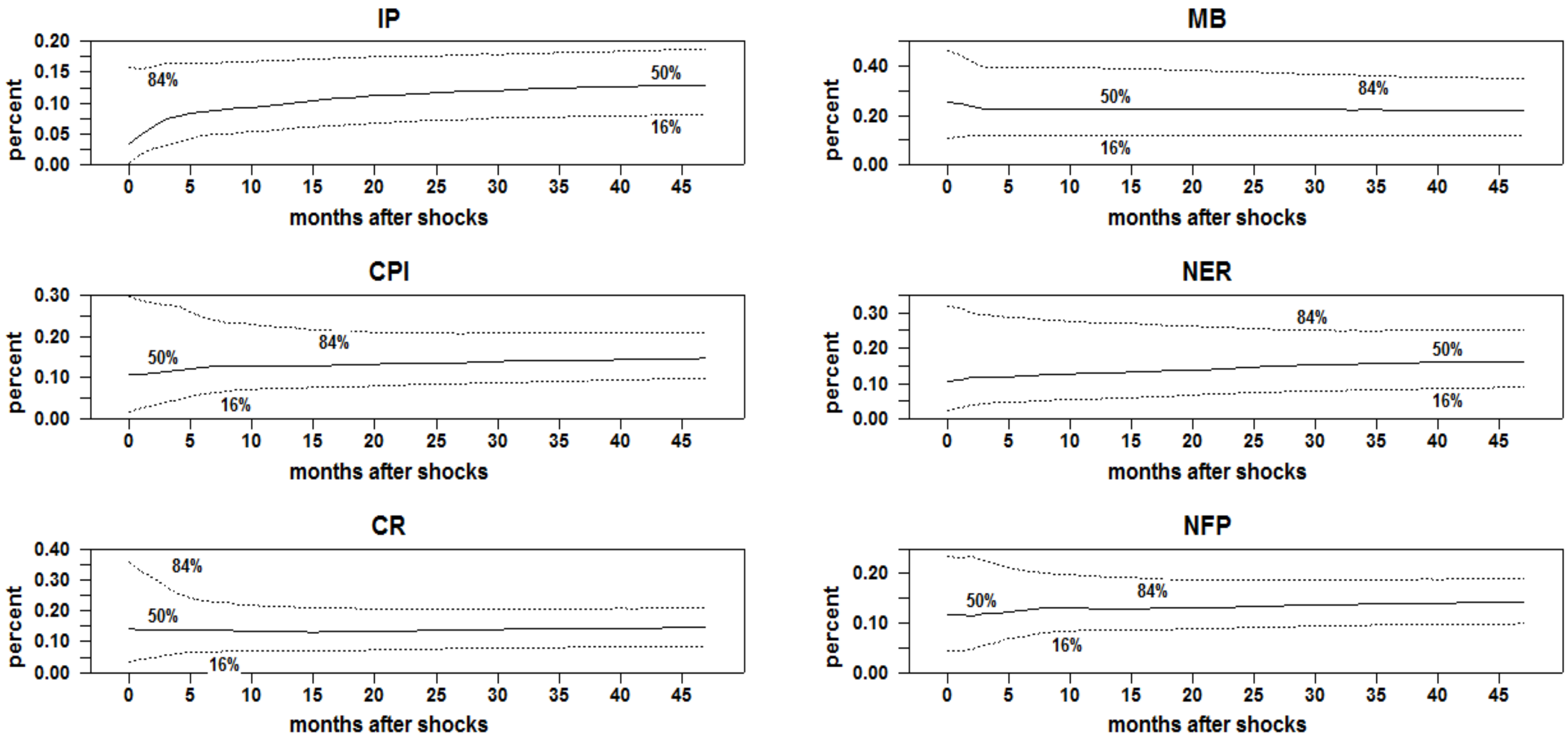
Figure 3.2.4 and Table A.2.4 (in Appendix) report the role of monetary policy shocks in explaining fluctuations of each variable at various horizons with 68% probability bands in the model with NFP and NER, based on forecast error variance decomposition. The results are not much different from those in the baseline model. The monetary policy shocks explain more than 10 % of fluctuations in NFP and NER.

Figure 3.2.3. Impulse Responses in the Model with Nominal Farm Prices and Nominal Exchange Rate for Korea



Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure 3.2.4. Forecast Error Variance Decomposition for Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for Korea



Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

3.2.2. Extended Experiments

In this section, we extend the baseline model in a variety of ways to verify the robustness of our results. First, alternative lag lengths are considered. In the baseline model, six lags are allowed, but three and twelve lags are considered.

Figures A.2.1, A.2.2, A.2.3, A.2.4, A.2.5, A.2.6, A.2.7 and A.2.8 (in Appendix) report the results. The results are not much different from those under the baseline model. Second, alternative restriction horizons are considered. In the baseline model, twelve month restrictions are imposed but now six month restrictions are imposed. Figures A.2.9, A.2.10, A.2.11 and A.2.12 (in Appendix) report the results. The main results do not change. Third, Lags are not allowed for exogenous variables in the baseline model to secure the degree of freedom. Here, we assume 6-lag of exogenous variables in the extended model. Figures A.2.13, A.2.14, A.2.15, and A.2.16 (in Appendix) report the results. The main conclusion remains unchanged.

Chapter 4

Conclusion

This empirical study examines the effects of monetary policy shocks on farm prices and exchange rate in Korea and the U.S. by applying structural VAR models. To identify monetary policy shocks, sign restrictions on impulse responses are imposed as suggested by Uhlig (2005).

The empirical model for the U.S. follows the detailed specifications of Uhlig (2005) that also analyzes the effects of monetary policy shocks in the U.S. In addition to farm prices and the exchange rate, the key macro variables such as output, non-borrowed reserves, the Federal Funds rate, the price level, and a price variable that is likely to reflect the expectation on the price level are included in the model. To identify negative interest rate shocks, we impose the following restrictions. The Federal Funds rate increases, the price level and the price variable decrease, and non-borrowed reserves decrease. These effects are consistent with the predictions of most economics theories on the effects of interest rate shocks.

As suggested by Kim and Lim (2015), the empirical model for Korea incorporates small open economy feature. The key macro variables such as product, the price level, the short-term interest rate, and monetary base are included, in addition to farm prices and the exchange rate. Further, we include the U.S. Federal Funds rate, the U.S. product, the U.S. price level, and VIX as exogenous variables in the empirical model, to reflect the small open economy feature in which US macroeconomic condition and international financial market condition are important factors. The following sign restrictions, that are similar to those used in the U.S. model, are imposed. The short-term rate increases, the price level and monetary base decrease.

The main empirical results for the U.S. are as follows. First, contractionary monetary policy shocks have significant negative effects on real farm prices, which suggest that farm prices respond to monetary policy shocks more than the general price level. This is against the traditional view based on the neutrality of money.

Second, the effects of monetary policy shocks on farm prices are stronger than the effects of monetary policy shocks on exchange rate. The former is as large as or greater than the latter even in the floating exchange rate regime period. The result is interesting since exchange rate is often thought of as a variable that is substantially affected by monetary policy shocks.

Third, farm price dynamics under monetary policy shocks show "delayed overshooting" as exchange rate dynamics under monetary policy shocks do. That is, in response to monetary policy shocks, the short-run responses of farm price are larger than the long-run responses of farm price, which is consistent with the overshooting model assumption. However, the exact dynamics is not consistent with the assumption. Only with a delay, the maximum effect of exchange rate is shown in particular. This result imply that the equilibrium condition between the interest rate and the expected return on holding farm products and the uncovered interest parity (UIP) condition do not hold conditional on monetary policy shocks.

The main empirical results for Korea are as follows. First, (contractionary) monetary policy shocks have significant negative effects on real farm prices, which suggests that farm prices respond to monetary policy shocks more strongly than the general price level. This is against the traditional view based on the neutrality of money. The effect on real farm prices in Korea is less persistent than in the U.S. This result may be explained by farm price stabilization policy and strong regulation in farm prices in Korea, compared to those in the benchmark country, the U.S.

Second, the effects of monetary policy shocks on farm prices are far stronger than the effects of monetary policy shocks on exchange rate. Such a tendency is even more clear in Korea than in the U.S. This result may be explained by the fact that exchange rate is less flexible in Korea than in the U.S. Farm price responses are short-lived and not inconsistent with the overshooting theory.

The results in this study suggest that macroeconomic shocks such as monetary policy shocks can affect farm prices significantly and generate volatility in farm prices, not only in the U.S. but also in Korea. Although micro factors mostly explain farm price dynamics, considering macro factors can also helpful in understanding farm price dynamics. In addition, it may be worthwhile to consider farm price stabilization policy in the presence of macro shocks such as monetary policy shocks. In particular, our empirical results suggest that the farm price responses are even stronger than the exchange rate responses. This may suggest that there are rooms for further farm price stabilization by the policy authority, compared to exchange rate stabilization.

However, the current study has the limitation. The current study does not explicitly consider various important factors of farm price determination, such as weather and micro factors, which may lead to a bias in the empirical results. A future study that control for such factors may be fruitful.

Table A.1.1. Impulse Responses to Contractionary Monetary Policy Shocks in the Baseline Model for the U.S

month	FFR			RFP			RER		
1	0.15	(0.05	,0.24)	-0.25	(-1.06	,0.58)	-0.06	(-0.47	,0.35)
2	0.22	(0.10	,0.34)	-0.18	(-1.07	,0.66)	-0.16	(-0.67	,0.35)
3	0.22	(0.11	,0.33)	-0.32	(-1.18	,0.51)	-0.16	(-0.67	,0.32)
4	0.18	(0.09	,0.29)	-0.39	(-1.22	,0.40)	-0.19	(-0.68	,0.28)
5	0.15	(0.06	,0.24)	-0.36	(-1.06	,0.32)	-0.30	(-0.72	,0.13)
6	0.13	(0.04	,0.22)	-0.32	(-1.09	,0.42)	-0.33	(-0.74	,0.09)
7	0.10	(0.01	,0.20)	-0.44	(-1.25	,0.33)	-0.35	(-0.75	,0.06)
8	0.05	(-0.06	,0.16)	-0.42	(-1.24	,0.39)	-0.36	(-0.74	,0.03)
9	0.03	(-0.08	,0.15)	-0.48	(-1.27	,0.32)	-0.37	(-0.76	,0.00)
10	0.05	(-0.07	,0.17)	-0.58	(-1.30	,0.13)	-0.35	(-0.74	,0.03)
11	0.06	(-0.06	,0.19)	-0.59	(-1.26	,0.10)	-0.45	(-0.86	-,0.06)
12	0.03	(-0.09	,0.17)	-0.46	(-1.17	,0.25)	-0.42	(-0.85	,0.01)
13	0.02	(-0.11	,0.16)	-0.46	(-1.22	,0.28)	-0.37	(-0.82	,0.06)
14	0.01	(-0.11	,0.14)	-0.51	(-1.23	,0.22)	-0.41	(-0.85	,0.04)
15	0.02	(-0.09	,0.14)	-0.54	(-1.24	,0.17)	-0.46	(-0.89	-,0.04)
16	0.03	(-0.08	,0.15)	-0.52	(-1.18	,0.13)	-0.50	(-0.91	-,0.08)
17	0.02	(-0.09	,0.13)	-0.56	(-1.19	,0.09)	-0.53	(-0.93	-,0.13)
18	0.00	(-0.11	,0.12)	-0.56	(-1.19	,0.09)	-0.54	(-0.93	-,0.14)
19	0.00	(-0.11	,0.12)	-0.61	(-1.23	,0.02)	-0.57	(-0.96	-,0.17)
20	-0.01	(-0.13	,0.11)	-0.62	(-1.27	,0.00)	-0.56	(-0.97	-,0.14)
21	-0.03	(-0.15	,0.10)	-0.66	(-1.27	-,0.05)	-0.55	(-0.97	-,0.11)
22	-0.04	(-0.17	,0.09)	-0.71	(-1.32	-,0.11)	-0.54	(-0.97	-,0.09)
23	-0.04	(-0.17	,0.09)	-0.66	(-1.28	-,0.03)	-0.56	(-0.99	-,0.11)
24	-0.03	(-0.16	,0.10)	-0.66	(-1.29	-,0.02)	-0.56	(-1.00	-,0.09)
25	-0.03	(-0.16	,0.11)	-0.70	(-1.30	-,0.06)	-0.57	(-1.03	-,0.10)
26	-0.03	(-0.17	,0.10)	-0.71	(-1.33	-,0.05)	-0.58	(-1.04	-,0.10)
27	-0.04	(-0.17	,0.09)	-0.70	(-1.32	-,0.07)	-0.58	(-1.05	-,0.09)
28	-0.04	(-0.18	,0.09)	-0.72	(-1.32	-,0.12)	-0.57	(-1.04	-,0.08)
29	-0.04	(-0.17	,0.09)	-0.73	(-1.34	-,0.10)	-0.58	(-1.04	-,0.09)
30	-0.05	(-0.18	,0.08)	-0.75	(-1.35	-,0.11)	-0.58	(-1.03	-,0.09)
31	-0.06	(-0.18	,0.08)	-0.77	(-1.37	-,0.13)	-0.57	(-1.03	-,0.09)
32	-0.06	(-0.19	,0.07)	-0.77	(-1.37	-,0.14)	-0.57	(-1.02	-,0.08)
33	-0.06	(-0.18	,0.07)	-0.77	(-1.38	-,0.15)	-0.56	(-1.03	-,0.08)
34	-0.06	(-0.18	,0.07)	-0.75	(-1.39	-,0.14)	-0.56	(-1.03	-,0.07)
35	-0.06	(-0.19	,0.07)	-0.76	(-1.40	-,0.13)	-0.55	(-1.02	-,0.07)
36	-0.07	(-0.20	,0.07)	-0.78	(-1.42	-,0.15)	-0.54	(-1.01	-,0.04)
37	-0.07	(-0.20	,0.06)	-0.78	(-1.41	-,0.16)	-0.53	(-1.00	-,0.04)
38	-0.07	(-0.20	,0.06)	-0.76	(-1.39	-,0.14)	-0.53	(-1.00	-,0.04)
39	-0.07	(-0.20	,0.06)	-0.77	(-1.38	-,0.15)	-0.52	(-0.99	-,0.03)
40	-0.07	(-0.20	,0.06)	-0.76	(-1.37	-,0.13)	-0.51	(-0.97	-,0.02)
41	-0.07	(-0.20	,0.06)	-0.75	(-1.37	-,0.12)	-0.50	(-0.98	-,0.01)
42	-0.07	(-0.20	,0.05)	-0.75	(-1.36	-,0.11)	-0.50	(-0.97	,0.00)
43	-0.07	(-0.20	,0.05)	-0.74	(-1.36	-,0.10)	-0.49	(-0.95	,0.01)
44	-0.07	(-0.20	,0.05)	-0.73	(-1.35	-,0.09)	-0.48	(-0.95	,0.02)
45	-0.08	(-0.20	,0.04)	-0.72	(-1.35	-,0.09)	-0.47	(-0.94	,0.03)
46	-0.08	(-0.21	,0.04)	-0.71	(-1.35	-,0.08)	-0.46	(-0.93	,0.04)
47	-0.08	(-0.21	,0.04)	-0.70	(-1.34	-,0.07)	-0.45	(-0.93	,0.05)
48	-0.08	(-0.21	,0.04)	-0.69	(-1.34	-,0.05)	-0.44	(-0.92	,0.06)

Note: This table shows impulse responses of each variable to monetary policy shocks with 68% error bands (in parenthesis) over 48 months horizons. The responding variables are denoted in the first row. Impulse responses are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Table A.1.2. Forecast Error Variance Decomposition: The Role of Monetary Policy Shocks in the Baseline Model for the U.S

month	FFR					RFP					RER				
1	0.08	(	0.02	,	0.25)	0.08	(	0.03	,	0.20)	0.07	(	0.02	,	0.22)
12	0.11	(	0.06	,	0.17)	0.10	(	0.05	,	0.18)	0.09	(	0.04	,	0.20)
24	0.11	(	0.06	,	0.16)	0.10	(	0.06	,	0.18)	0.10	(	0.07	,	0.17)
36	0.11	(	0.07	,	0.16)	0.11	(	0.06	,	0.17)	0.11	(	0.07	,	0.15)
48	0.11	(	0.07	,	0.16)	0.11	(	0.06	,	0.17)	0.11	(	0.08	,	0.15)
60	0.11	(	0.08	,	0.16)	0.11	(	0.06	,	0.16)	0.11	(	0.08	,	0.15)

Note: Percentage contribution of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in parentheses) are reported over 60 months horizons. The variables under consideration are denoted at the first row.

Table A.1.3. Impulse Responses to Contractionary Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S

month	FFR			NFP			NER		
1	0.15	(0.05 ,	0.26)	-0.31	(-1.16 ,	0.51)	-0.13	(-0.61 ,	0.32)
2	0.23	(0.11 ,	0.35)	-0.26	(-1.14 ,	0.58)	-0.22	(-0.84 ,	0.39)
3	0.23	(0.12 ,	0.33)	-0.41	(-1.29 ,	0.44)	-0.20	(-0.80 ,	0.38)
4	0.19	(0.09 ,	0.28)	-0.49	(-1.33 ,	0.29)	-0.19	(-0.77 ,	0.37)
5	0.16	(0.07 ,	0.25)	-0.46	(-1.18 ,	0.24)	-0.29	(-0.85 ,	0.24)
6	0.13	(0.04 ,	0.23)	-0.40	(-1.19 ,	0.35)	-0.30	(-0.83 ,	0.22)
7	0.10	(0.01 ,	0.20)	-0.52	(-1.33 ,	0.33)	-0.32	(-0.83 ,	0.17)
8	0.05	(-0.05 ,	0.16)	-0.49	(-1.33 ,	0.36)	-0.34	(-0.79 ,	0.13)
9	0.04	(-0.08 ,	0.15)	-0.58	(-1.42 ,	0.26)	-0.35	(-0.82 ,	0.11)
10	0.05	(-0.07 ,	0.18)	-0.69	(-1.45 ,	0.06)	-0.34	(-0.83 ,	0.13)
11	0.07	(-0.06 ,	0.20)	-0.71	(-1.45 ,	0.02)	-0.43	(-0.92 ,	0.06)
12	0.04	(-0.10 ,	0.17)	-0.63	(-1.39 ,	0.10)	-0.41	(-0.91 ,	0.09)
13	0.03	(-0.11 ,	0.17)	-0.66	(-1.43 ,	0.10)	-0.37	(-0.87 ,	0.13)
14	0.02	(-0.10 ,	0.15)	-0.68	(-1.41 ,	0.05)	-0.39	(-0.87 ,	0.10)
15	0.03	(-0.08 ,	0.16)	-0.70	(-1.42 ,	0.01)	-0.44	(-0.92 ,	0.02)
16	0.05	(-0.07 ,	0.17)	-0.68	(-1.34 ,	0.00)	-0.47	(-0.93 ,	-0.03)
17	0.04	(-0.08 ,	0.15)	-0.70	(-1.38 ,	0.01)	-0.48	(-0.91 ,	-0.05)
18	0.02	(-0.09 ,	0.15)	-0.69	(-1.37 ,	0.00)	-0.50	(-0.92 ,	-0.09)
19	0.02	(-0.09 ,	0.14)	-0.74	(-1.40 ,	-0.05)	-0.54	(-0.94 ,	-0.12)
20	0.01	(-0.10 ,	0.13)	-0.75	(-1.41 ,	-0.07)	-0.53	(-0.94 ,	-0.09)
21	-0.01	(-0.12 ,	0.12)	-0.80	(-1.41 ,	-0.16)	-0.51	(-0.93 ,	-0.06)
22	-0.02	(-0.14 ,	0.11)	-0.85	(-1.46 ,	-0.21)	-0.52	(-0.95 ,	-0.07)
23	-0.02	(-0.14 ,	0.11)	-0.82	(-1.46 ,	-0.17)	-0.54	(-0.98 ,	-0.09)
24	-0.01	(-0.13 ,	0.12)	-0.82	(-1.45 ,	-0.16)	-0.54	(-0.99 ,	-0.07)
25	0.00	(-0.12 ,	0.12)	-0.86	(-1.49 ,	-0.17)	-0.55	(-1.01 ,	-0.08)
26	-0.01	(-0.13 ,	0.12)	-0.88	(-1.51 ,	-0.18)	-0.55	(-1.01 ,	-0.09)
27	-0.01	(-0.13 ,	0.11)	-0.88	(-1.53 ,	-0.21)	-0.55	(-1.02 ,	-0.09)
28	-0.01	(-0.14 ,	0.10)	-0.90	(-1.55 ,	-0.22)	-0.54	(-1.01 ,	-0.08)
29	-0.02	(-0.14 ,	0.10)	-0.91	(-1.56 ,	-0.22)	-0.54	(-1.01 ,	-0.09)
30	-0.02	(-0.15 ,	0.10)	-0.93	(-1.56 ,	-0.26)	-0.54	(-1.01 ,	-0.08)
31	-0.03	(-0.15 ,	0.09)	-0.95	(-1.59 ,	-0.27)	-0.53	(-1.00 ,	-0.07)
32	-0.03	(-0.16 ,	0.09)	-0.96	(-1.57 ,	-0.28)	-0.52	(-1.01 ,	-0.06)
33	-0.03	(-0.15 ,	0.09)	-0.96	(-1.59 ,	-0.25)	-0.52	(-1.02 ,	-0.04)
34	-0.03	(-0.15 ,	0.09)	-0.95	(-1.58 ,	-0.24)	-0.51	(-1.00 ,	-0.03)
35	-0.03	(-0.16 ,	0.09)	-0.96	(-1.62 ,	-0.25)	-0.49	(-0.98 ,	-0.01)
36	-0.04	(-0.16 ,	0.08)	-0.98	(-1.65 ,	-0.26)	-0.48	(-0.98 ,	0.01)
37	-0.04	(-0.17 ,	0.09)	-0.98	(-1.65 ,	-0.26)	-0.47	(-0.98 ,	0.02)
38	-0.03	(-0.16 ,	0.09)	-0.97	(-1.67 ,	-0.24)	-0.46	(-0.96 ,	0.03)
39	-0.03	(-0.17 ,	0.09)	-0.97	(-1.69 ,	-0.23)	-0.45	(-0.96 ,	0.05)
40	-0.04	(-0.17 ,	0.09)	-0.97	(-1.68 ,	-0.24)	-0.43	(-0.95 ,	0.07)
41	-0.04	(-0.17 ,	0.09)	-0.97	(-1.68 ,	-0.23)	-0.42	(-0.95 ,	0.08)
42	-0.04	(-0.17 ,	0.09)	-0.96	(-1.68 ,	-0.23)	-0.41	(-0.93 ,	0.10)
43	-0.03	(-0.17 ,	0.09)	-0.97	(-1.71 ,	-0.24)	-0.40	(-0.90 ,	0.12)
44	-0.04	(-0.17 ,	0.09)	-0.96	(-1.69 ,	-0.20)	-0.38	(-0.90 ,	0.13)
45	-0.04	(-0.17 ,	0.09)	-0.96	(-1.70 ,	-0.19)	-0.37	(-0.88 ,	0.15)
46	-0.04	(-0.18 ,	0.09)	-0.95	(-1.71 ,	-0.17)	-0.35	(-0.86 ,	0.16)
47	-0.03	(-0.17 ,	0.09)	-0.94	(-1.70 ,	-0.15)	-0.34	(-0.85 ,	0.17)
48	-0.03	(-0.17 ,	0.09)	-0.93	(-1.69 ,	-0.13)	-0.32	(-0.83 ,	0.20)

Note: This table shows impulse responses of each variable to monetary policy shocks with 68% error bands (in parenthesis) over 48 months horizons. The responding variables are denoted in the first row. Impulse responses are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Table A.1.4. Forecast Error Variance Decomposition: The Role of Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.

month	FFR			NFP			NER		
1	0.06	(0.02 ,	0.25)	0.09	(0.03 ,	0.19)	0.07	(0.02 ,	0.22)
12	0.11	(0.06 ,	0.17)	0.10	(0.06 ,	0.18)	0.09	(0.04 ,	0.20)
24	0.11	(0.07 ,	0.17)	0.11	(0.06 ,	0.17)	0.11	(0.06 ,	0.17)
36	0.11	(0.07 ,	0.16)	0.11	(0.06 ,	0.17)	0.11	(0.07 ,	0.16)
48	0.11	(0.07 ,	0.16)	0.11	(0.07 ,	0.17)	0.12	(0.08 ,	0.16)
60	0.11	(0.07 ,	0.16)	0.11	(0.07 ,	0.17)	0.12	(0.08 ,	0.16)

Note: Percentage contribution of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in parentheses) are reported over 60 months horizons. The variables under consideration are denoted at the first row.

Table A.2.1. Impulse Responses to Contractionary Monetary Policy Shocks in the Baseline Model for Korea

month	CR			RER			RFP		
1	0.03	(0.01 ,	0.05)	-0.45	(-1.10 ,	0.22)	-1.51	(-2.51 ,	-0.51)
2	0.04	(0.02 ,	0.06)	-0.48	(-1.25 ,	0.32)	-1.05	(-1.99 ,	-0.09)
3	0.05	(0.02 ,	0.07)	-0.30	(-1.03 ,	0.42)	-0.57	(-1.19 ,	0.02)
4	0.05	(0.02 ,	0.08)	-0.46	(-1.16 ,	0.30)	0.05	(-0.50 ,	0.61)
5	0.05	(0.02 ,	0.08)	-0.52	(-1.21 ,	0.20)	-0.10	(-0.57 ,	0.37)
6	0.05	(0.02 ,	0.07)	-0.46	(-1.11 ,	0.21)	-0.08	(-0.68 ,	0.52)
7	0.04	(0.02 ,	0.07)	-0.41	(-1.02 ,	0.22)	-0.31	(-0.89 ,	0.29)
8	0.04	(0.02 ,	0.06)	-0.35	(-0.90 ,	0.22)	-0.17	(-0.70 ,	0.38)
9	0.04	(0.02 ,	0.06)	-0.34	(-0.89 ,	0.20)	-0.15	(-0.61 ,	0.28)
10	0.04	(0.01 ,	0.06)	-0.40	(-0.93 ,	0.14)	0.05	(-0.35 ,	0.43)
11	0.04	(0.02 ,	0.06)	-0.39	(-0.92 ,	0.14)	-0.02	(-0.35 ,	0.31)
12	0.04	(0.02 ,	0.06)	-0.38	(-0.89 ,	0.12)	-0.12	(-0.47 ,	0.24)
13	0.04	(0.02 ,	0.06)	-0.35	(-0.83 ,	0.13)	-0.23	(-0.57 ,	0.10)
14	0.04	(0.01 ,	0.06)	-0.33	(-0.80 ,	0.13)	-0.16	(-0.51 ,	0.17)
15	0.03	(0.01 ,	0.05)	-0.31	(-0.75 ,	0.14)	-0.13	(-0.47 ,	0.17)
16	0.03	(0.01 ,	0.05)	-0.28	(-0.70 ,	0.13)	-0.08	(-0.39 ,	0.22)
17	0.03	(0.01 ,	0.05)	-0.26	(-0.68 ,	0.14)	-0.08	(-0.35 ,	0.18)
18	0.03	(0.00 ,	0.04)	-0.26	(-0.66 ,	0.14)	-0.06	(-0.31 ,	0.19)
19	0.02	(0.00 ,	0.04)	-0.26	(-0.65 ,	0.13)	-0.07	(-0.33 ,	0.19)
20	0.02	(0.00 ,	0.04)	-0.26	(-0.63 ,	0.12)	-0.07	(-0.34 ,	0.19)
21	0.02	(0.00 ,	0.04)	-0.25	(-0.62 ,	0.13)	-0.07	(-0.34 ,	0.15)
22	0.02	(0.00 ,	0.04)	-0.25	(-0.61 ,	0.13)	-0.06	(-0.33 ,	0.16)
23	0.02	(0.00 ,	0.04)	-0.25	(-0.60 ,	0.14)	-0.07	(-0.32 ,	0.14)
24	0.02	(0.00 ,	0.04)	-0.24	(-0.59 ,	0.14)	-0.09	(-0.34 ,	0.12)
25	0.02	(-0.01 ,	0.03)	-0.24	(-0.58 ,	0.15)	-0.10	(-0.34 ,	0.09)
26	0.02	(-0.01 ,	0.03)	-0.24	(-0.57 ,	0.15)	-0.10	(-0.36 ,	0.11)
27	0.02	(-0.01 ,	0.03)	-0.24	(-0.57 ,	0.15)	-0.10	(-0.35 ,	0.11)
28	0.01	(-0.01 ,	0.03)	-0.24	(-0.57 ,	0.14)	-0.09	(-0.33 ,	0.10)
29	0.01	(-0.01 ,	0.03)	-0.24	(-0.56 ,	0.14)	-0.09	(-0.33 ,	0.09)
30	0.01	(-0.01 ,	0.03)	-0.24	(-0.56 ,	0.14)	-0.09	(-0.33 ,	0.09)
31	0.01	(-0.01 ,	0.03)	-0.24	(-0.57 ,	0.15)	-0.10	(-0.33 ,	0.08)
32	0.01	(-0.01 ,	0.03)	-0.25	(-0.57 ,	0.14)	-0.10	(-0.34 ,	0.09)
33	0.01	(-0.01 ,	0.03)	-0.25	(-0.57 ,	0.15)	-0.10	(-0.33 ,	0.09)
34	0.01	(-0.01 ,	0.03)	-0.26	(-0.57 ,	0.15)	-0.09	(-0.33 ,	0.08)
35	0.01	(-0.01 ,	0.03)	-0.27	(-0.57 ,	0.14)	-0.09	(-0.33 ,	0.08)
36	0.01	(-0.01 ,	0.03)	-0.27	(-0.58 ,	0.14)	-0.09	(-0.32 ,	0.08)
37	0.01	(-0.01 ,	0.03)	-0.28	(-0.58 ,	0.15)	-0.09	(-0.32 ,	0.08)
38	0.01	(-0.01 ,	0.03)	-0.28	(-0.58 ,	0.15)	-0.09	(-0.32 ,	0.09)
39	0.01	(-0.01 ,	0.03)	-0.29	(-0.58 ,	0.14)	-0.09	(-0.32 ,	0.08)
40	0.01	(-0.01 ,	0.02)	-0.30	(-0.59 ,	0.13)	-0.09	(-0.31 ,	0.08)
41	0.01	(-0.01 ,	0.02)	-0.31	(-0.60 ,	0.14)	-0.08	(-0.31 ,	0.08)
42	0.01	(-0.01 ,	0.02)	-0.31	(-0.61 ,	0.13)	-0.08	(-0.30 ,	0.08)
43	0.01	(-0.01 ,	0.02)	-0.32	(-0.61 ,	0.13)	-0.08	(-0.30 ,	0.09)
44	0.01	(-0.01 ,	0.02)	-0.33	(-0.61 ,	0.13)	-0.08	(-0.30 ,	0.09)
45	0.01	(-0.01 ,	0.02)	-0.34	(-0.62 ,	0.13)	-0.08	(-0.29 ,	0.09)
46	0.01	(-0.01 ,	0.02)	-0.35	(-0.63 ,	0.12)	-0.08	(-0.29 ,	0.10)
47	0.01	(-0.01 ,	0.02)	-0.36	(-0.64 ,	0.12)	-0.08	(-0.29 ,	0.10)
48	0.01	(-0.01 ,	0.02)	-0.37	(-0.64 ,	0.11)	-0.07	(-0.28 ,	0.09)

Note: This table shows impulse responses of each variable to contractionary monetary policy shocks with 68% error bands (in parenthesis) over 48 months horizons. The responding variables are denoted in the first row. Impulse responses are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Table A.2.2. Forecast Error Variance Decomposition: The Role of Monetary Policy Shocks in the Baseline Model for Korea

month	CR						RER						RFP					
1	0.12	(	0.02	,	0.33	)	0.11	(	0.02	,	0.35	)	0.11	(	0.04	,	0.25	)
12	0.12	(	0.07	,	0.21	)	0.13	(	0.06	,	0.28	)	0.13	(	0.08	,	0.20	)
24	0.13	(	0.08	,	0.20	)	0.15	(	0.08	,	0.27	)	0.13	(	0.09	,	0.19	)
36	0.13	(	0.09	,	0.20	)	0.16	(	0.09	,	0.26	)	0.14	(	0.09	,	0.20	)
48	0.14	(	0.09	,	0.21	)	0.16	(	0.09	,	0.26	)	0.14	(	0.10	,	0.20	)

Note: Percentage contribution of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in parentheses) are reported over 48 months horizons. The variables under consideration are denoted at the first row.

Table A.2.3. Impulse Responses to Contractionary Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for Korea

month	CR			NER			NFP		
1	0.03	(0.01 ,	0.05)	-0.55	(-1.20 ,	0.13)	-1.59	(-2.65 ,	-0.48)
2	0.04	(0.02 ,	0.06)	-0.62	(-1.44 ,	0.21)	-1.17	(-2.18 ,	-0.16)
3	0.05	(0.02 ,	0.07)	-0.37	(-1.11 ,	0.36)	-0.70	(-1.41 ,	0.01)
4	0.05	(0.02 ,	0.08)	-0.50	(-1.20 ,	0.24)	-0.07	(-0.64 ,	0.48)
5	0.05	(0.02 ,	0.08)	-0.58	(-1.30 ,	0.16)	-0.20	(-0.61 ,	0.26)
6	0.05	(0.02 ,	0.08)	-0.55	(-1.20 ,	0.13)	-0.19	(-0.79 ,	0.41)
7	0.04	(0.02 ,	0.07)	-0.47	(-1.03 ,	0.10)	-0.46	(-1.06 ,	0.18)
8	0.04	(0.02 ,	0.06)	-0.40	(-0.91 ,	0.11)	-0.27	(-0.82 ,	0.31)
9	0.04	(0.02 ,	0.06)	-0.40	(-0.91 ,	0.10)	-0.22	(-0.67 ,	0.24)
10	0.04	(0.01 ,	0.06)	-0.43	(-0.92 ,	0.05)	-0.03	(-0.41 ,	0.33)
11	0.04	(0.02 ,	0.06)	-0.42	(-0.92 ,	0.05)	-0.13	(-0.43 ,	0.19)
12	0.04	(0.02 ,	0.06)	-0.42	(-0.89 ,	0.03)	-0.22	(-0.55 ,	0.13)
13	0.04	(0.02 ,	0.06)	-0.40	(-0.84 ,	0.03)	-0.32	(-0.63 ,	0.02)
14	0.04	(0.02 ,	0.06)	-0.38	(-0.80 ,	0.03)	-0.25	(-0.58 ,	0.10)
15	0.03	(0.01 ,	0.05)	-0.34	(-0.75 ,	0.04)	-0.23	(-0.54 ,	0.07)
16	0.03	(0.01 ,	0.05)	-0.32	(-0.70 ,	0.07)	-0.19	(-0.49 ,	0.11)
17	0.03	(0.01 ,	0.05)	-0.29	(-0.67 ,	0.07)	-0.19	(-0.49 ,	0.09)
18	0.02	(0.00 ,	0.04)	-0.29	(-0.66 ,	0.06)	-0.15	(-0.43 ,	0.12)
19	0.02	(0.00 ,	0.04)	-0.29	(-0.65 ,	0.06)	-0.16	(-0.44 ,	0.11)
20	0.02	(0.00 ,	0.04)	-0.29	(-0.64 ,	0.06)	-0.16	(-0.43 ,	0.11)
21	0.02	(0.00 ,	0.04)	-0.28	(-0.62 ,	0.06)	-0.17	(-0.43 ,	0.08)
22	0.02	(0.00 ,	0.04)	-0.27	(-0.62 ,	0.07)	-0.16	(-0.40 ,	0.08)
23	0.02	(0.00 ,	0.04)	-0.27	(-0.61 ,	0.07)	-0.18	(-0.41 ,	0.05)
24	0.01	(0.00 ,	0.03)	-0.26	(-0.60 ,	0.08)	-0.19	(-0.42 ,	0.06)
25	0.01	(0.00 ,	0.03)	-0.25	(-0.58 ,	0.08)	-0.21	(-0.42 ,	0.03)
26	0.01	(-0.01 ,	0.03)	-0.25	(-0.57 ,	0.09)	-0.20	(-0.41 ,	0.04)
27	0.01	(-0.01 ,	0.03)	-0.24	(-0.56 ,	0.09)	-0.20	(-0.40 ,	0.03)
28	0.01	(-0.01 ,	0.03)	-0.24	(-0.55 ,	0.09)	-0.19	(-0.39 ,	0.04)
29	0.01	(-0.01 ,	0.03)	-0.24	(-0.54 ,	0.10)	-0.19	(-0.39 ,	0.03)
30	0.01	(-0.01 ,	0.03)	-0.23	(-0.54 ,	0.10)	-0.18	(-0.39 ,	0.04)
31	0.01	(-0.01 ,	0.02)	-0.23	(-0.53 ,	0.09)	-0.19	(-0.38 ,	0.02)
32	0.01	(-0.01 ,	0.02)	-0.23	(-0.54 ,	0.09)	-0.18	(-0.38 ,	0.03)
33	0.01	(-0.01 ,	0.02)	-0.23	(-0.54 ,	0.10)	-0.19	(-0.38 ,	0.03)
34	0.01	(-0.01 ,	0.02)	-0.23	(-0.53 ,	0.10)	-0.18	(-0.37 ,	0.04)
35	0.01	(-0.01 ,	0.02)	-0.23	(-0.53 ,	0.10)	-0.18	(-0.38 ,	0.03)
36	0.01	(-0.01 ,	0.02)	-0.23	(-0.53 ,	0.10)	-0.18	(-0.37 ,	0.04)
37	0.01	(-0.01 ,	0.02)	-0.23	(-0.52 ,	0.10)	-0.18	(-0.36 ,	0.04)
38	0.01	(-0.01 ,	0.02)	-0.23	(-0.52 ,	0.10)	-0.17	(-0.35 ,	0.04)
39	0.01	(-0.01 ,	0.02)	-0.23	(-0.52 ,	0.10)	-0.17	(-0.34 ,	0.04)
40	0.01	(-0.01 ,	0.02)	-0.23	(-0.52 ,	0.09)	-0.16	(-0.34 ,	0.05)
41	0.01	(-0.01 ,	0.02)	-0.23	(-0.52 ,	0.09)	-0.16	(-0.34 ,	0.04)
42	0.01	(-0.01 ,	0.02)	-0.24	(-0.53 ,	0.09)	-0.16	(-0.33 ,	0.05)
43	0.01	(-0.01 ,	0.02)	-0.24	(-0.53 ,	0.08)	-0.16	(-0.33 ,	0.05)
44	0.01	(-0.01 ,	0.02)	-0.24	(-0.53 ,	0.09)	-0.15	(-0.32 ,	0.05)
45	0.01	(-0.01 ,	0.02)	-0.24	(-0.53 ,	0.09)	-0.15	(-0.32 ,	0.05)
46	0.00	(-0.01 ,	0.02)	-0.24	(-0.53 ,	0.09)	-0.15	(-0.31 ,	0.05)
47	0.00	(-0.01 ,	0.02)	-0.25	(-0.52 ,	0.09)	-0.15	(-0.31 ,	0.06)
48	0.00	(-0.01 ,	0.02)	-0.25	(-0.52 ,	0.09)	-0.14	(-0.30 ,	0.06)

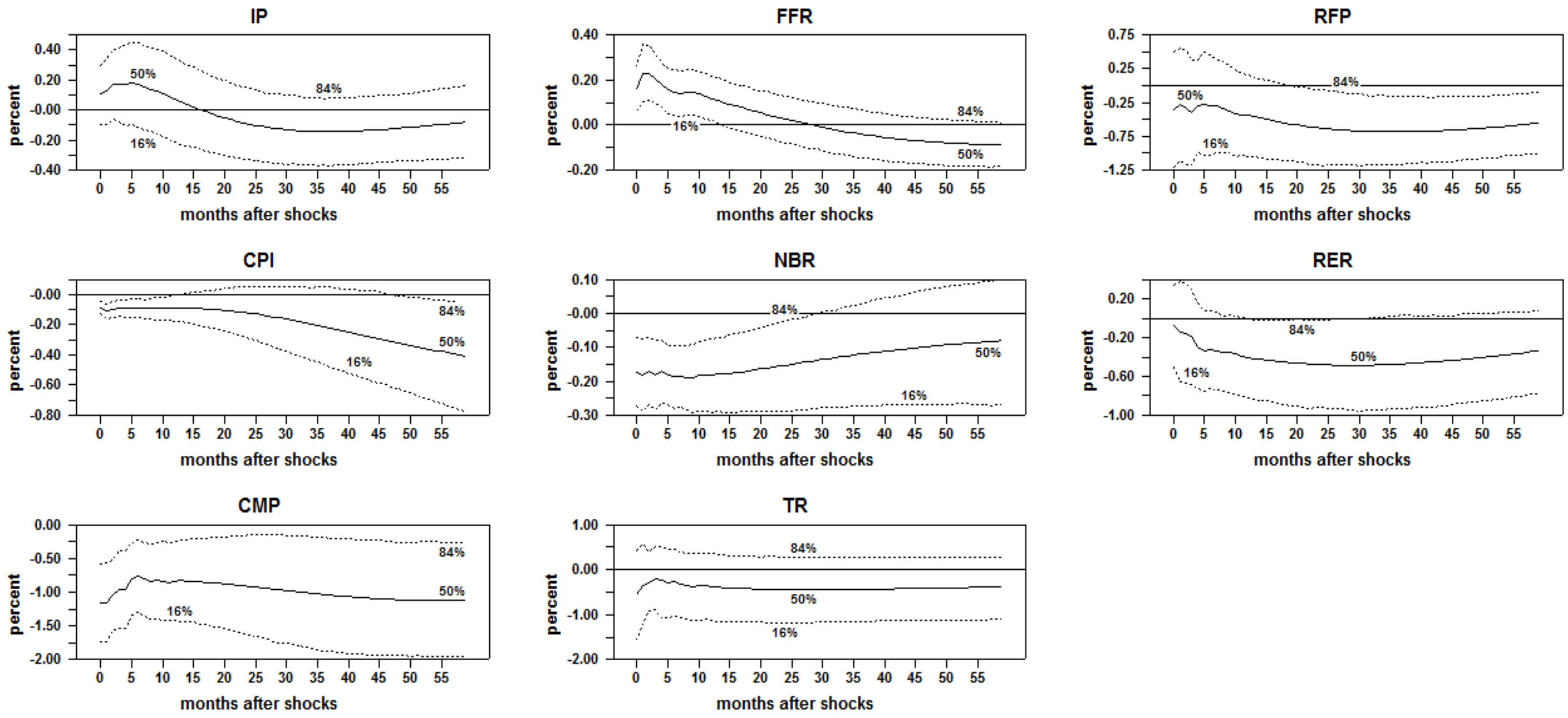
Note: This table shows impulse responses of each variable to monetary policy shocks with 68% error bands (in parenthesis) over 48 months horizons. The responding variables are denoted in the first row. Impulse responses are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Table A.2.4. Forecast Error Variance Decomposition: The Role of Monetary Policy Shocks in the Model with Nominal Farm Prices and Nominal Exchange Rate for Korea

month	CR						NER						NFP					
1	0.14	(	0.03	,	0.33	)	0.11	(	0.02	,	0.39	)	0.12	(	0.04	,	0.24	)
12	0.12	(	0.07	,	0.21	)	0.13	(	0.06	,	0.31	)	0.13	(	0.08	,	0.20	)
24	0.13	(	0.07	,	0.20	)	0.15	(	0.07	,	0.29	)	0.13	(	0.09	,	0.19	)
36	0.13	(	0.08	,	0.20	)	0.16	(	0.09	,	0.27	)	0.13	(	0.09	,	0.19	)
48	0.13	(	0.08	,	0.20	)	0.17	(	0.09	,	0.27	)	0.14	(	0.10	,	0.19	)

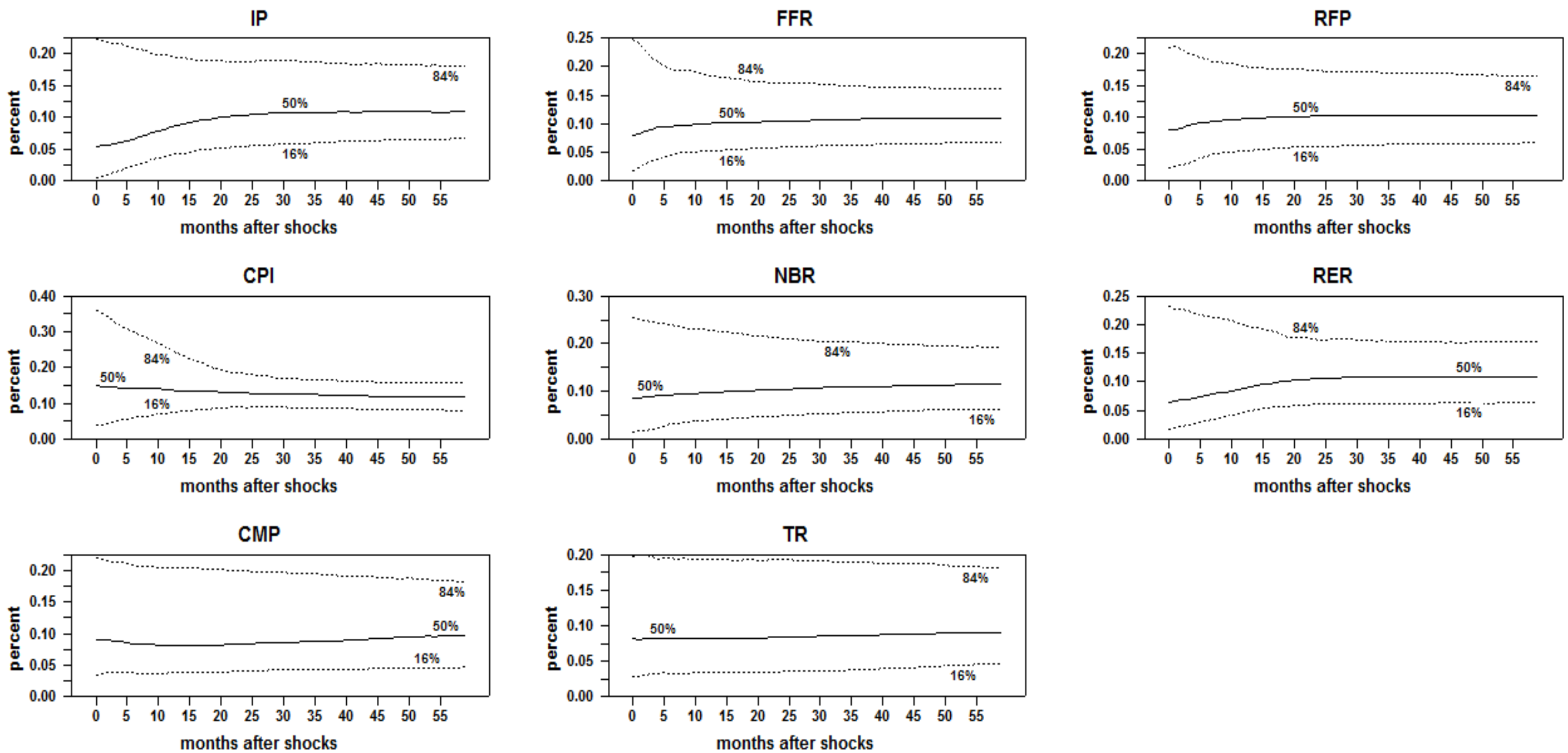
Note: Percentage contribution of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in parentheses) are reported over 48 months horizons. The variables under consideration are denoted at the first row.

Figure A.1.1. Impulse Responses in the Extended Model for the U.S.: Alternative Number of Lags (Six Lags)



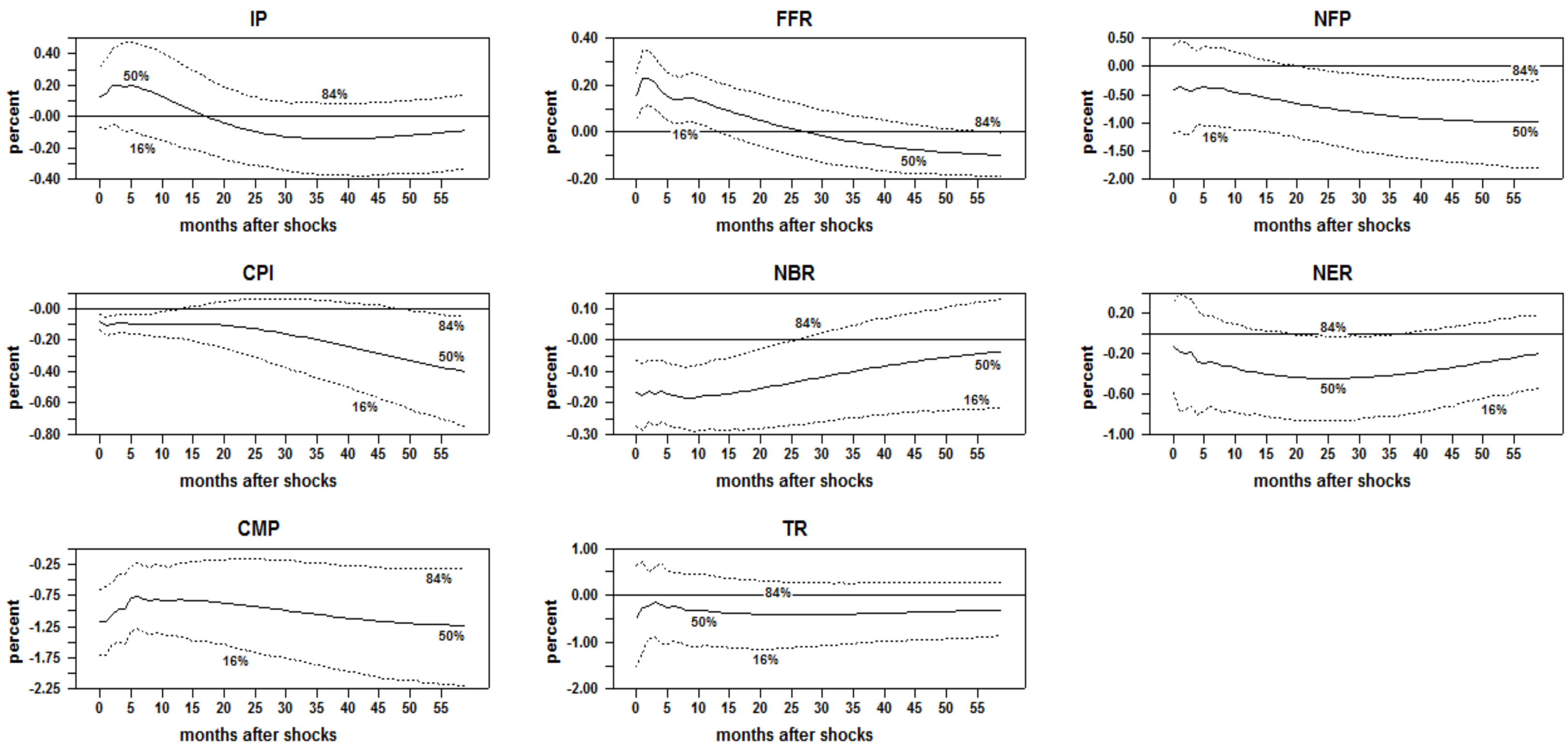
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value). .

Figure A.1.2. Forecast Error Variance Decomposition in the Extended Model for the U.S.: Alternative Number of Lags (Six Lags)



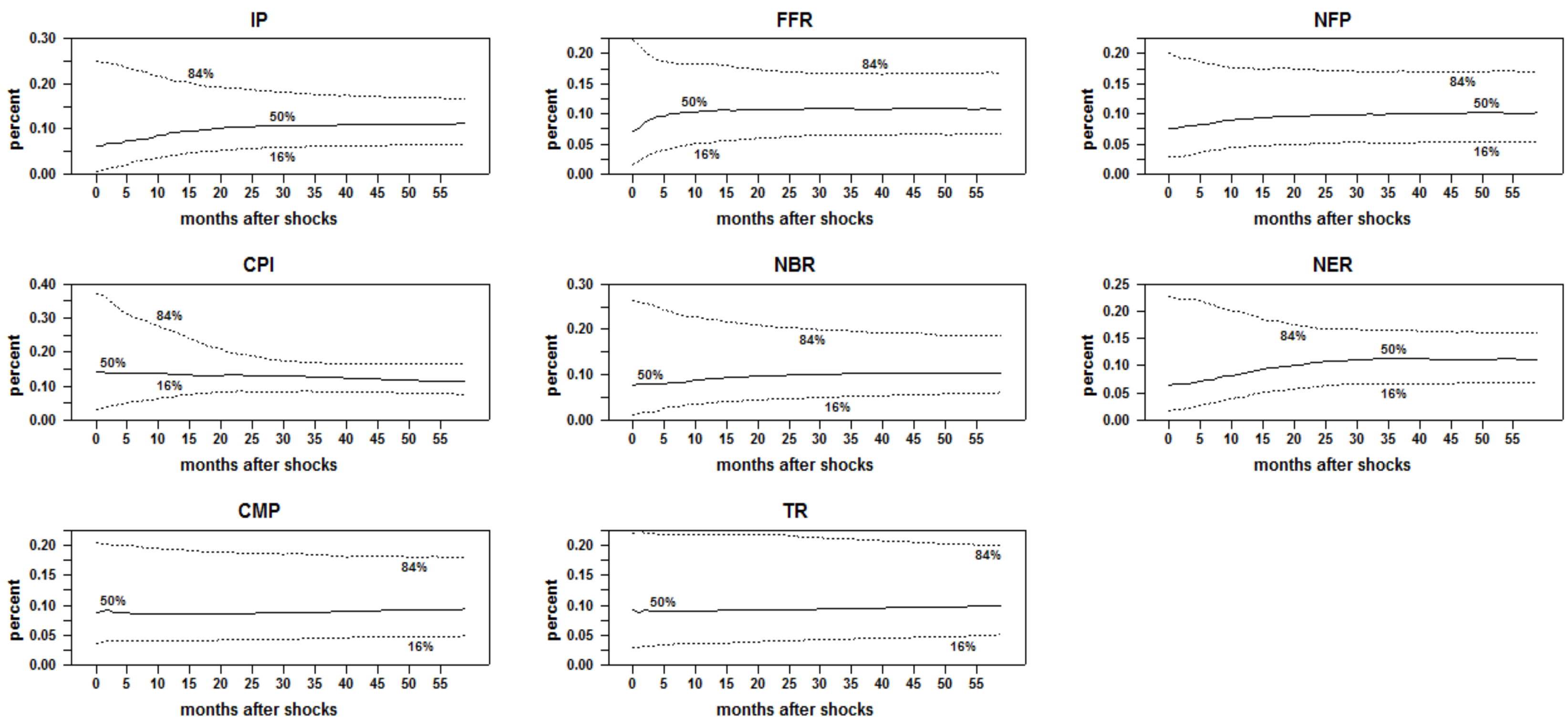
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.3. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Number of Lags (Six Lags)



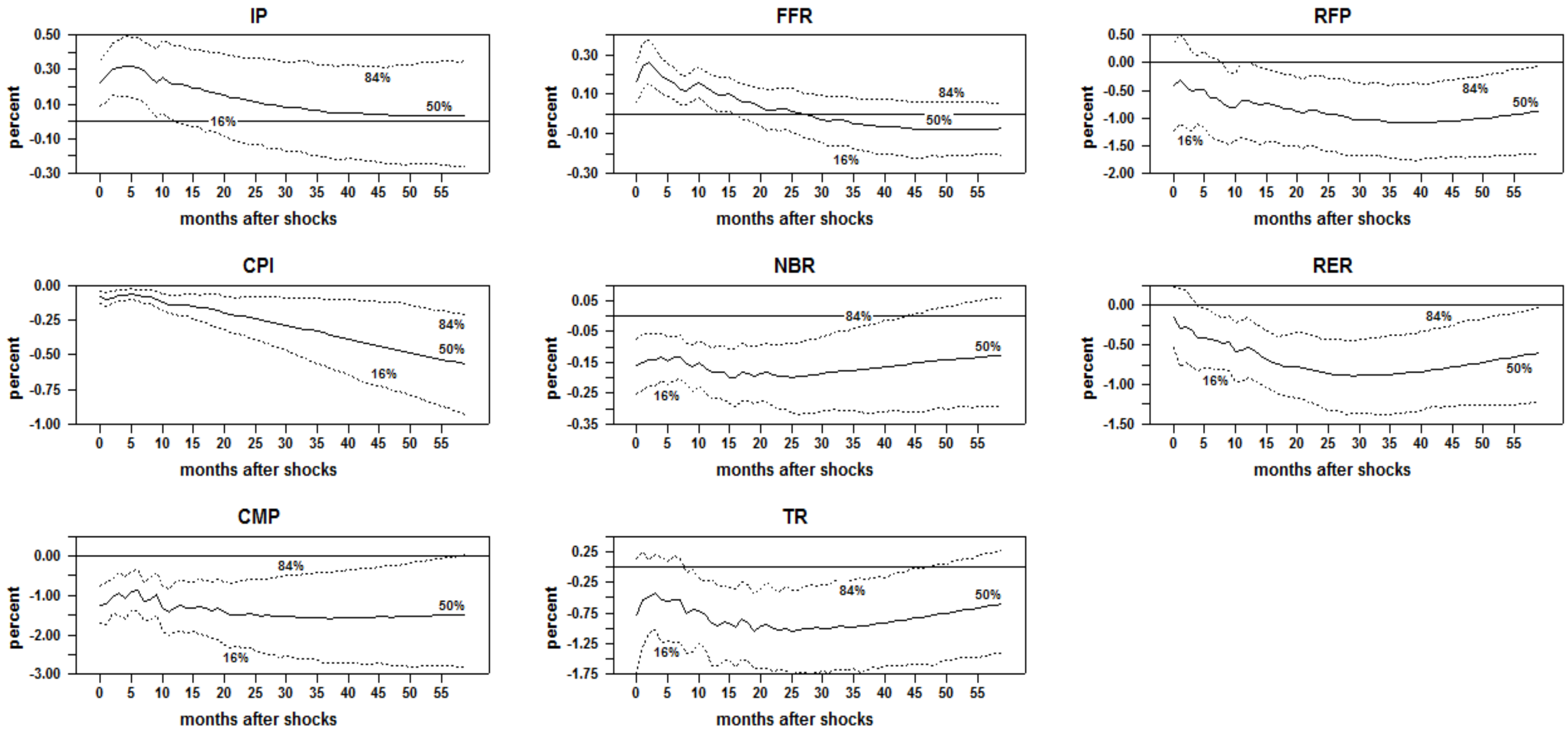
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.4. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Number of Lags (Six Lags)



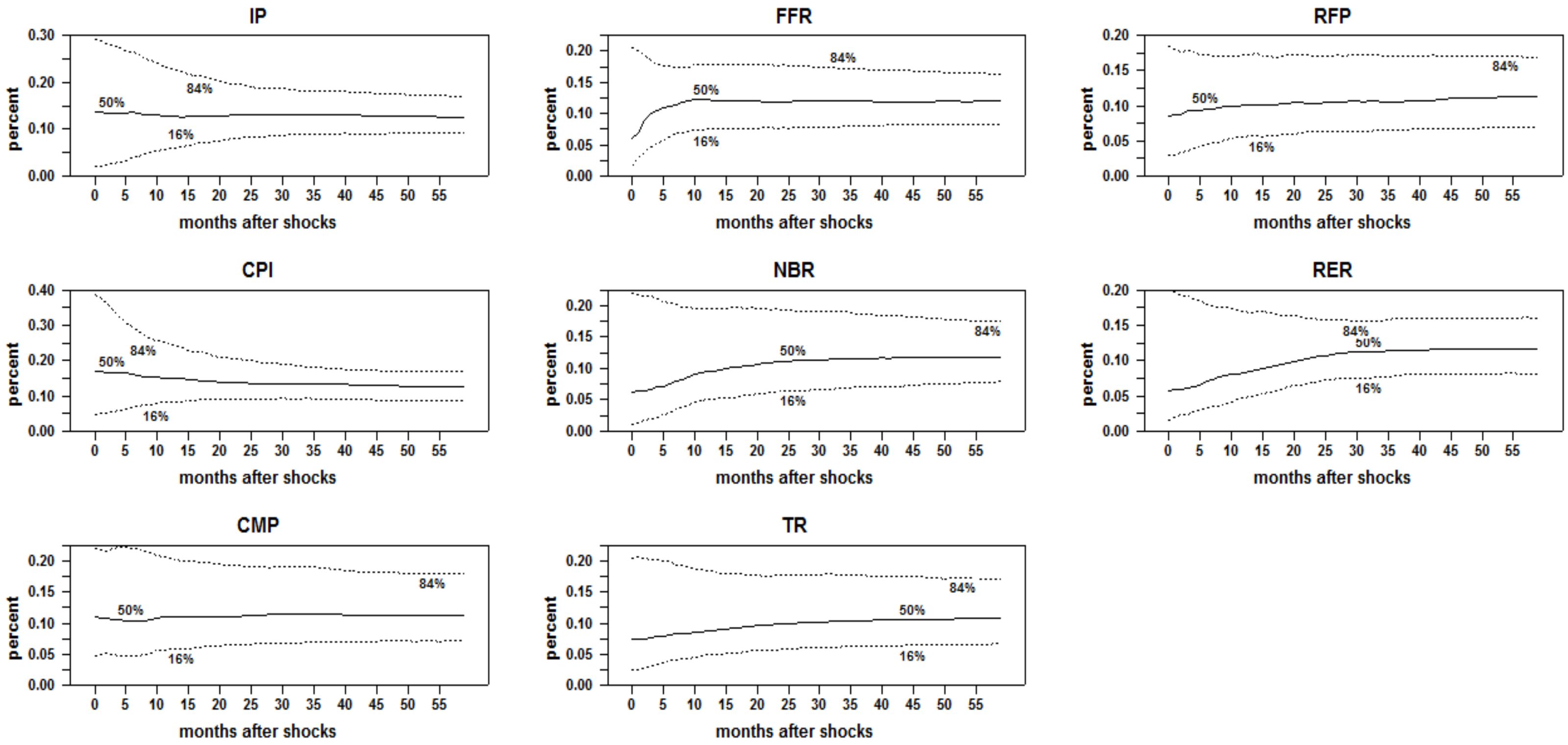
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.5. Impulse Responses in the Extended Model for the U.S.: Alternative Restriction Horizons (Twelve months)



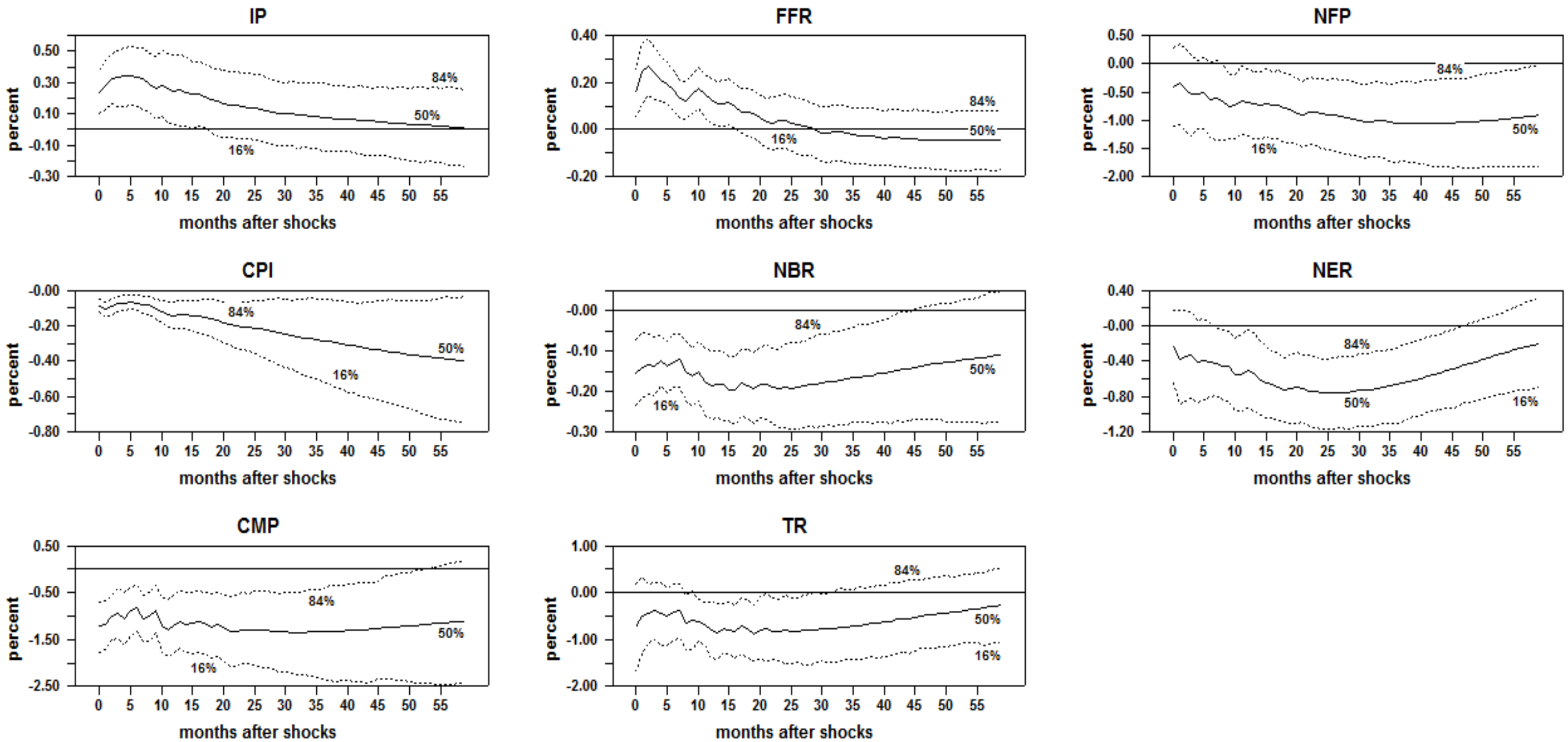
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.6. Forecast Error Variance Decomposition in the Extended Model for the U.S.: Alternative Restriction Horizons (Twelve months)



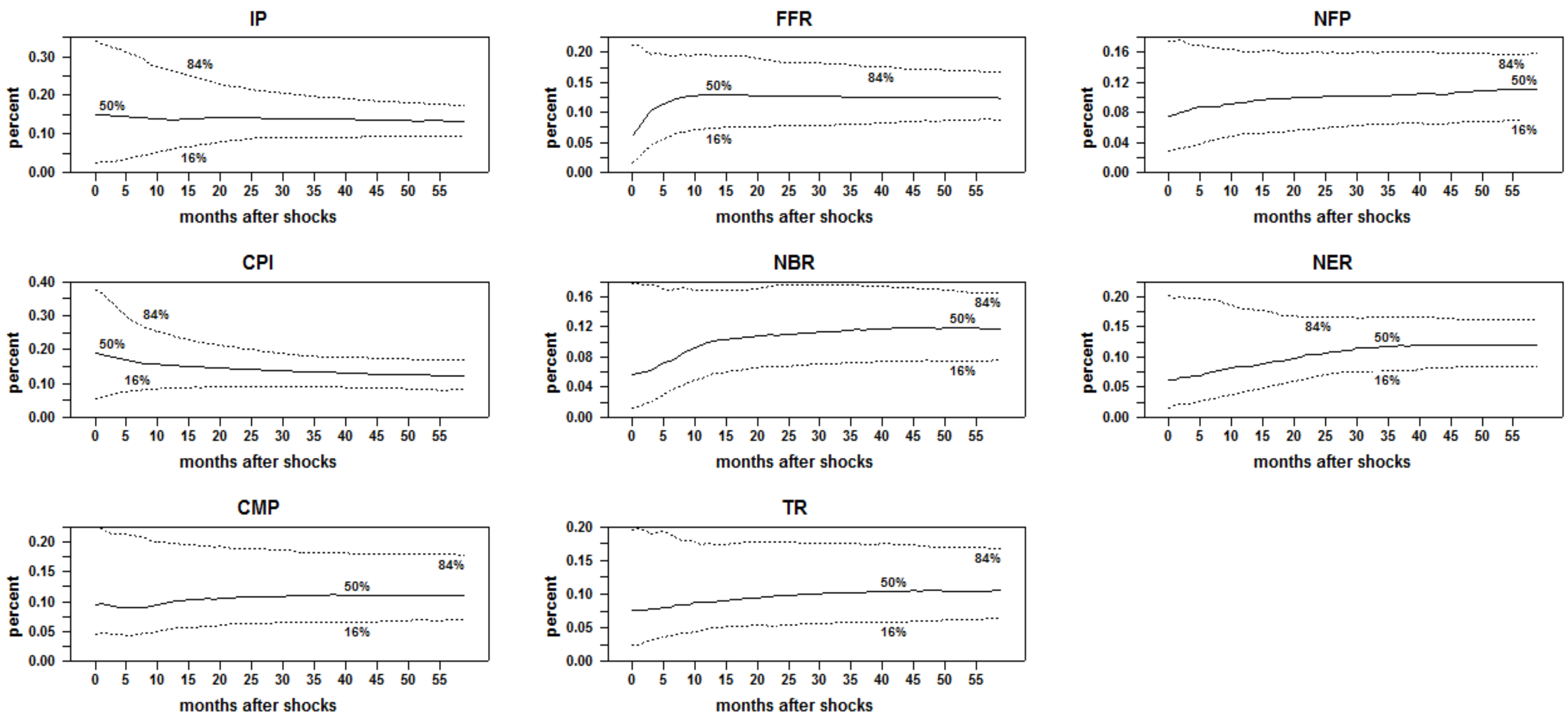
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.7. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Restriction Horizons with (Twelve months)



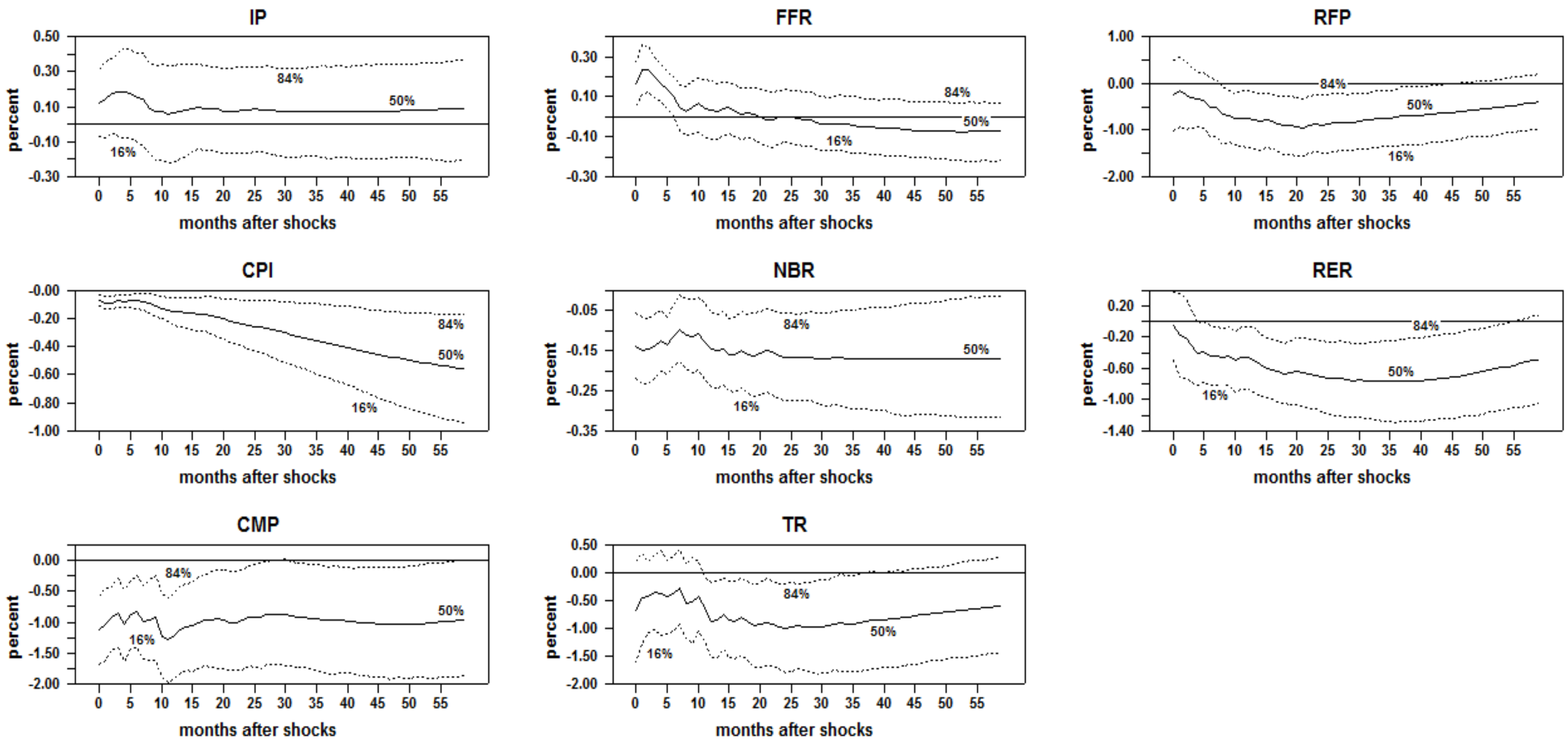
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.8. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Restriction Horizons with (Twelve months)



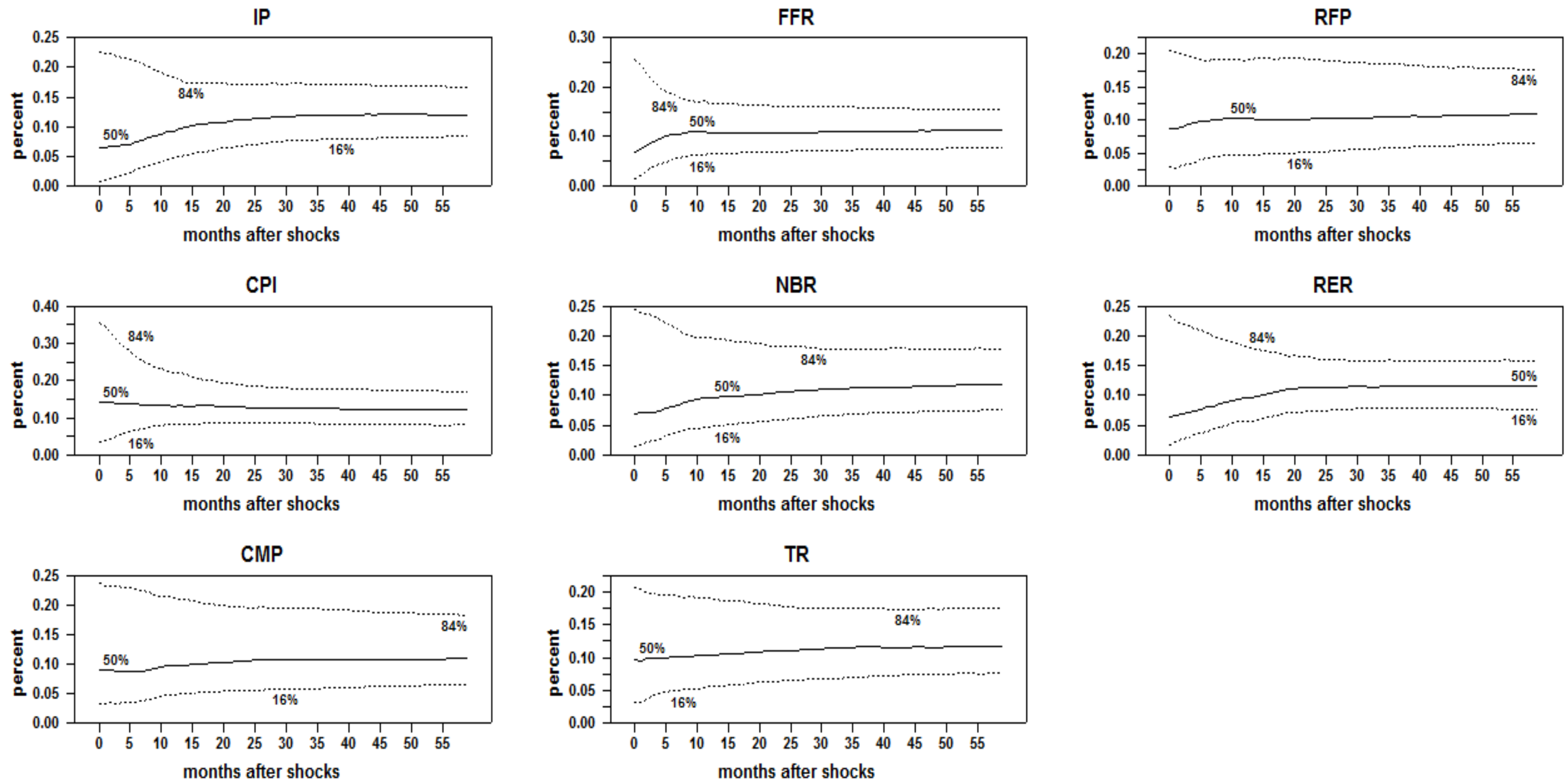
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.9. Impulse Responses in the Extended Model for the U.S.: Data from Uhlig (2005)



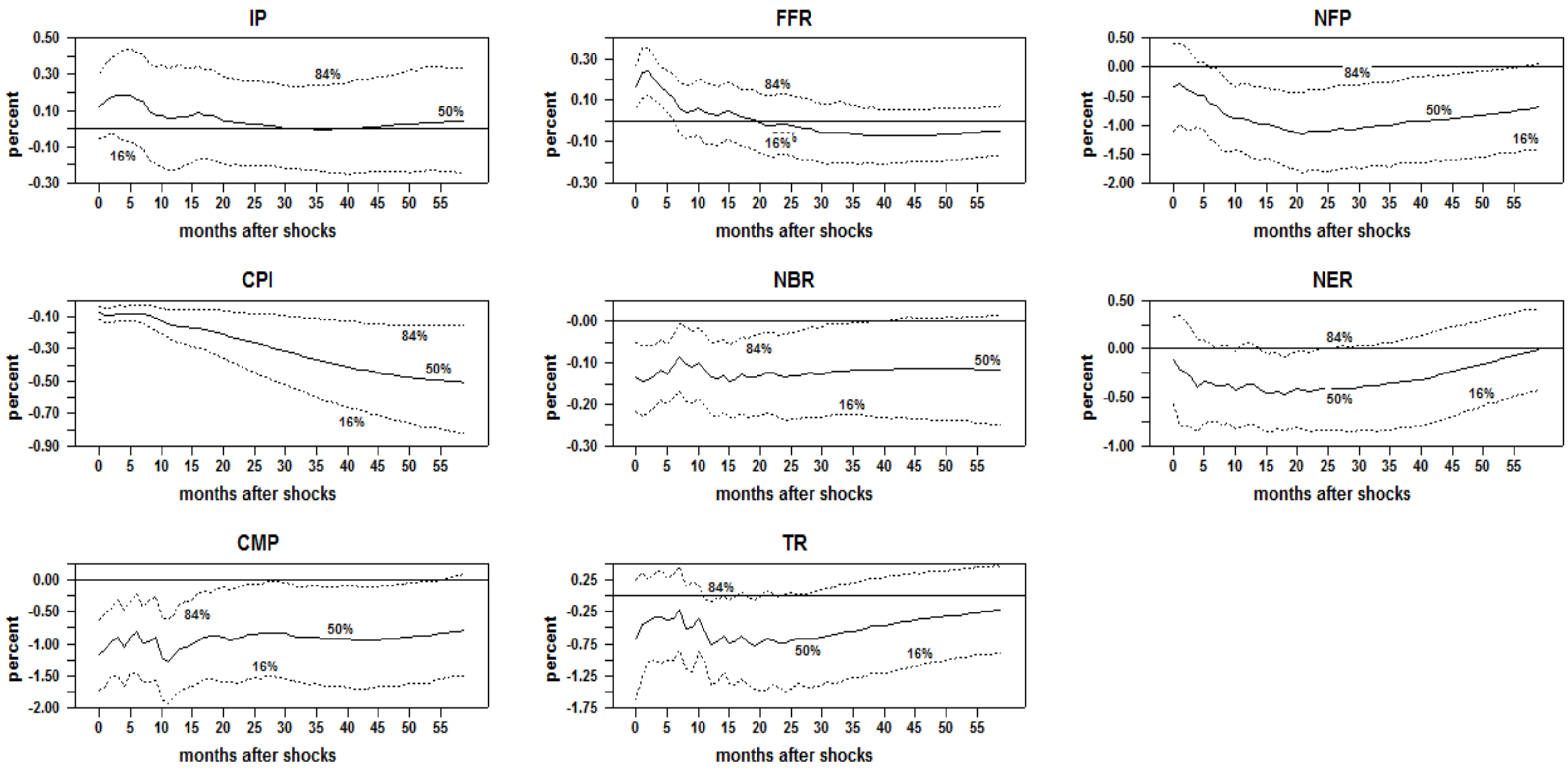
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.10. Forecast Error Variance Decomposition in the Extended Model for the U.S.: Data from Uhlig (2005)



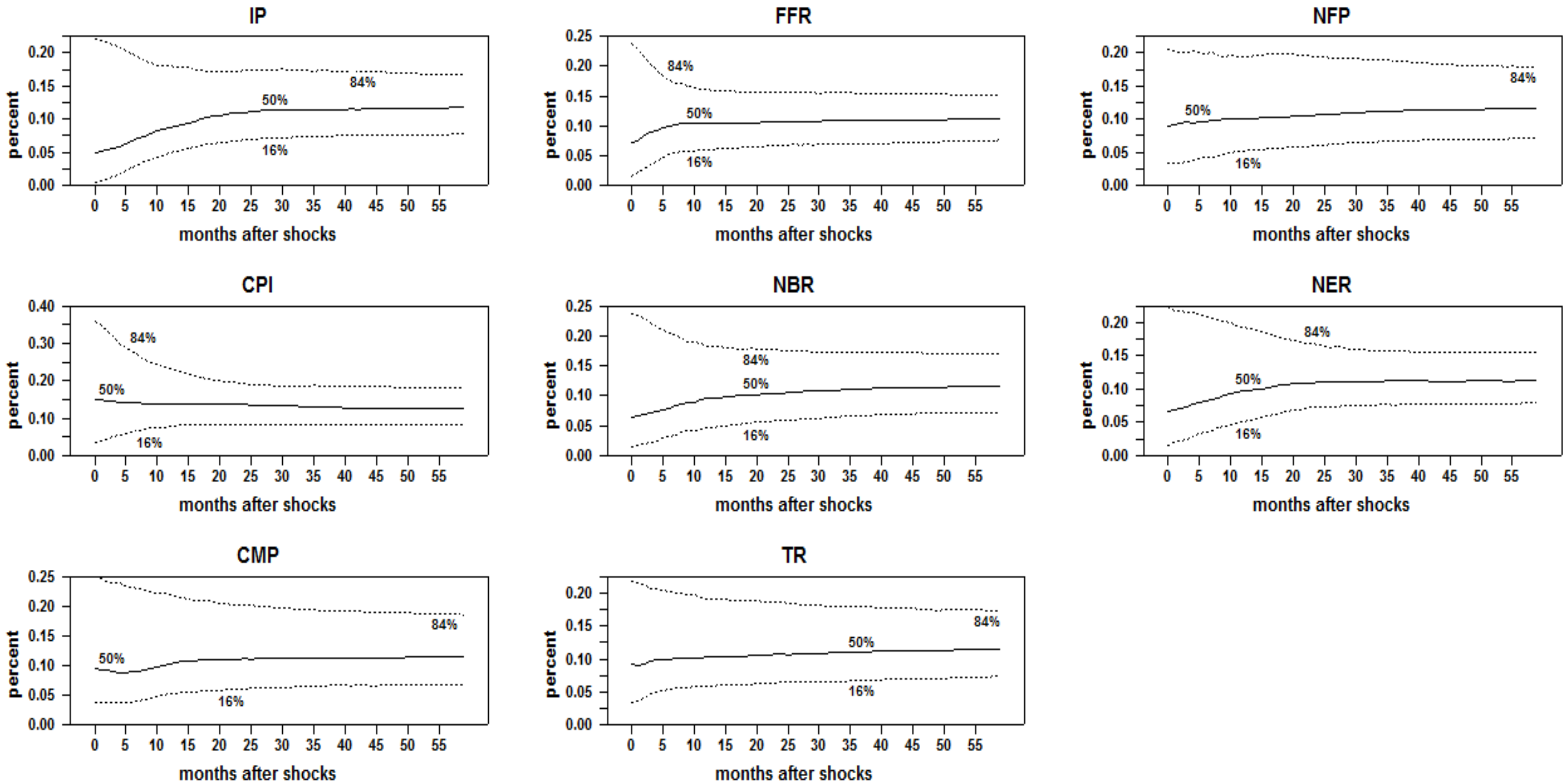
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.11. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Data from Uhlig (2005)



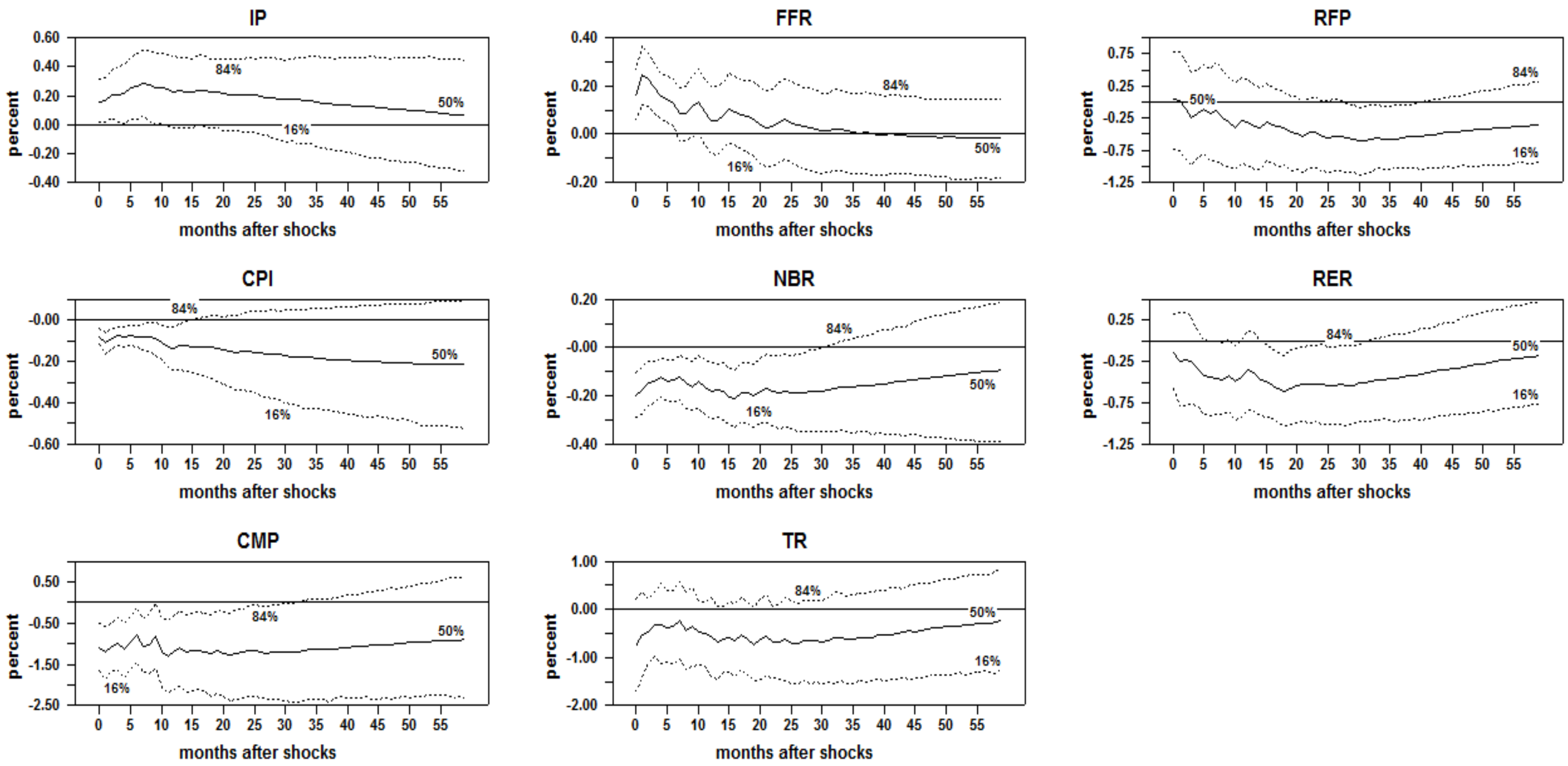
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.12. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Data from Uhlig (2005)



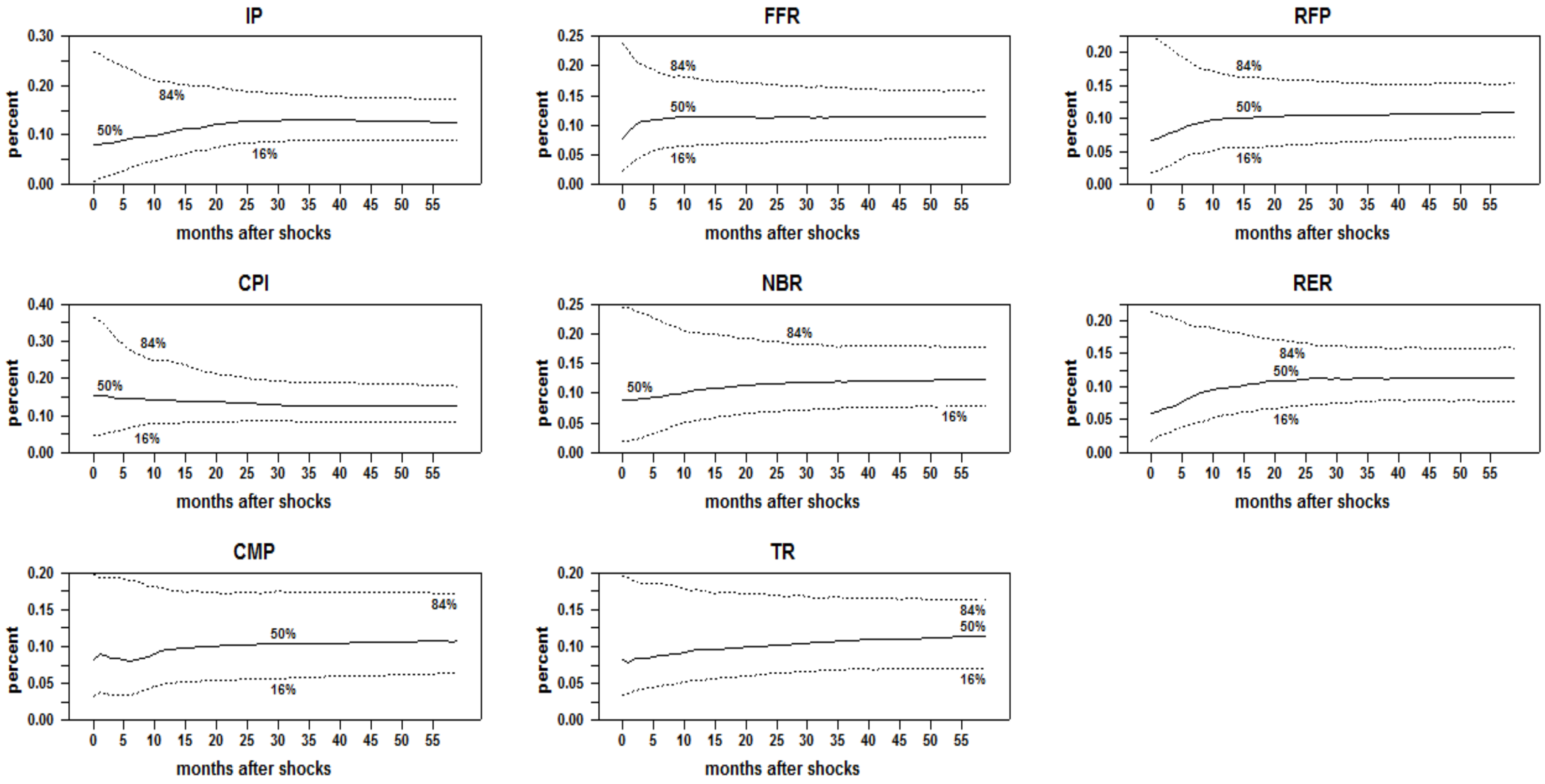
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.13. Impulse Responses in the Extended Model for the U.S.: Alternative Sample Periods (1974-2008, Flexible Exchange Rate Regime Period)



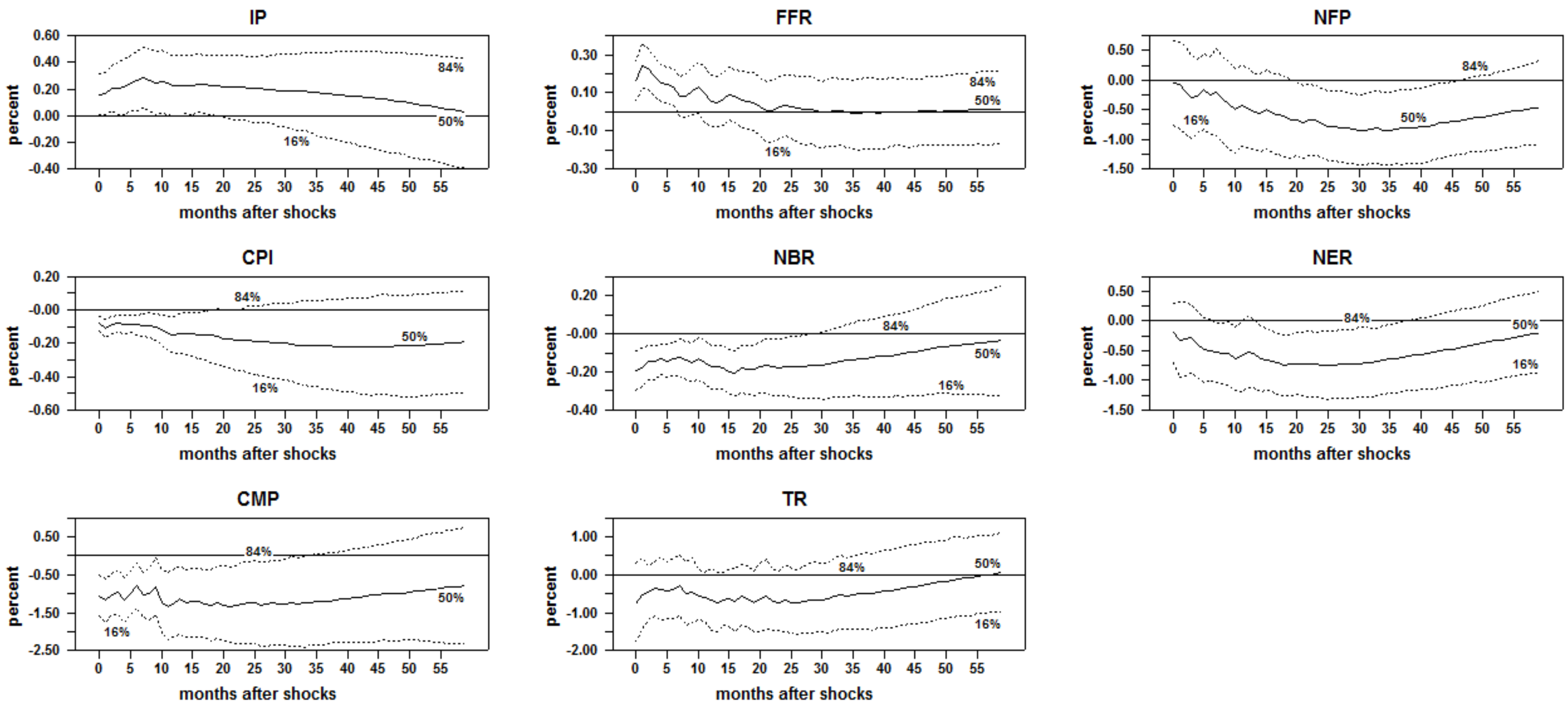
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.14. Forecast Error Variance Decomposition in the Extended Model for the U.S.: Alternative Sample Periods (1974-2008, Flexible Exchange Rate Regime Period)



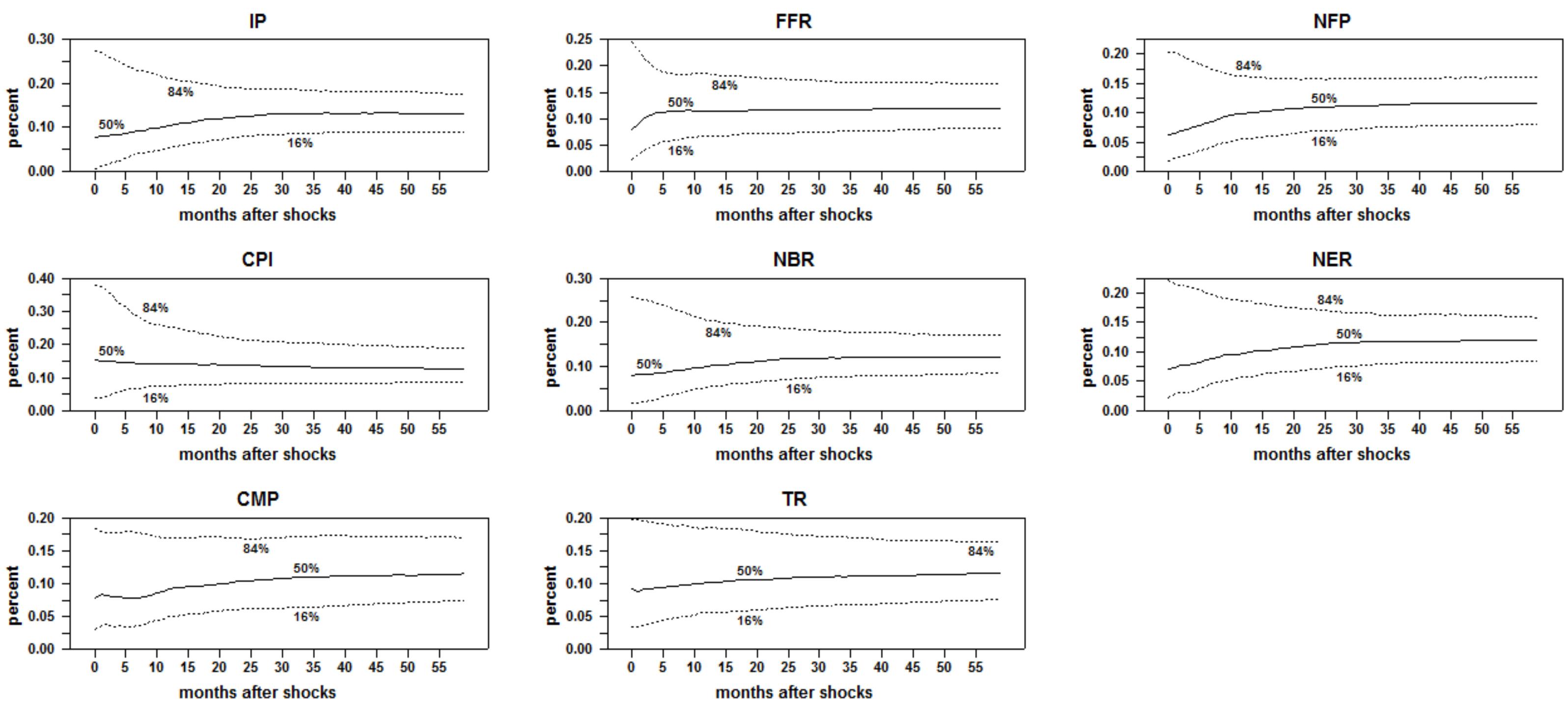
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.1.15. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Sample Periods (1974-2008, Flexible Exchange Rate Regime Period)



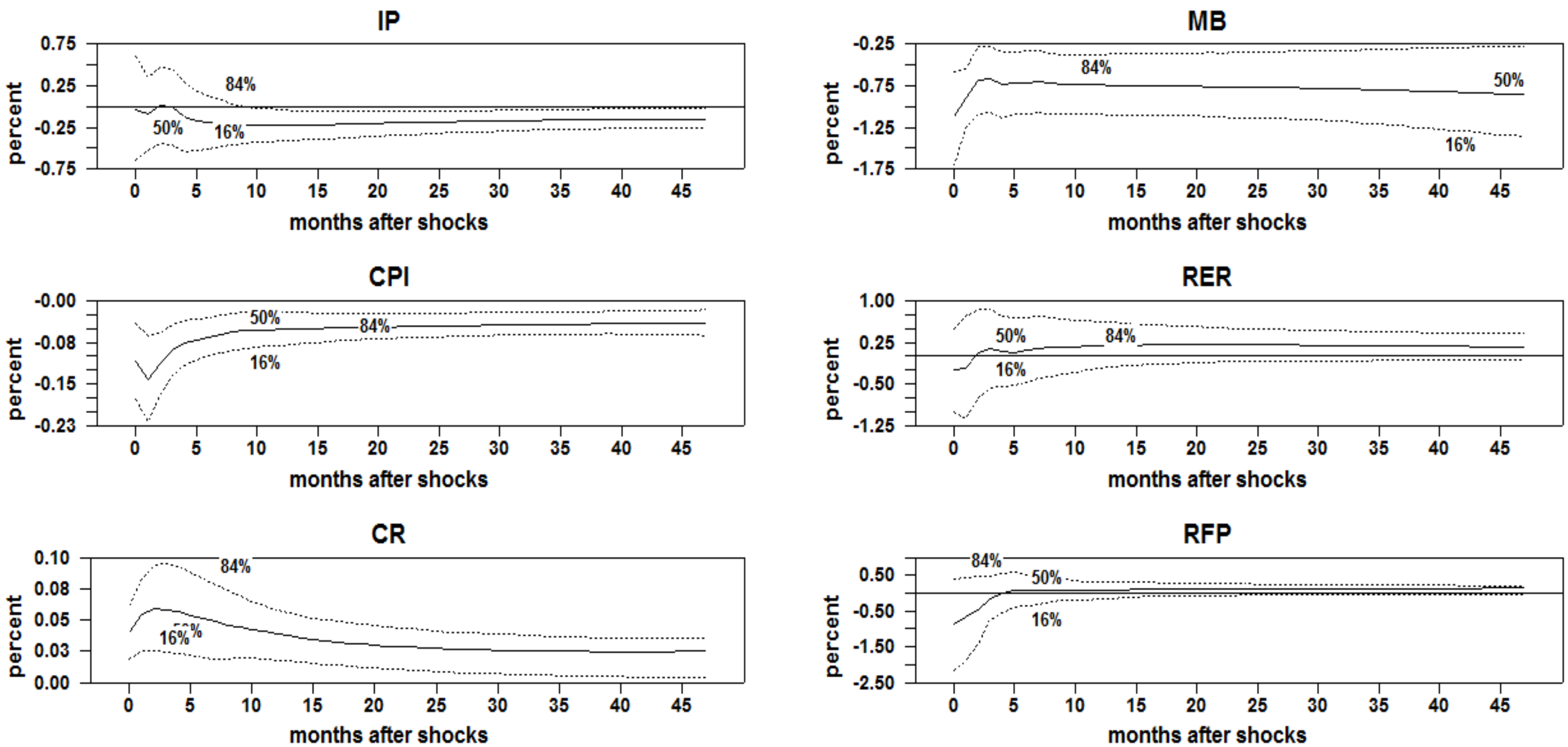
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.1.16. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for the U.S.: Alternative Sample Periods (1974-2008, Flexible Exchange Rate Regime Period)



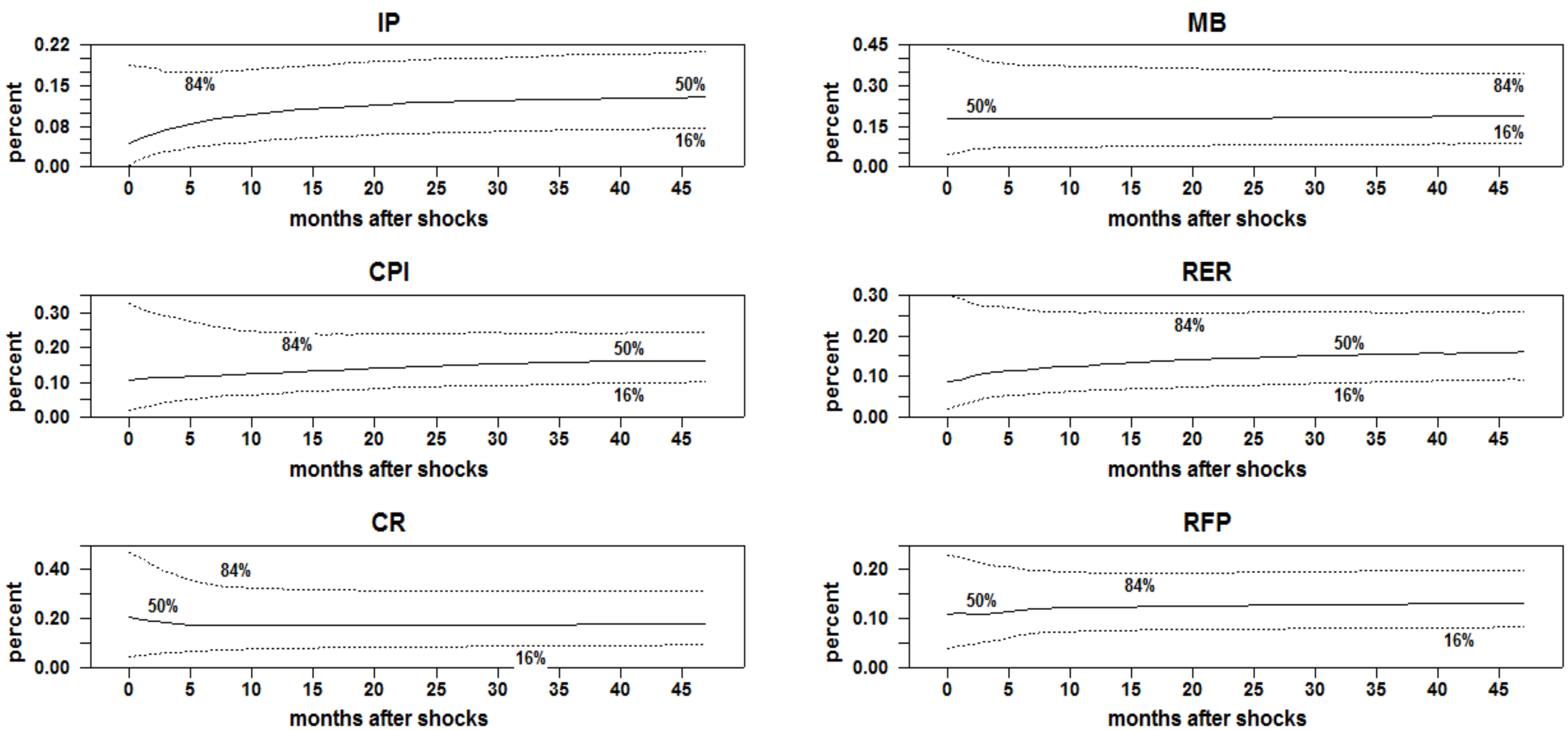
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 60 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.1. Impulse Responses in the Extended Model for Korea: Alternative Number of Lags (Three Lags)



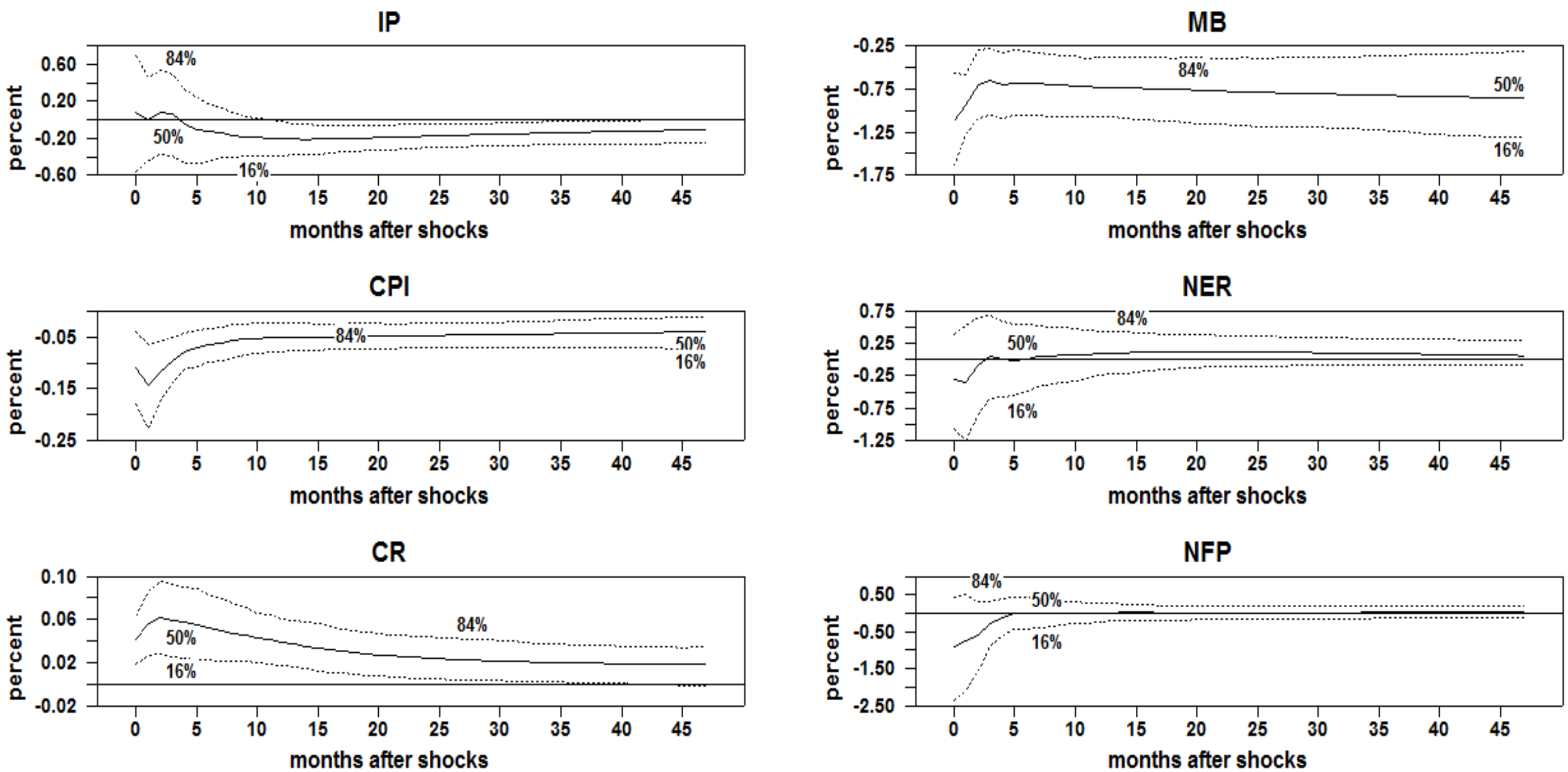
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.2. Forecast Error Variance Decomposition in the Extended Model for Korea: Alternative Number of Lags (Three Lags)



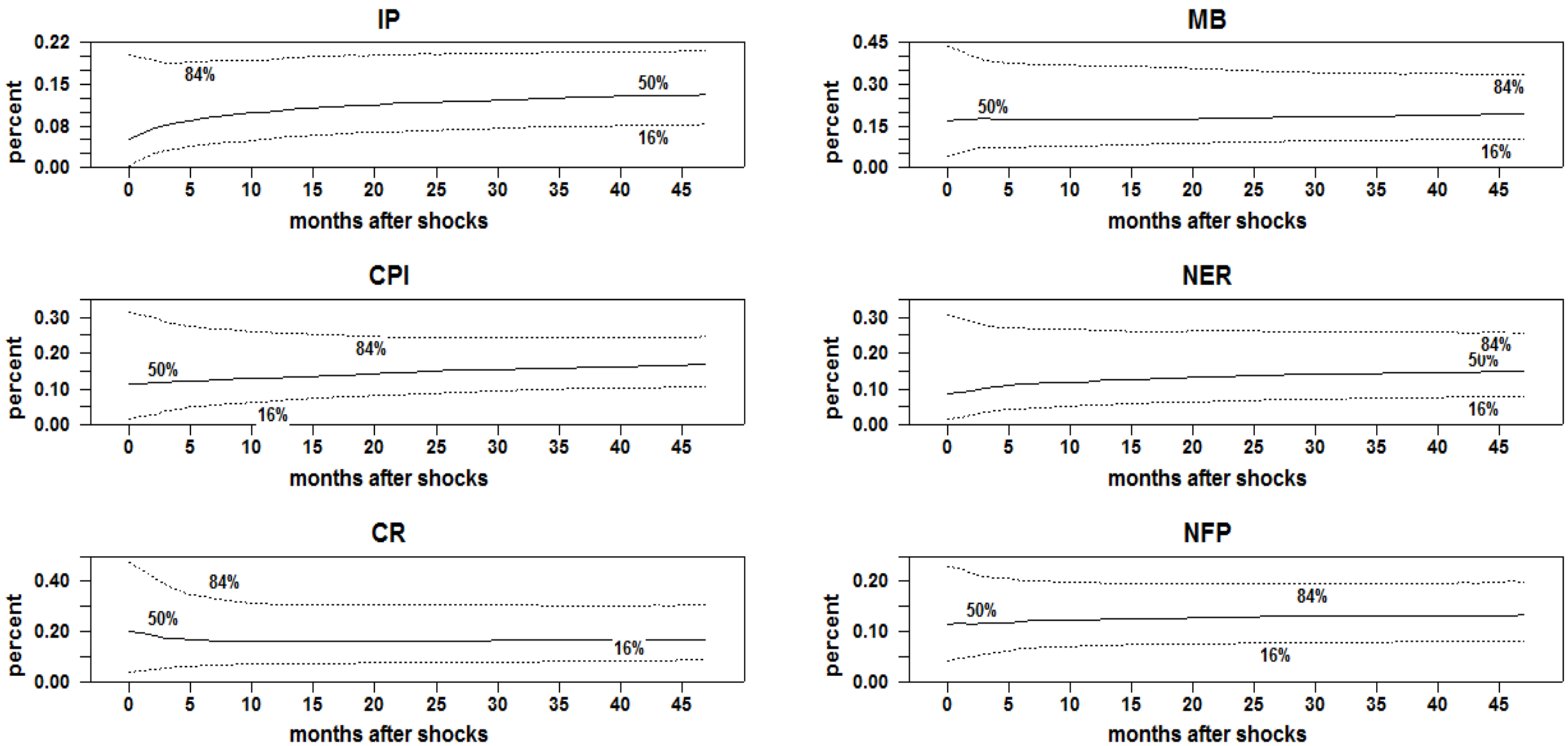
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.3. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Number of Lags (Three Lags)



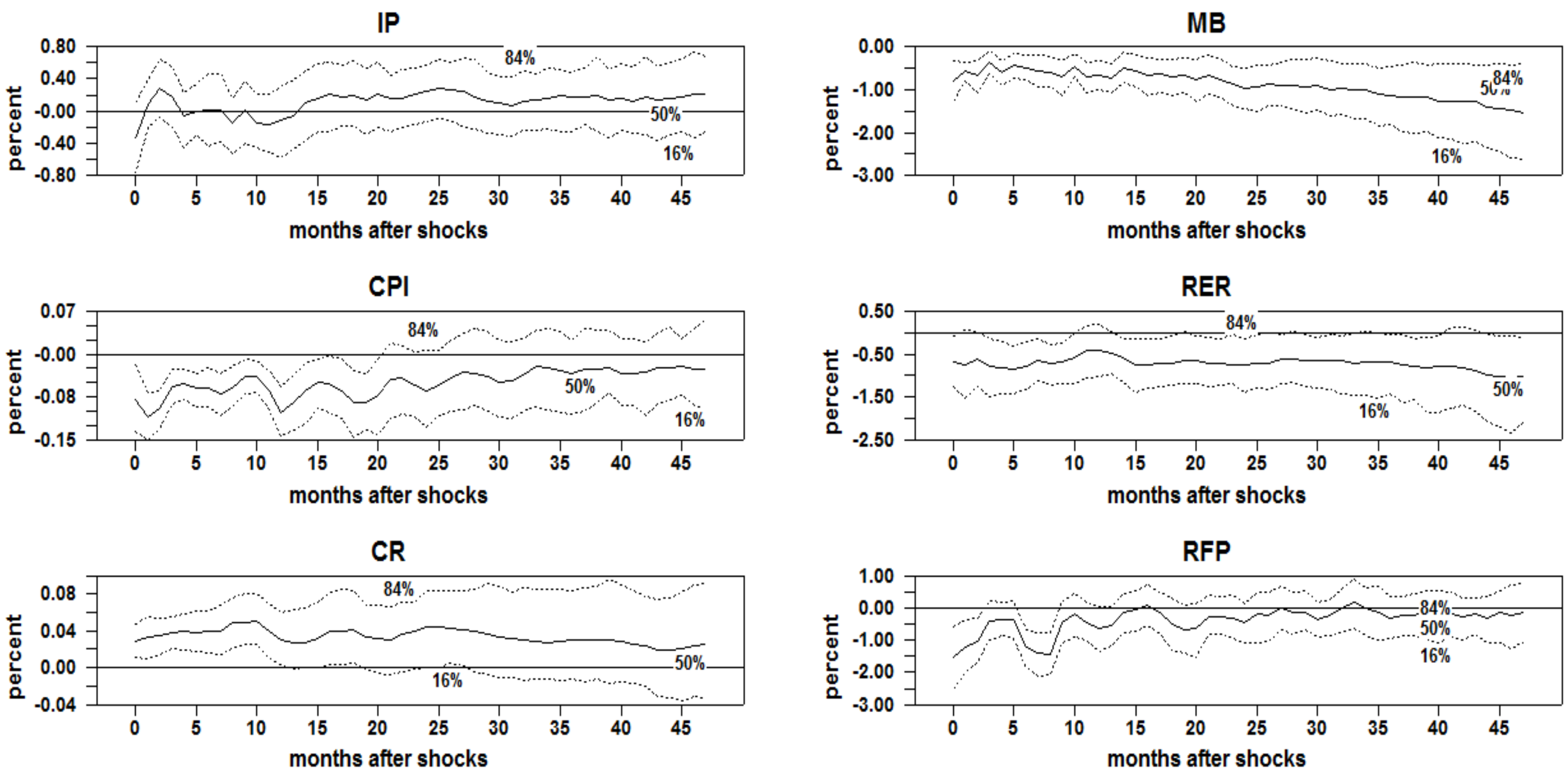
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.4. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Number of Lags (Three Lags)



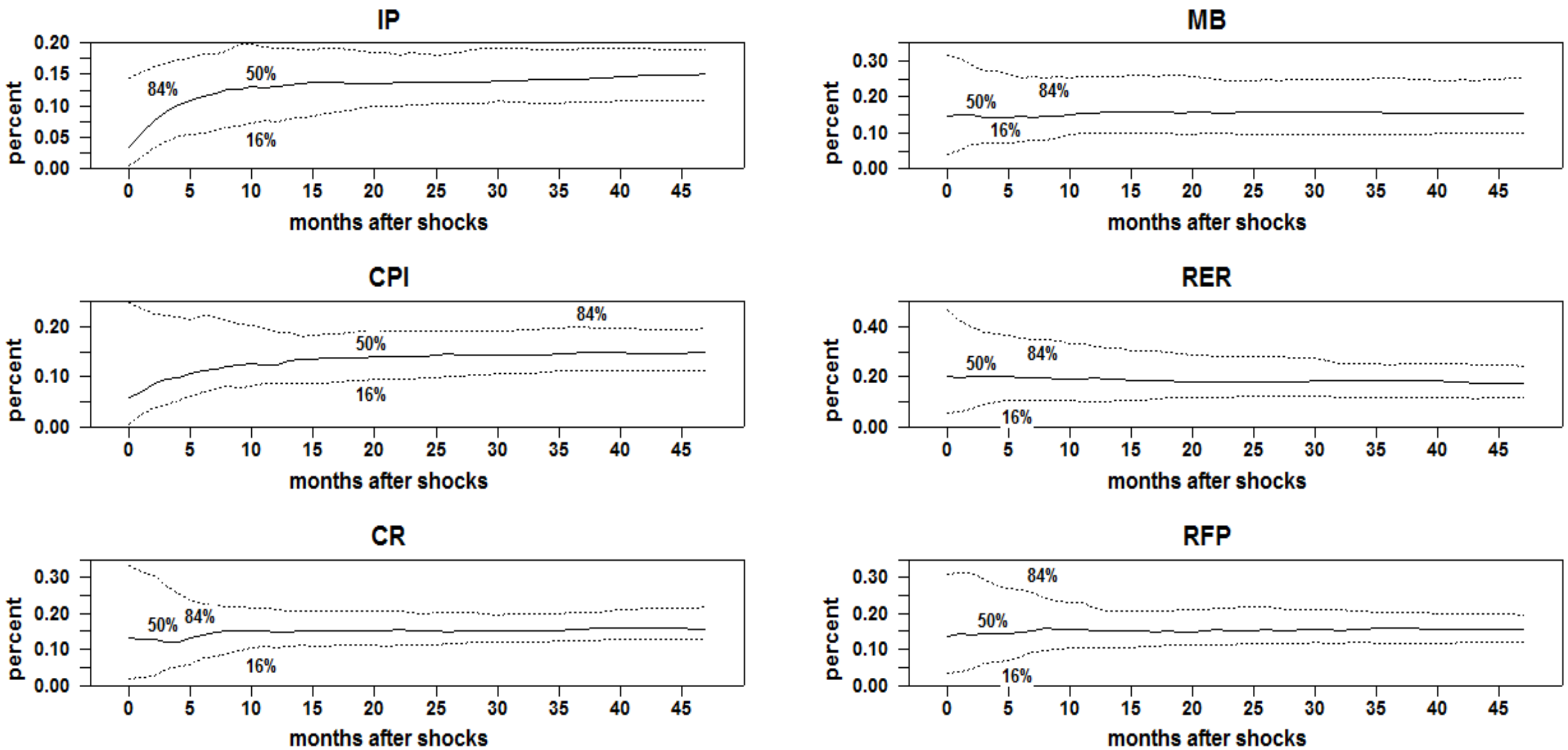
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.5. Impulse Responses in the Extended Model for Korea: Alternative Number of Lags (Twelve Lags)



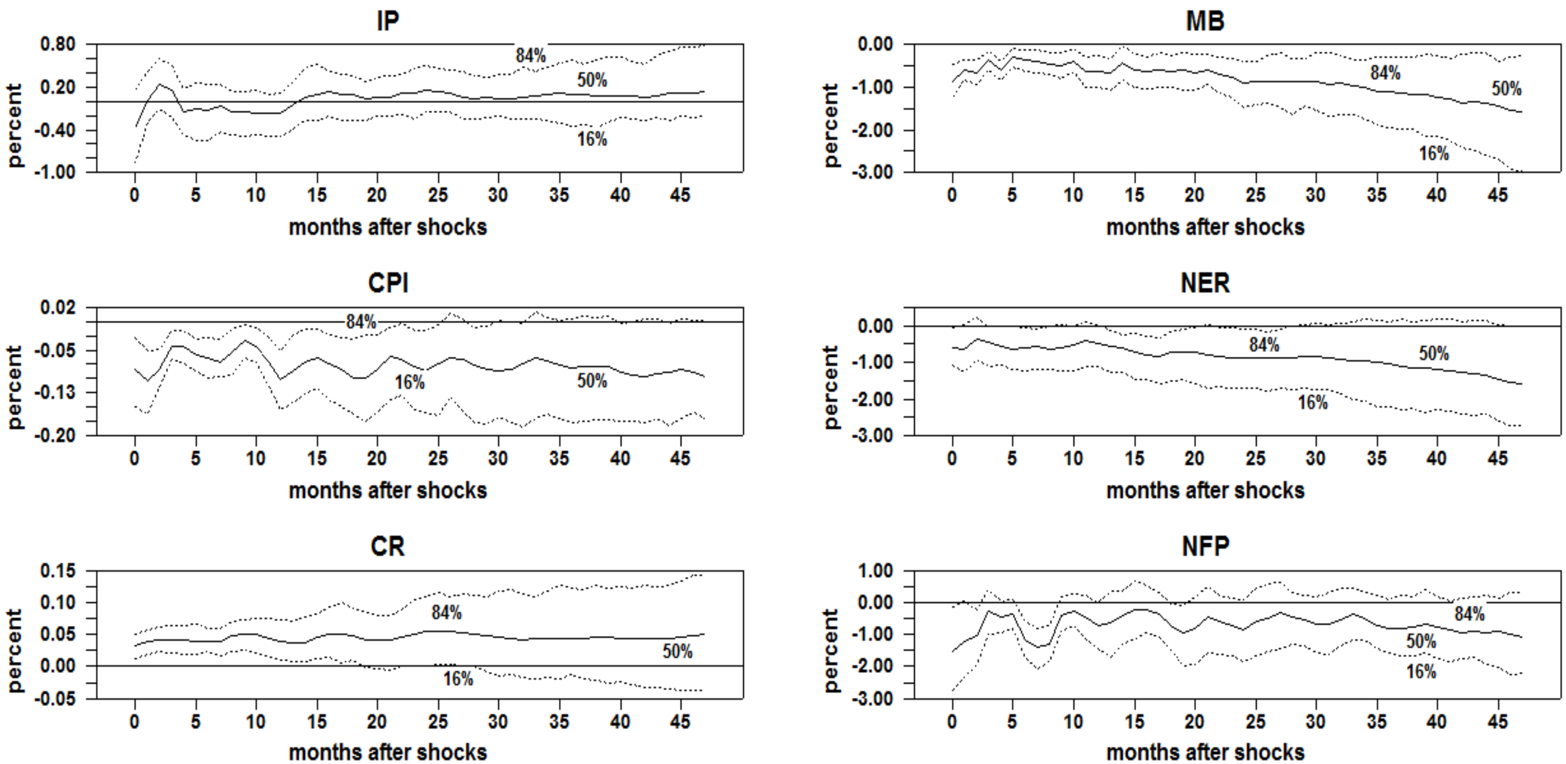
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.6. Forecast Error Variance Decomposition in the Extended Model for Korea: Alternative Number of Lags (Twelve Lags)



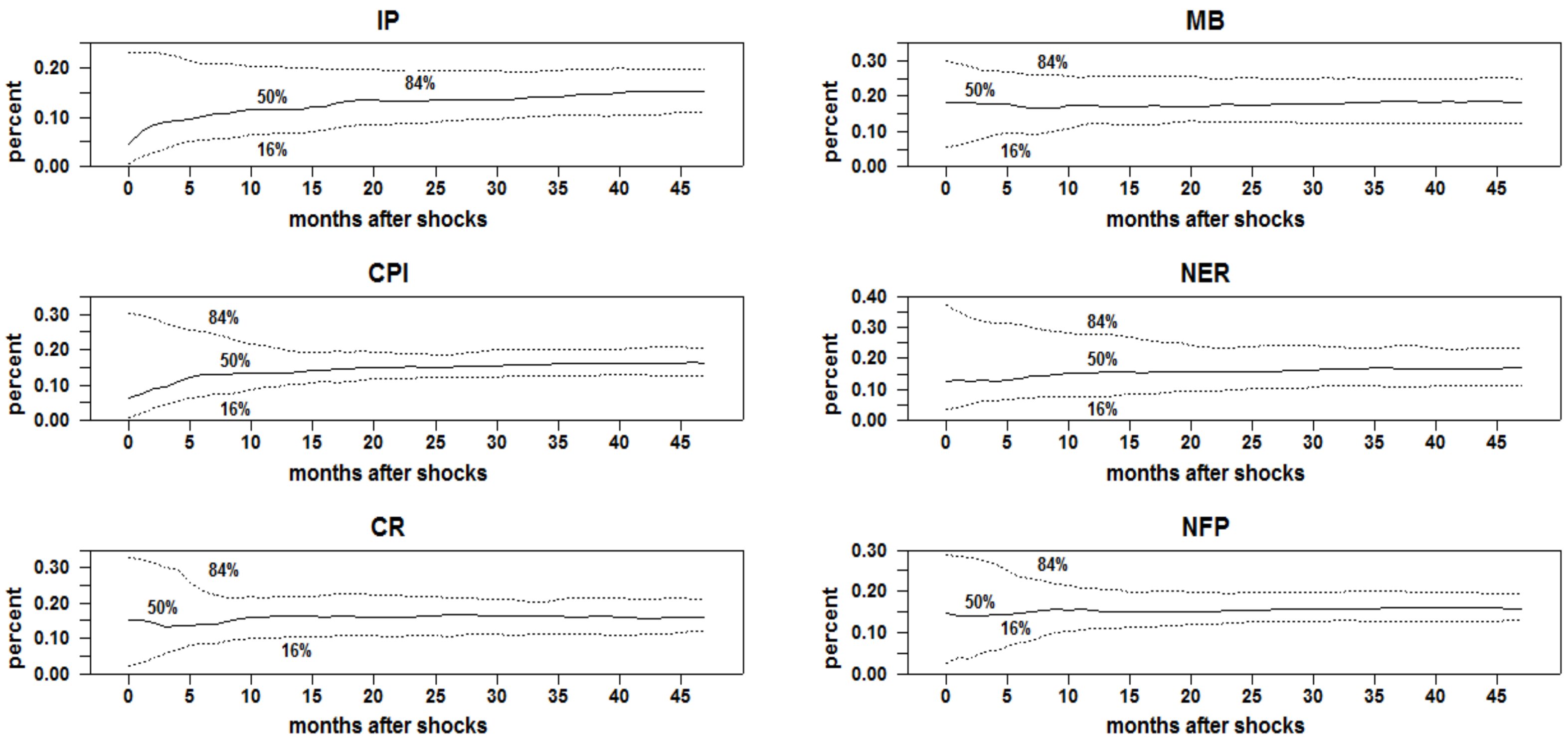
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.7. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Number of Lags (Twelve Lags)



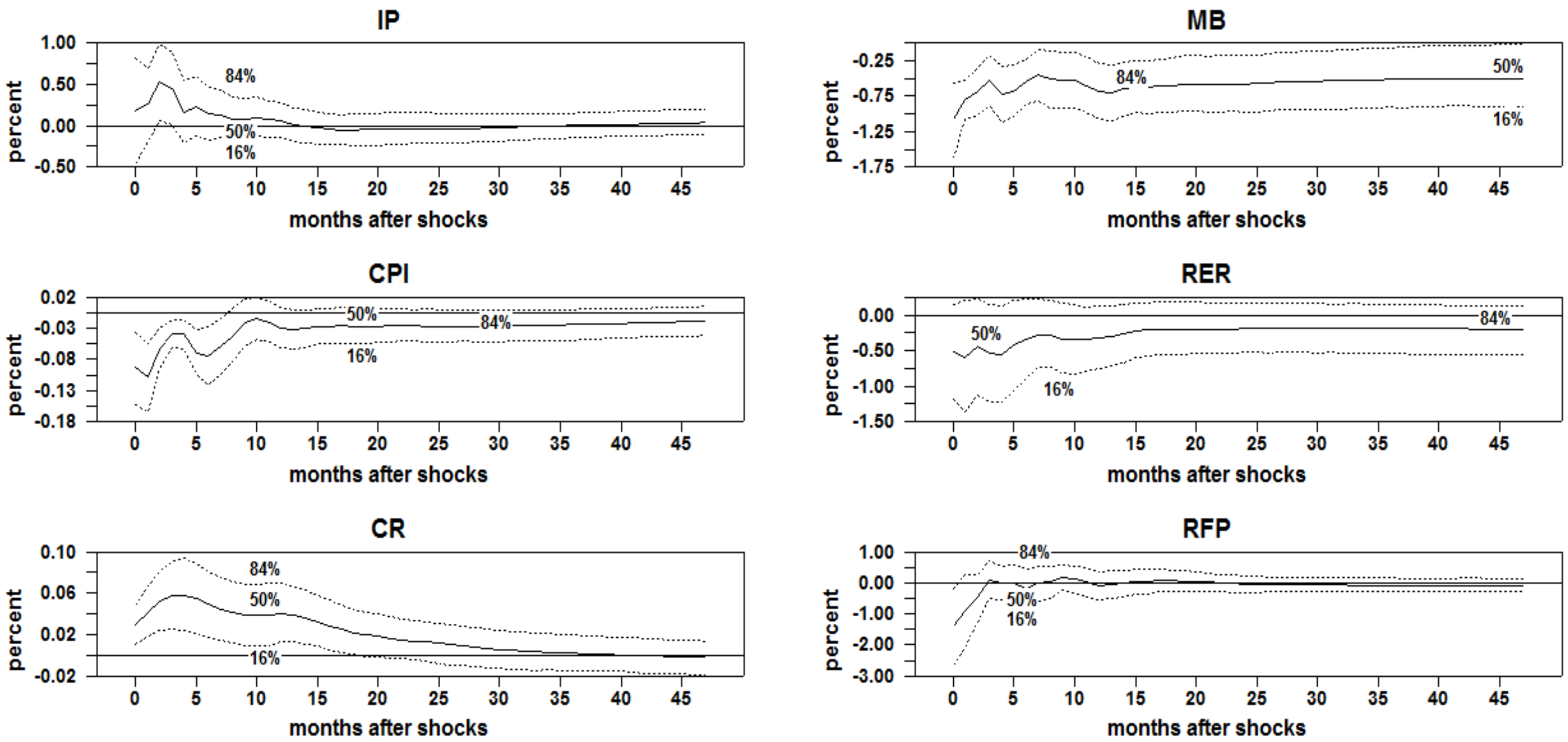
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.8. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Number of Lags (Twelve Lags)



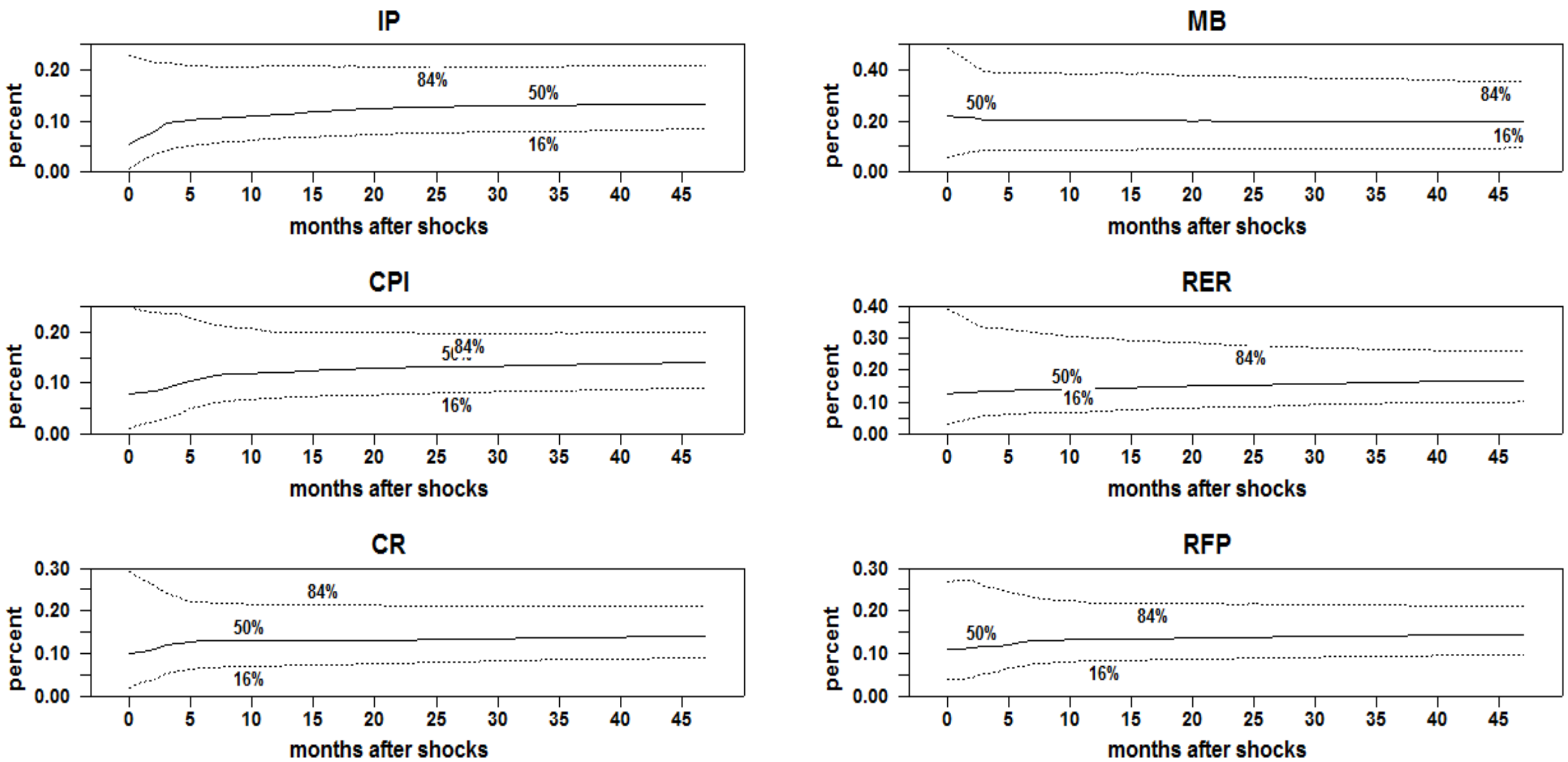
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.9. Impulse Responses in the Extended Model for Korea: Alternative Restriction Horizons (Six months)



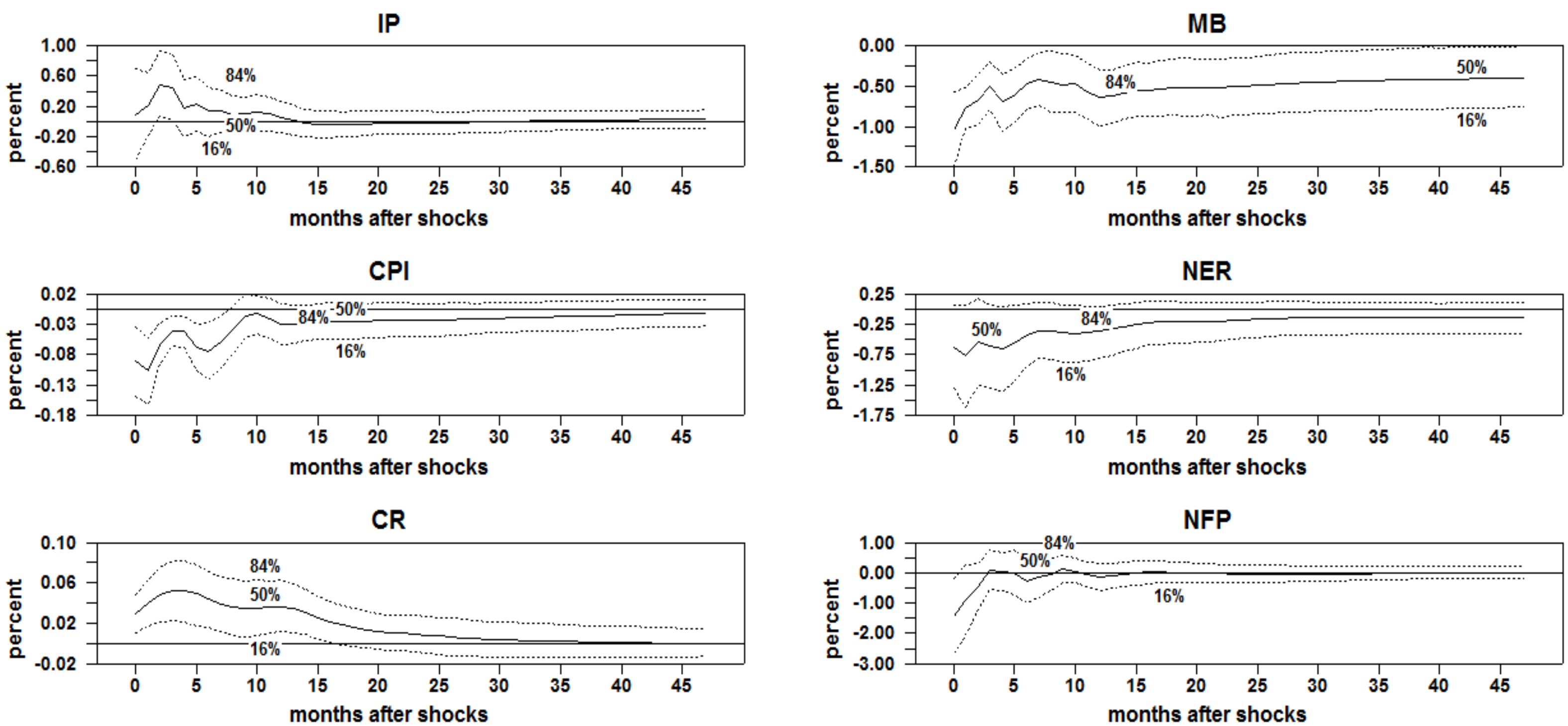
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.10. Forecast Error Variance Decomposition in the Extended Model for Korea: Alternative Restriction Horizons (Six months)



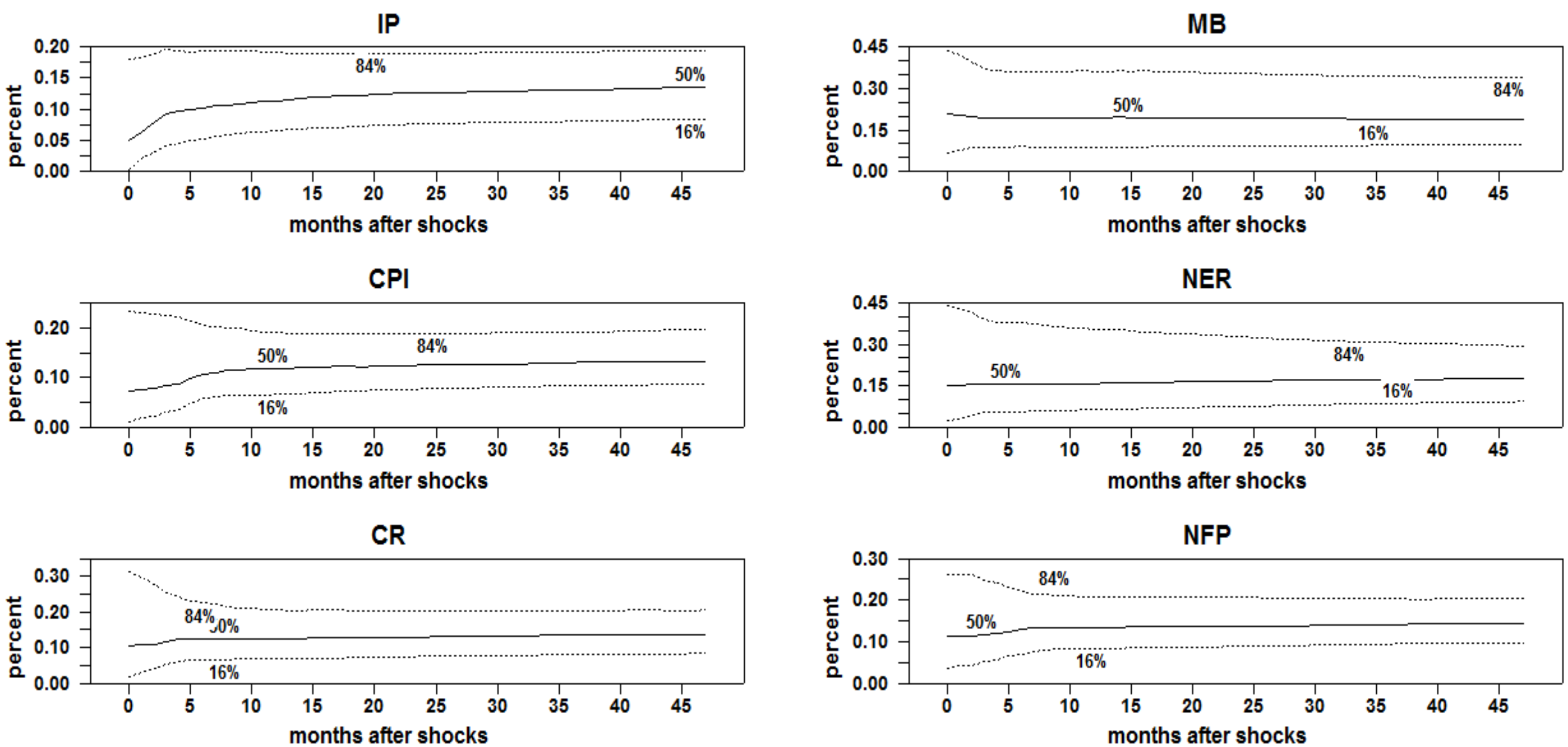
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.11. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Restriction Horizons (Six months)



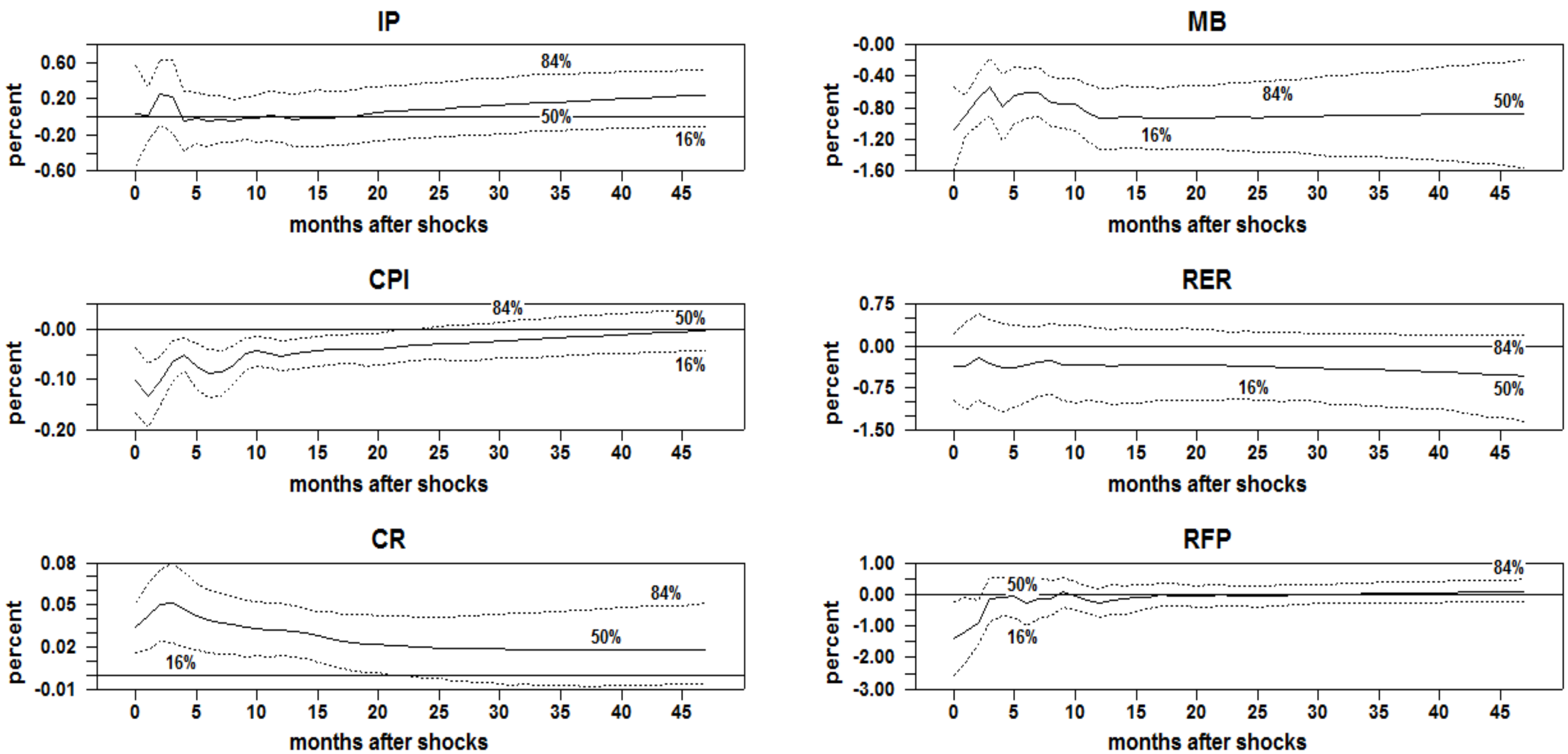
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.12. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Alternative Restriction Horizons (Six months)



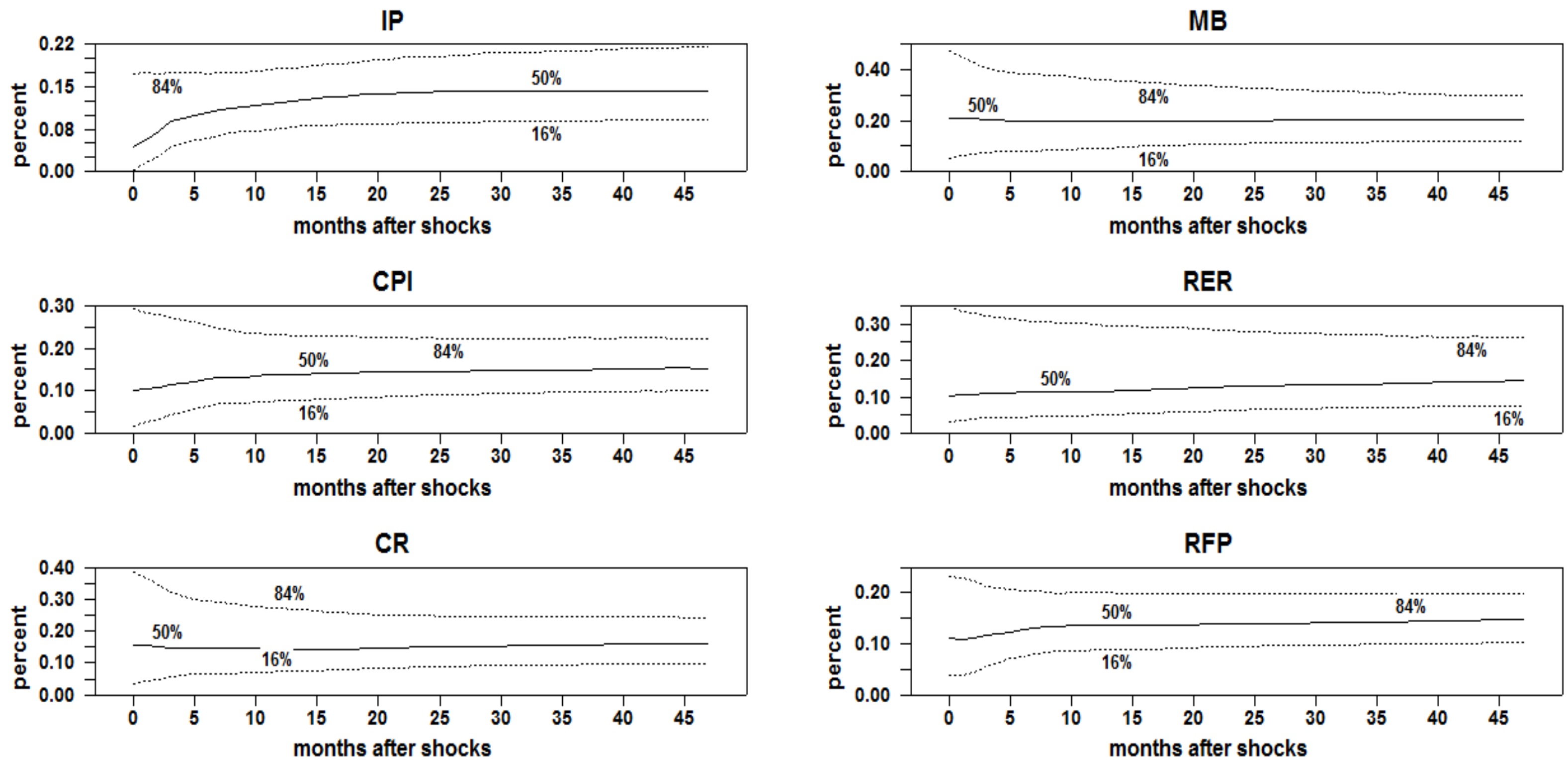
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.13. Impulse Responses in the Extended Model for Korea: Six Lags for Exogenous Variables



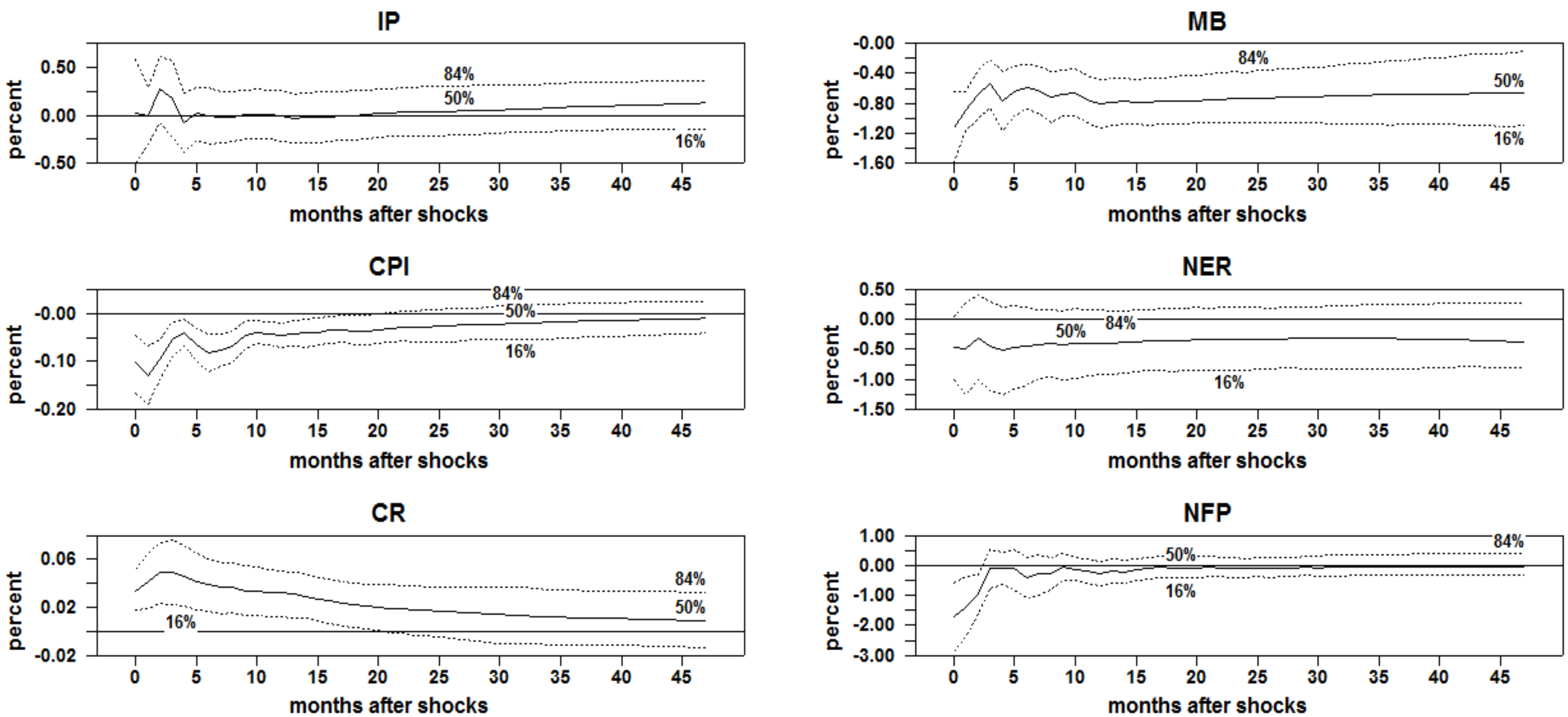
Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.14. Forecast Error Variance Decomposition in the Extended Model for Korea: Six Lags for Exogenous Variables



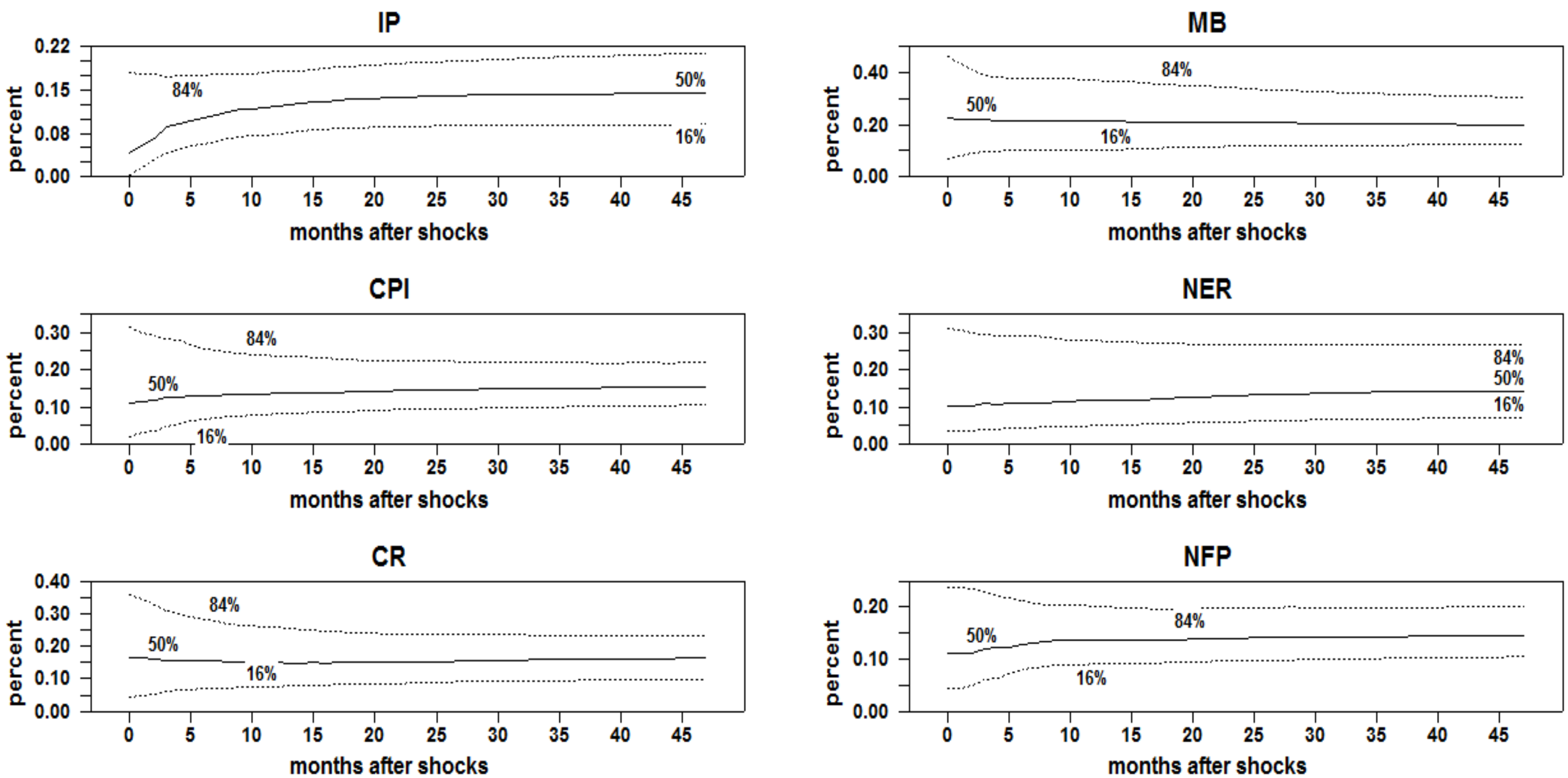
Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

Figure A.2.15. Impulse Responses in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Six Lags for Exogenous Variables



Note: These graphs show impulse responses of each variable (in y-axis) to contractionary monetary policy shocks over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph and error bands are 68%. Impulse responses of each variable are shown as percentage changes from the initial values, except for those of the interest rate (shown as deviations from the initial value).

Figure A.2.16. Forecast Error Variance Decomposition in the Extended Model with Nominal Farm Prices and Nominal Exchange Rate for Korea: Six Lags for Exogenous Variables



Note: Percentage contributions of monetary policy shocks in explaining forecast error variance of each variable with 68% error bands (in y-axis) are reported over 48 months horizons (in x-axis). The variables under consideration are denoted at the top of each graph.

References

Barnett, R., D. Bessler, and R. Thompson, 1983. The Money Supply and Nominal Agricultural Prices. *American Journal of Agricultural Economics* 65: 303-307.

Barro, R.J., 1976. Rational Expectations and the Role of Monetary Policy. *Journal of Monetary Economics*: 1-32.

Belongia, M.T., 1991. Monetary Policy and the Farm/Nonfarm Price Ratio: A Comparison of Effects in Alternative Models. *Federal Reserve Bank of St. Louis, Review* 73: 30-46.

Belongia, M.T., and R.A. King, 1983. A Monetary Analysis of Food Price Determinant. *American Journal of Economics* 65(1): 131-135.

Bernanke, B.S. and A.S. Blinder, 1991. The Federal Funds Rate and the Channels of Monetary Transmission. *American Economic Review* 82: 901-921.

Bernanke, B.S. and I.Mihov, 1998a. Measuring Monetary Policy. *Quarterly Journal of Economics* 113(3): 869-902.

Bernanke, B.S. and I.Mihov, 1998b. The liquidity effect and long-run neutrality: Identification by inequality constraints. *Carnegie-Rochester Conference Series on Public Policy* 49(0): 149-194.

Bernanke, B.S., Jean Boivin, and Piotr Eliasz, 2005. Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach. *Quarterly Journal of Economics*.

Bessler, D.A., 1984. Relative Prices and Money: A Vector Autoregression on Brazilian Data. *American Journal of Agricultural Economics* 66: 25-30.

Bessler, D.A. AND D.G. Akleman, 1998. Farm Prices, Retail Prices and Directed Graphs: Results for Pork and Beef. *Ameriacan Journal of Agricultural Economics* 80: 1144-1149.

Bordo, M.D., 1980. The effects of Monetary Change on Relative Commodity Prices and the Role of Long-term Contracts. *Journal of Political Economy* 88: 1088-1109.

Canova, F., 1995. VAR: specification, estimation, testing and forecasting. In: Pesaran, H., Wickens, M. (Eds)., *Handbook of Applied Econometrics*: 31-65.

Chambers, R.G., 1984. Agricultural and Financial Market Independence in the Short Run. *American Journal of Agricultural Economics* 66(1): 12-24.

Chambers, R.G. and R.E. Just, 1982. An Investigation of the Effect of Monetary Factors on Agriculture. *Journal of Monetary Economics* 9(2): 235-247.

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

Christiano, L.J., M. Eichenbaum, and C.L. Evans, 1997. Sticky price and limited participation models of money: a comparison. *European Economic Review* 41(6): 1201-1249.

Christiano, L.J., M. Eichenbaum and C.L. Evans, 1999. Monetary policy shocks: what have we learned and to what end*?* in J. Taylor and M. Woodford, (Eds.), *Handbook of Macroeconomics*, vol. 1A, Amsterdam , Elsevier North-Holland: 65–148.

Devadoss, S., and W. H. Meyers, 1987. Relative Prices and Money: Further Results for the United States. *American Journal of Agricultural Economics* 69(4): 838-842.

Doan, T., 1992. *RATS Manual 4.0*, Evanston, IL: Estima.

Dorfman, J.H., and W.D. Lastrapes., 1996. The Dynamic Responses of Crop and Livestock Prices to Money-Supply Shocks: A Bayesian Analysis Using Long-Run Identifying Restriction. *American Journal of Agricultural Economics* 78(3): 530-541.

Dornbusch, R., 1976. Expectations and Exchange Rates Dynamics. *Journal of Political Economy* 84(6): 1161-1176.

Eichenbaum, M., 1992. Comments on 'Interpreting the Macroeconomic Time Series Facts: the Effects of Monetary Policy'. *European Economic Review* 36: 1001-1011.

Eichenbaum, M., and C.L. Evans, 1995. Some Empirical Evidence of Shocks to Monetary Policy on Exchange Rates. *Quarterly Journal of Economics* 110(4): 975-1010.

Enders, W., 1995. *Applied Econometric Time Series,* New York: Wiley.

Faust, J., 1998. The Robustness of identified VAR conclusions about Money. *Carnegie-Rochester Conference Series in Public Policy* 49: 207-244.

Frankel, J.A., 1984. Commodity Prices and Money: Lessons from International Finance. *American Journal of Agricultural Economics* 66: 560-566.

Frankel, J.A., 1986. Expectations and Commodity Price Dynamics: The Overshooting Model. *American Journal of Agricultural Economics* 68(2): 344-48.

Friedman, M. and A.J. Schwartz, 1963. A Monetary History of the United States 1867-1960. *Princeton: Princeton University Press, Princeton.*

Gambetti, L., 1999. The real effects of monetary policy: a new VAR identification procedure. *Rivista di politica Economica* 89(12): 149-169.

Han, D.B., D.W. Jansen and J.B. Penson, 1990. Variance of Agricultural Prices, Industrial Price and Money. *American Journal of Agricultural Economics* 72(4): 1066-1073.

Han, D.B and S.Y Kim, 2005. Monetary Policy Shocks and Real Farm Price: Evidence from Identification Scheme using Federal Funds Rate Shocks. *The Korean Economic Review* 21(2): 163-178.

International Monetary Funds, *International Financial Statistics*, CD-ROM.

Issac, A.G. and D.E. Rapach, 1997. Monetary Shocks and Relative Farm Prices: A Re-examination. *American Journal of Agricultural Economics* 79(4): 1332-1339.

Kim, S., 1999. Does Monetary Policy shocks Matter in the G-7 countries? Using Common Identifying Assumptions about Monetary Policy across Countries. *Journal of International Economics* 47: 871-893.

Kim, S., 2001. International Transmission of U.S. Monetary Policy Shocks: Evidence from VAR's. *Journal of Monetary Economics* 48(2): 339-372.

Kim, S., 2013. VAR Models for Macroeconomic Policy Analysis, *Handbook of Research Methods and Applications in Empirical Macroeconomics*, edited by N. Hashimzade and M.A. Thornton, Edgar Elgar Publishing: 555-574.

Kim, S. and D.Y. Yang, 2012. Are Capita Controls Effective? The Case of Republic of Korea. *Asian Development Review* 29(2), 96-135.

Kim, S. and G. Lim, 2015. Effects of Monetary Policy Shocks on Exchange Rate in Emerging Countries, Working Paper.

Kim, S. and N. Roubini, 2000. Liquidity and Exchange Rates in the G-7 countries: Evidence from Identified VAR's. *Journal of Monetary Economics* 45: 561-86.

Kim, S. and Y.C. Park, 2006. Inflation Targeting in Korea: Model of Success? *BIS Papers No. 31, Monetary Policy in East Asia: Approaches and Implementations*: 140-164.

Kwon, D.H., and W.W. Koo, 2009. Interdependence of Macro and Agricultural Economics: How Sensitive is the Relationship? *American Journal of Agricultural Economics* 91(5): 1194-1200.

Lai, C., and V. Wang, 1996. Commodity Price Dynamics and Anticipated Shocks. *American Journal of Agricultural Economics* 78: 982-990.

Lapp, J.S., 1990. Relative Agricultural Prices and Monetary Policy. *American Journal of Agricultural Economics* 72(3): 622-630.

Lee, B.S., 1995. Analysis on Effects of Monetary Policy on Relative Farm Prices (in Korean). *Korea Journal of Agricultural Management and Policy* 22(1): 263-276.

Lee, B.S. and P.C. Jung, 1994. . Empirical Analysis on Causality between Farm Prices and Money in Korea (in Korean). *Korea Journal of Agricultural Management and Policy* 21(2): 81-97.

Leeper, E.M., C.A. Sims, and T. Zha, 1996. What Does Monetary Policy Do? *Brookings Papers on Economic Activity* 2: 1-63.

Leeper, E.M. and D.B. Gordon, 1992. In Search of the Liquidity Effect. *Journal of Monetary Economics* 29(3): 341-369.

Obstfeld, M., 1986. Overshooting Agricultural Commodity Markets and Public Policy: Discussion. *American Journal of Agricultural Economics* 68: 420-421.

Orden,D., and P.L. Fackler, 1989. Identifying Prices in VAR Models. *American Journal of Agricultural Economics* 71: 495-502.

Reichenstein, W., 1987. The Impact of Money on Short Term Interest Rates. *Economic Inquiry* 25(1): 67-82.

Robertson, J.C. and D. Orden, 1990. Monetary Impacts on Prices in the Short and Long Run: Some Evidence from New Zealand. *American Journal of Agricultural Economics* 72(1): 160-171.

Saghaian S.H., M.F. Hasan, and M.R. Reed, 2002. Overshooting of Agricultural Prices in Four Asian Economies. *Journal of Agricultural and Applied Economics* 34(1): 95-109.

Saghaian S.H., M.R. Reed, and M.A. Marchant, 2002. Monetary Impacts and Overshooting of Agricultural Prices in an Open Economy. *American Journal of Agricultural Economics* 84(1): 90-103.

Sargent, T.J., and N. Wallace, 1973. The Stability of Models of Money and Growth with Perfect Foresight. *Econometrica* 41(6): 1043-1048.

Scholl, A. and H. Uhlig, 2008. New evidence on the puzzles: Results from agnostic identification on monetary policy and exchange rates. *Journal of International Economics* 76(1): 1-13.

Schuh, G.E., 1974. The Exchange Rate and U.S. Agriculture. *American Journal of Agricultural Economics* 56: 1-13.

Sims, C.A., 1980. Macroeconomics and Reality. *Econometrica* 48(1): 1–48.

Sims, C.A., 1992. Interpreting the macroeconomic time series facts: the effects of monetary policy. *European Economic Review* 36(5): 975–1000.

Sims, C. A., 1988. Bayesian Skepticism on Unit Root Econometrics. *Journal of Economic Dynamics and Control* 12(2-3): 463-474.

Sims, C. A., H. Uhlig, 1991. Understanding Unit Rooters: A Helicopter Tour. *Econometrica* 59(6): 1591—1599.

Sims, C.A. and T. Zha, 1999. Error bands for impulse responses. *Econometrica* 67(5): 1113-1155.

Stamoulis, K.G. and G.C. Rausser, 1988. Overshooting of Agricultural Prices. *Macroeconomics, Agriculture and Exchange Rates. P.L. Paarlgerg and R.G. Chambers, eds. pp.*163-189. *Boulder: Westview Press.*

Taylor, J.S. and J.Spriggs, 1989. Effects of the Monetary Macro-Economy on Canadian Agricultural Prices. *The Canadian Journal of Economics* 22(2): 278-289.

Tobin, J., 1970. Money and Income: Post Hoc Ergo Propter Hoc? *The Quarterly Journal of Economics* 84(2): 301-317.

Uhlig. H., 1997. Bayesian vector autoregressions with stochastic volatility. *Econometrica* 65(1): 59-73.

Uhlig. H., 1998. The robustness of identified VAR conclusions about money. A comment. *Carnegie-Rochester Series in Public Economics* 49: 245-263.

Uhlig, H., 2005. What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure. *Journal of Monetary Economics* 52(2): 381-419.

국 문 초 록

1980년대 초 미국의 통화 정책 체제의 변화에 따른 농가 금융위기 이후 통화 및 거시경제적 충격이 농산물 시장에 미치는 영향에 대한 중요성이 부각되기 시작하였다. 미국의 농가 금융위기는 농산물 가격의 변화가 단지 농업시장 충격으로부터만 발생하는 것이 아니라 통화 및 거시경제적 충격으로부터 기인할 수도 있다는 점에 대해 많은 경제학자들이 재고할 수 있게 한 역사적으로 중요한 사건이다. 농가 위기 이후 통화 정책이 농산물 가격에 미치는 영향에 대한 많은 연구가 이루어졌다. 특히 화폐 중립성과 신축적 가격을 가정한 전통적인 이론과 달리 오버슈팅(overshooting) 이론에서는, 비농산물 가격이 경직적인 경우 통화 정책 충격 하에서 농산물 가격의 단기 반응이 장기 반응 보다 더 크게 나타날 수 있고 이에 따라 단기적으로 실질 농산물 가격이 변할 수 있음을 보여주었다. 이론적 분석뿐 아니라 특히 미국을 대상으로 하는 많은 실증 분석 연구가 있었는데 기존의 분석들은 통화 정책 충격이 실질 농산물 가격에 유의한 효과를 미치는지에 대해 서로 다른 결과들을 제시하고 있다.

한편 한국과 같은 신흥국을 대상으로 분석한 연구들은 거의 없다.

이는 한국 및 신흥국의 경우 선진국과 달리 전통적으로 농업시장을 보호하고 가격을 안정화한다는 목적 아래 빈번한 정부개입이 이루어지는 등 농업 시장에 대한 정부의 많은 규제와 관리가 있었다. 하지만 한국의 경우 1980년대 이후 관련 규제들이 많이 철폐되고 있어 농산물 가격 결정에 있어서 시장의 역할이 점점 중요해지고 있을 뿐 아니라 가격의 변동성도 점점 높아지고 있는 실정이다. 통화 정책 체제의 경우도 외환 위기 이후에 많은 변화가 이루어졌다. 이자율을 정책 수단으로 사용하기 시작했고 물가 안정 목표제와 자유 변동환율제를 도입하는 등 선진국과 비슷한 통화 정책 체제로 변화했으므로 외환위기 이후 기간을 대상으로 통화 정책 충격 등 단기적으로 농산물 가격의 변동을 초래하는 거시적 요인들에 대해 분석하는 것은 반드시 필요하다.

본 연구는 통화 정책 충격이 실질 농산물 가격에 미치는 영향에 관해 실증 분석하고 기존 이론 중에서 어떤 이론이 실증적으로 정합한지, 특히 실질 농산물 가격에 유의한 영향을 미치는지, 그리고 농산물 가격의 동학 반응이 이론에서 제시하는 오버슈팅(overshooting)과 비슷한지를 분석한다. 미국 자료뿐 아니라 농산물 시장에서 규제가 완화된 최근 기간에 대해 한국 자료를 이용하여 분석한다. 최근에

개발된 벡터 자기 회귀 모형 (VAR: Vector Auto-Regression) 을 이용한 실증 분석 방법인 충격 반응 함수의 부호를 제약한 통화 정책 충격 식별 방법 (VAR with Sign Restriction) 을 응용하여 보다 외생적인 통화 정책 충격을 식별하고 그 효과를 분석한다. 또한 농산물 가격에 대한 효과를 분석하거나 환율에 대한 효과를 분석한 기존의 연구들과 달리 농산물 가격과 환율이 상대적으로 어떻게 반응하는지에 대해 동시에 살펴보고 비교 분석한다. 통화 정책에 대한 환율의 반응과 관련하여 오버슈팅 이론이 개발되었고 이후 통화 정책에 대한 농산물 가격의 반응에 대해 오버슈팅 이론이 확장되었다는 면에서 이러한 비교는 꽤 흥미롭다.

미국에 대한 실증 분석 모형은 Uhlig (2005) 에서 제안한 부호제약을 이용한 VAR (Vector Auto-Regression) 모형을 기반으로 하였다. 생산량, 물가, 비차입지준금, 미연방기준금리, 미래 물가압력을 반영하는 변수에 농산물 가격, 환율을 포함하여 모형을 확장하였다. 통화(긴축)정책 충격 후 미연방 기준 금리는 증가하고, 물가, 물가압력 변수, 비차입지준금은 하락한다는 대부분의 경제 이론이 예측하는 통화 정책 충격의 기본적인 효과를 적용한 부호제약을 부가하여 분석하였다.

한국에 대한 실증 분석 모형은 Uhlig (2005) 모형을 응용하여 소규모 개방경제의 특성을 반영한 모형을 제안한 Kim and Lim (2015) 의 모형을 응용하여 구축하였다. 농산물 가격, 환율뿐 아니라, 생산량, 물가, 단기이자율, 본원통화 등의 변수를 모형에 포함하였다. 또한 미국 연방 기준 금리, 미국 생산량, 미국 물가, 변동성 지수 등 미국 주요 거시 변수들을 외생 변수로 포함하여 미국의 경제와 국제금융시장의 여건이 한국과 같은 소규모 개방경제에 중요한 영향을 미치는 특성을 반영하였다. 또한 통화(긴축)정책 충격 후 단기 이자율은 상승하고, 물가와 본원 통화는 감소한다는 부호 제약을 부가하여 통화 정책 충격을 식별하였다.

미국에 대한 주요 실증 분석 결과는 다음과 같다. 첫째, 긴축적인 통화 정책 충격은 실질 농산물 가격에 유의한 음의 효과를 나타냈다. 이러한 결과는 통화 정책 충격에 대해 농산물 가격이 물가보다 더 많이 반응한다는 것을 의미하고, 이는 화폐 중립성과 신축적 가격을 가정한 전통적인 이론의 예측에 위배된다.

둘째, 통화 정책 충격의 농산물 가격에 대한 효과는 환율에 대한 효과 보다 더 크게 나타났다. 자유 변동 환율제 기간만을 대상으로 하는 경우에도 통화 정책 충격의 농산물 가격에 대한 효과는 적어도

환율에 대한 효과만큼 크게 나타났다. 환율은 통화 정책 충격에 많은 영향을 받는 변수 중 하나로 여겨지는 변수이므로 이러한 결과는 특히 흥미롭다.

셋째, 통화 정책 충격 하에 농산물 가격과 환율 모두 오버슈팅이 지연되어 나타나는 현상(delayed–overshooting) 을 보였다. 농산물 가격의 최대 효과는 충격 후 약 3 년 이후에 나타났고 이는 환율에 대한 최대 효과보다도 더 지연되어 나타났다. 이러한 결과는 통화 정책 하에서 농산물 가격과 환율의 움직임이 각각 기대 농산물 보유 수익률과 이자율이 같아져야 한다는 균형조건과 이자율 평형 정리에 부합되지 않는다는 것을 의미한다.

한국에 대한 주요 실증 분석 결과는 다음과 같다. 첫째, 긴축적인 통화 정책 충격에 대한 실질 농산물 가격은 유의한 음의 반응을 보였다. 즉, 농산물 가격이 물가보다 더 많이 반응하였고 이러한 결과는 금리 충격이 물가보다 농산물 가격에 더 큰 영향을 미친 것을 의미한다. 통화 정책 충격이 실질 농산물 가격에 미치는 효과는 상당히 크게 나타났다. 미국과 비교하여 실질 농산물 가격에 미치는 영향이 훨씬 덜 지속적인 것으로 나타났는데 이는 한국의 농산물 가격 안정화 정책과 농산물 가격 규제에 기인한 것으로 보인다.

둘째, 통화 정책 충격에 대한 농산물 가격의 반응은 환율의 반응보다 훨씬 크게 나타났다. 특히 미국과 비교해서도 농산물 가격의 반응이 환율의 반응보다 상대적으로 훨씬 크게 나타났는데, 이러한 결과는 한국의 환율 안정화 정책에 기인했을 수도 있다. 또한 미국과 달리, 농산물 가격과 환율에 대한 효과가 단기적으로 나타나고 오버슈팅은 거의 지연되지 않는 경향이 있음이 발견되었다.

이러한 결과들은 미국뿐 아니라 한국에서도 통화 정책 충격과 같은 거시 경제적 요인이 농산물 가격에 유의한 영향을 미치고 농산물 가격의 변동성을 증가시킬 수 있으므로 농산물 가격 변동 분석 시 미시적 요인에 추가적으로 통화 정책과 같은 거시 경제적 충격의 특징을 이해하는 것이 중요할 수 있음을 시사한다. 또한 통화 정책 충격과 같은 거시적 충격이 발생하는 경우에 농산물 가격 안정화를 위한 정책적 노력이 필요할 수 있음을 의미한다. 하지만 본 연구에서는 거시적인 요인 이외에 농산물 가격에 영향을 미칠 수 있는 다른 중요한 요인들을 명시적으로 고려하지 않았기 때문에 결과에 어느 정도의 편향이 있을 수 있는 한계점이 있어 향후 연구에서 개선되어야 할 것이다.

주요어: VAR, 통화 정책 충격, 환율, 농산물 가격, 오버슈팅, 미국, 한국

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