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Nonlinear models for the sources of real effective exchange rate fluctuations: Evidence from the Republic of Korea

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ABSTRACT

The real effective exchange rate has exhibited sizable fluctuations from 1970Q1 to 2015Q1 in the Republic of Korea. This paper quantitatively investigates the sources of the fluctuations and the impacts of heterogeneous shocks on the conditional volatility of the real effective exchange rate through estimating a structural vector autoregressive (SVAR) model and an exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model. The variance decomposition and historical decomposition consistently demonstrate that about 90% of the real effective exchange rate fluctuations is attributed to demand shocks, about 9.10% of the fluctuations is due to supply shocks, while only around 0.74% of the variations is because of nominal shocks. Moreover, the historical decomposition reveals that these contributions are time-varying. In addition, the estimated EGRACH model reveals that the conditional volatility of the Korean real effective exchange rate in response to negative shocks is much larger than that in response to positive shocks. Our analysis implies that temporary capital flow regulations and discretionary monetary policies should be combined to stabilize the real effective exchange rate fluctuations in the presence of negative demand shocks.

1. Introduction

Since the collapse of the fixed exchange rate system in the early 1970s, many countries have experienced a high level of fluctuations in the real effective exchange rate, which has stimulated lots of studies to investigate the sources and the time series properties of the real effective exchange rate fluctuations.

In examining the sources of real effective exchange rate fluctuations, Clarida and Gali (1994), Chadha and Prasad (1997), Huh (1999), Wang (2005), Erjavec et al. (2012), Valcarcel (2013), and Chen and MacDonald (2014) consistently demonstrate that heterogeneous shocks, such as demand shock, supply shock, and nominal shock, play important but different characters in affecting the fluctuations of the real effective exchange rate for different economies. One common feature of these studies is that they examined the effects of heterogeneous shocks on real effective exchange rate fluctuations within the framework of linear models.

However, while investigating the time series properties of the real effective exchange rate fluctuations, Sercu et al. (1995), Michael et al. (1997), Peel and Speight (1997), Taylor and Peel (2000), Taylor et al. (2001), Sollis et al. (2002), Chortareas et al. (2002), Kilian and Taylor (2003), Maican and Sweeney (2013), Zhou and Kutan (2014), Soon et al. (2015), Kutan and Zhou (2015), Lo and Morley (2015), Jiang et al. (2016) consistently suggest that the time series behavior of the real effective exchange rate is nonlinear. In particular, nonlinearity in conditional mean and nonlinearity in conditional variance have been identified for different economies. Thus, it is important to employ nonlinear models to investigate the time series behavior of the real effective exchange rate fluctuations.

Furthermore, the nonlinear relationships between a specific shock and the real effective exchange rate as well as the asymmetric effects of a specific shock on the real effective exchange rate have been partially investigated. Ho and Huang (2015) established a nonlinear relationship between the stock indexes and the exchange rate using data from Brazil, Russia, India, and China. Mensi et al. (2015), Ferraro et al. (2015), and Basher et al. (2016) not only show the nonlinear relationship between oil price

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and the exchange rate, but also provide evidence of significant asymmetric volatility spillovers between oil price and the exchange rate. Balcilar et al. (2015) demonstrated the nonlinear relationship among oil price, precious metal price, and the exchange rate. One common feature of these investigations is that they concentrate on examining the relationship between one specific shock and the real effective exchange rate, thus the relationship between the general shock and the real effective exchange rate is overlooked.

To bridge these gaps, this paper not only employs both linear model and nonlinear model to examine the sources as well as the time series behavior of the real effective exchange rate fluctuations, but also investigates the asymmetric effects of general shocks on the real effective exchange rate. In addition, this paper employs a sample of data from the Republic of Korea to conduct our investigations because: On the one hand, the real effective exchange rate of Korea has experienced substantial fluctuations since the early 1970s (Nam and Kim, 1999; Chen and Wu, 1997), as shown in Fig. 1. Understanding the sources of these fluctuations is very important not only for achieving desirable exchange rate stabilization, but also for improving the theories about exchange rate determination and evolution. On the other hand, although lots of studies examine the issue of real effective exchange rate fluctuations in many economies (e.g., Chen and MacDonald, 2014; Valcarcel, 2013; Erjavec et al., 2012; Wang, 2005; Ahmed, 2003; Dibooglu and Kutan, 2001), there is no systematic study that examines similar issues for the republic of Korea, which is a very important economy in Asia.

Therefore, the main target of this paper is to rigorously investigate the sources of the real effective exchange rate fluctuations in Korea and identify the shock that fundamentally drives the volatility of the real effective exchange rate. Moreover, this paper also tries to explore the time series properties of the Korean real effective exchange rate. In addition, this study attempts to evaluate the asymmetric effects of heterogeneous shocks on the real effective exchange rate and compare the results with existing studies.

The structural vector autoregressive (SVAR) model is used to explore the sources of real exchange rate fluctuations in Korea. Through imposing the long-run restrictions following Clarida and Gali (1994) and Blanchard and Quah (1989), three categories of macroeconomic shocks, i.e., supply shock, demand shock, and nominal shock, are well identified. The variance decomposition and historical decomposition are conducted to assess the effects of these three types of shocks on real effective exchange rate fluctuations. Moreover, an exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model is employed to characterize the time series properties of the real effective exchange rate and investigate the asymmetric impacts of heterogeneous shocks on the conditional volatility of real effective exchange rate.

The results of variance decomposition demonstrate that demand shock is the fundamental determinant of the real effective exchange rate fluctuations, where about 90% of the volatilities in real exchanged rate is attributed to demand shock. Supply shock explains about 9.10% of the real effective exchange rate fluctuations. Nominal shock plays a negligible character, and only 0.74% of the real exchange rate fluctuations is due to nominal shock.

In addition, the historical decomposition shows similar results to those of the variance decomposition. Specifically, in our sample period, demand shock plays the most important character in explaining the real effective exchange rate fluctuations, followed by supply shock, and then nominal shock. Moreover, the contributions of supply shock, demand shock, and nominal shock to the fluctuations of the real effective exchange rates are time-varying, which implies that it is very important to consider the effect of time as well as the sample period under investigation when evaluating the relative importance of different structural shocks.

The EGARCH model is adopted to characterize the time series behavior of the real effective exchange rate and detect the leverage effect for the Korean economy, i.e., the negative correlation between the changes in real effective exchange rate and the conditional volatility of real effective exchange. The investigation reveals that the conditional variance of real effective exchange rate is time varying. Moreover, the asymmetric effects of positive shock and negative shock on the conditional volatility of the real effective exchange rate are identified from the estimated EGARCH model.

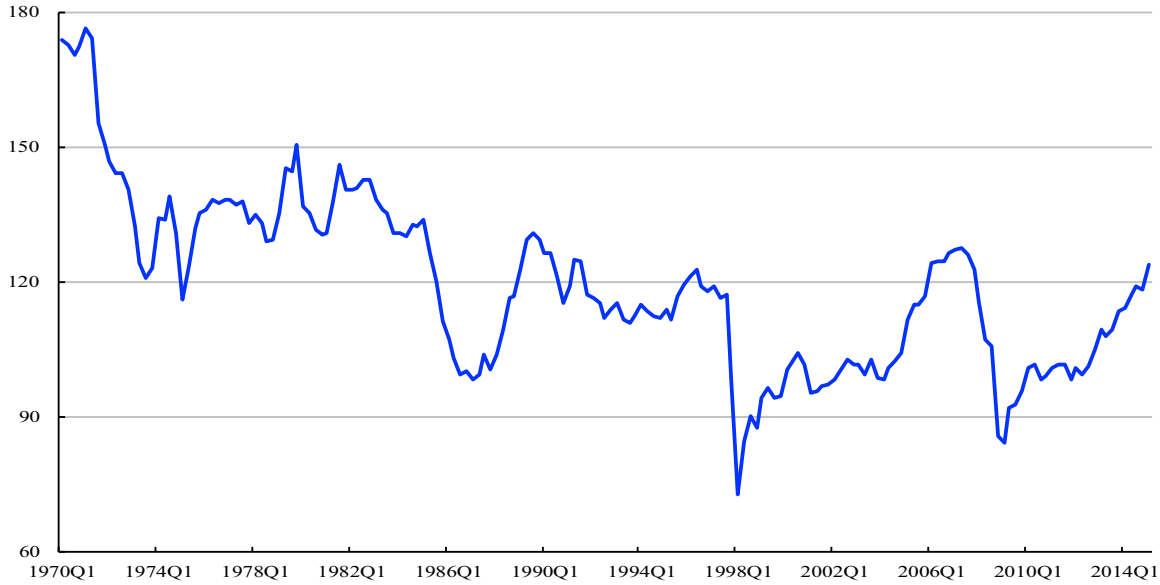

Fig. 1. The Real Effective Exchange Rate of Korea: 1970Q1–2015Q1.
Notes: (1) The quarterly real effective exchange rates are calculated by the authors according to the monthly data estimated by the Bank for International Settlements (BIS); (2) The original monthly real effective exchange rates are weighted averages of bilateral exchange rates adjusted by relative consumer prices; (3) The raw data could be accessed through the official webpage: http://www.bis.org/statistics/eer.htm