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The EU real exchange rates: A structural Bayesian VAR. A note.

Los tipos de cambio reales de la UE: Un VAR bayesiano estructural. Una nota.

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Abstract

In this paper we contribute to the long literature on the real exchange determination by estimating a Bayesian structural vector autoregressive model. We aim at identifying the effect on the EU-28 RER of shock originating in its main fundamental variables, namely, current account, government consumptions, investment and real income. We find in most of the shocks that the RER moves away for long periods, proving yet again, that the purchasing power parity condition is rarely fulfilled empirically.

Key words: Real exchange rates, competitiveness, Bayesian, European integration.

JEL code: C22, F15.

Resumen

En este trabajo se contribuye a la larga literatura sobre la determinación del intercambio real mediante la estimación de un modelo autorregresivo del vector estructural bayesiano. Nuestro objetivo es identificar el efecto en

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la TRE de la UE-28 de los shocks originados en sus principales variables fundamentales, a saber, cuenta corriente, consumos del gobierno, inversión e ingresos reales. Encontramos en la mayoría de las perturbaciones que la TRE se aleja durante largos períodos, lo que demuestra una vez más, que la condición de paridad de poder adquisitivo rara vez se cumple empíricamente.

Palabras clave: Tipos de cambio reales, competitividad, bayesiano, integración europea.

Código JEL: C22, F15.

I. INTRODUCTION

Purchasing power parity (PPP) has probably been one of the most studied hypotheses in international macroeconomics since the monks of Salamanca introduced the concept. The main reason is that the fulfilment of the PPP hypothesis can be seen as a measure of economic integration (Wei and Parsley 1995).

Although it is proposed that the PPP is a long run equilibrium theory (Taylor, 2002) there is a vast literature on the empirical analysis of the PPP theory, with disappointing conclusions: only when some assumptions are relaxed, one can find some evidence on its empirical fulfilment. (See Cuestas 2009, and the references therein, amongst many others).

Given these results, in this note we focus on the analysis of the long run determinants of the real exchange rate (RER) for a group of European Union (EU) countries. The idea is to find which variables may be driving the RER from its long run equilibrium. This is of particular importance given that the RER can be also understood as a measure of competitiveness since it measures the ratio of home to foreign prices measured in common currency. In addition, for the Economic and Monetary Union (EMU) countries, is also of strategic importance given that they cannot use the exchange rate policy to enhance their competitiveness. Let's recall that the main trading partners of EU countries are other EU countries.

In this paper we analyse the relationship between the RERs of the EU28 and some of their main fundamentals, by means of estimating a structural Bayesian vector autoregressive model. The EU28 consists of several different countries with different degrees of economic integration and development (Cunado 2011). As shown in Figure 1 the *mainland* EU countries do not show any clear pattern of appreciation or depreciation, however it is quite clear the effect of the 2008-onwards crisis (Cuestas, et al. 2014). The RERs of the central and eastern European countries (CEECs) meanwhile show a clear upward trend until 2008.

All the member estates except Czechia and Croatia must fulfil the Euro Plus Pact and the Macroeconomic Imbalance Procedure of the Six Pack which, amongst other measures, target competitiveness. Hence, the importance of its analysis.

Given that it has been established by the previous literature that RERs are not stationary in the EU, we analyse the relationship between the RER (q) and its main fundamentals, which are current account as a proportion of gross domestic product (GDP) (ca); real government consumption (gco); real gross fixed capital formation as a proxy for investment ($gfcf$) and real GDP (y).[1] In order to avoid the problem of I(1) variables (Sims 1988) we estimate vector autoregressive models (VARs) using Bayesian methods.

The remainder of the paper is organised as follows. In section 2, the econometric model. In section 3, we present the data and the results and finally, the last section summarises the main conclusions.

II. The modelling

Our model builds upon the long-run equation proposed by Berg and Miao (2010), Vieira and MacDonald (2012) and Comunale (2017).[2]

Our equilibrium RER specification is as follows:

1.There may be other importance variables such as the terms of trade in determining the RER, Neary (1988), Amano and van Norden (1995 and 1998), and Benigno and Thoneissen (2003) among others, however, to keep the estimated model parsimonius they have not been included.

2. The starting point of theoretical models are the models developed by Obstfeld and Rogoff (1995) and Frenkel and Razin (1996).

$$q_{ti} = c + \beta_1 ca_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 y_{ti} + \varepsilon_{ti} \qquad (1)$$

where *ca* is the current account, *gco* is government consumption, *gfcf* is gross fixed capital formation, and *y* is national real income. It is difficult to establish a priori expected signs for all the coefficients, as in many cases the sign depends on whether the tradeable or the non-tradeable sector dominates.

As aforementioned, we use Bayesian structural VAR (BSVAR) techniques to estimate the models and we treat them all as endogenous. These models are based on the estimation of structural vector autoregressive (SVAR) models such as:

$$\delta_0 Y_t = \delta(L) Y_t + \varepsilon_t \qquad (2)$$

where δ_0 is the matrix of contemporaneous parameters, δ is a matrix of coefficients for the lagged variables, and L is the lag operator in polynomial form. As δ_0 cannot be identified, we use Pesaran and Shin (1998) method which allow us to estimate generalised impulse response functions and eases our task since an ordering is not required.

We estimate equation (2) using Bayesian methods to obtain

$$\pi(\partial|Y) \propto f(Y|\partial)\pi(\partial) \qquad (3)$$

where ∂ is a vector of coefficients, $\pi(\partial \mid Y)$ is the posterior distribution conditional on the sample *Y*, $f(Y|\partial)$ is the likelihood function, and $\pi(\partial)$ is the prior distribution about the parameters. Bayesian methods have several advantages compared with frequentist methods, as they use a set of information that is enriched by priors. We use the Normal-Wishart (NW) prior, which is fairly common in the literature and is based on the Minnesota prior by Litterman (1986). The variance of the parameters is calculated as:

$$\sigma^2_{\delta_{ii}} = \left(\frac{\lambda_1}{l^{\lambda_3}}\right)^2 \qquad (4)$$

$$\sigma^2_{\delta_{ij}} = \left(\frac{\sigma_i^2}{\sigma_j^2}\right)\left(\frac{\lambda_1 \lambda_2}{l^{\lambda_3}}\right) \qquad (5)$$

with $\lambda_1 = 0.1$, $\lambda_2 = 1$ and $\lambda_3 = 1$.

III. Empirical analysis

The data consists of the log of the real effective exchange rate using the consumer price index for the 37 main industrial-country trading partners with an increase indicating an appreciation in real terms, q; the current account as proportion of the GDP, ca; the log of real government consumption, *gco*; the log of real gross fixed capital formation, *gfcf*, and the log of real GDP, *y* for our target EU28 countries. The data has been obtained from *Eurostat* and runs from 1995-2017 in quarterly observations. The model is estimated as an unbalanced panel for the 28 EU countries, since some observations were missing in a few cases.

All the models include three centred seasonal dummies to account for seasonal effects in the variables and individual fixed effects.

In Figure 2 we display the posterior distributions for the impulse-response functions (IRF) based on a BSVAR with two lags. Since our interest is to assess the effect of the RER main fundamentals we only show the IRF of shocks on the RER fundamentals.

We observe that the RER reacts positively in the contemporaneous period to a current account shock but then it depreciates with long lasting effects (Gil-Alana et al. 2008). Since the positive shock on the current account may be related to capital outflows it shows how the demand and supply of currency correct the increase in supply of home currency as a results of capital outflows.

The effect of a government consumption shock is overall negative, after some over shooting at the beginning. This first swings may be related to the uncertainty generated by an expansionary fiscal policy, which at the end depreciates the currency in real terms.

Investment seems to have an overall positive impact on the real exchange rate, since after a couple of quarters it appreciates having long lasting effects. This probably has to do with an increase in internal demand which may have increase the prices of non-tradeable goods, hence, appreciating the currency.

A positive shock on real income seems to have similar results than a shock on investment. We observe that the real exchange rate appreciates after two quarters. Again this mimics an aggregate demand shock, which causes an increase in internal prices and hence an appreciation of the exchange rate in real terms.

Finally, in the appendix we present the distributions of the IRFs, since when using Bayesian techniques we cannot talk about confidence intervals.

IV. CONCLUSION

In this paper we have aimed to analyse how shocks originating in a set of RER fundamentals affect this variable for a group of EU countries. Using an unbalanced panel for quarterly data 1995-2017 we have estimated BSVAR in a panel set up.

We find that in general the reaction of RER to shocks originating in its main fundamentals seem to have an aggregate demand origin, as the RER tends to appreciate in most cases.

As avenues for future research we propose to analyse the central and eastern European countries and the rest separately, and account for structural breaks caused by the Great Recession of 2008 onwards.

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Figure 1. RER EU28

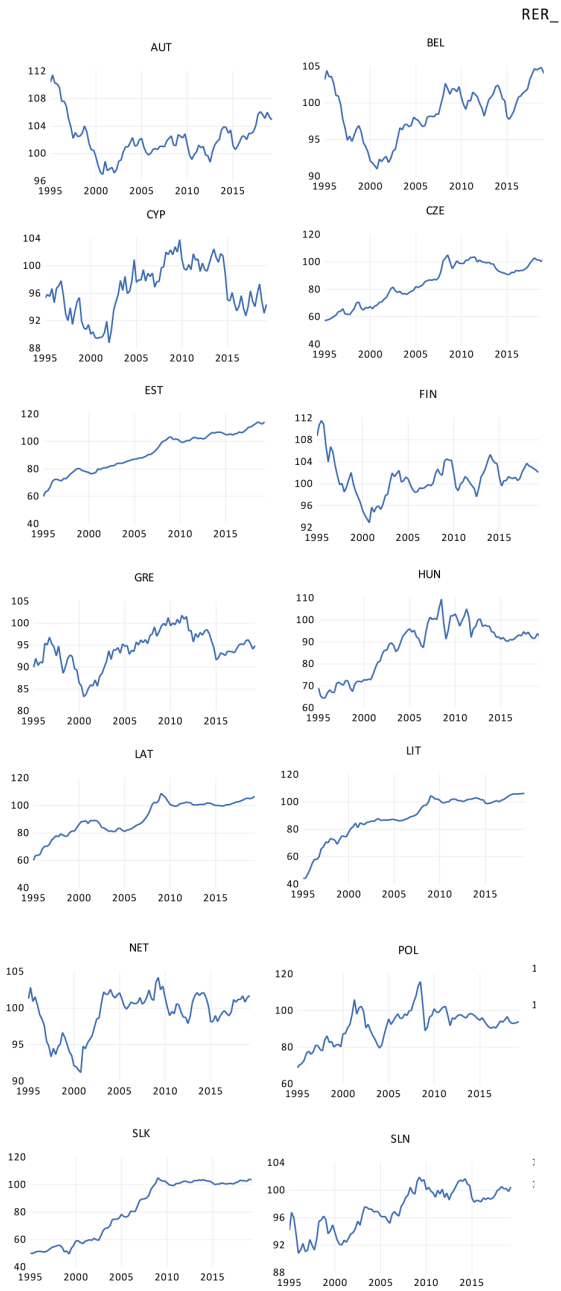


Figure 1. RER EU28 (cont.)

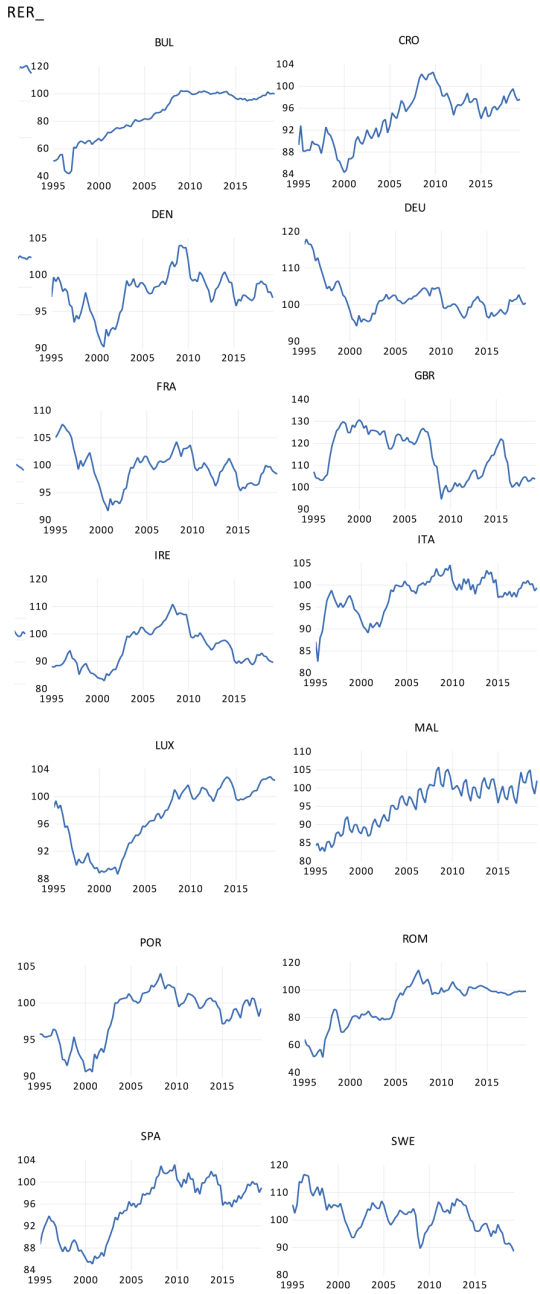


Figure 2 (a). IRFs. Response to Generalized One S.D. Innovations
Response of LRER to CA

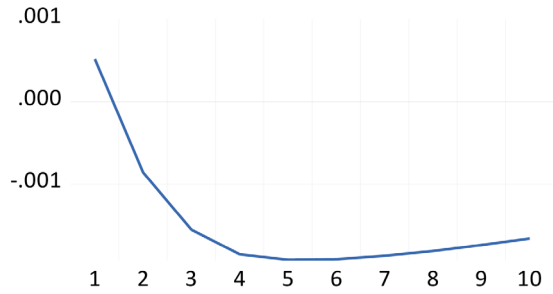


Figure 2 (b). IRFs. Response to Generalized One S.D. Innovations
Response of LRER to LGCO

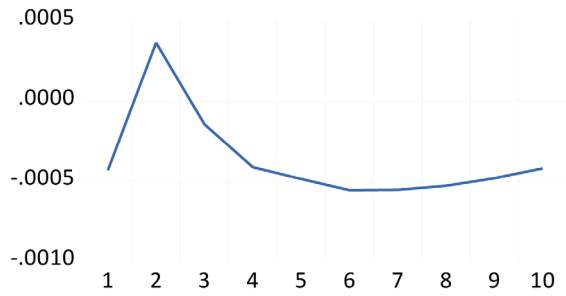


Figure 2 (c). IRFs. Response to Generalized One S.D. Innovations
Response of LRER to LGFCF

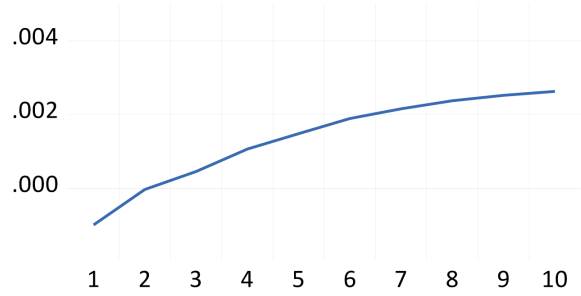
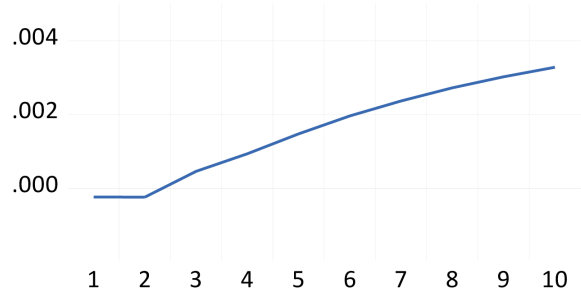
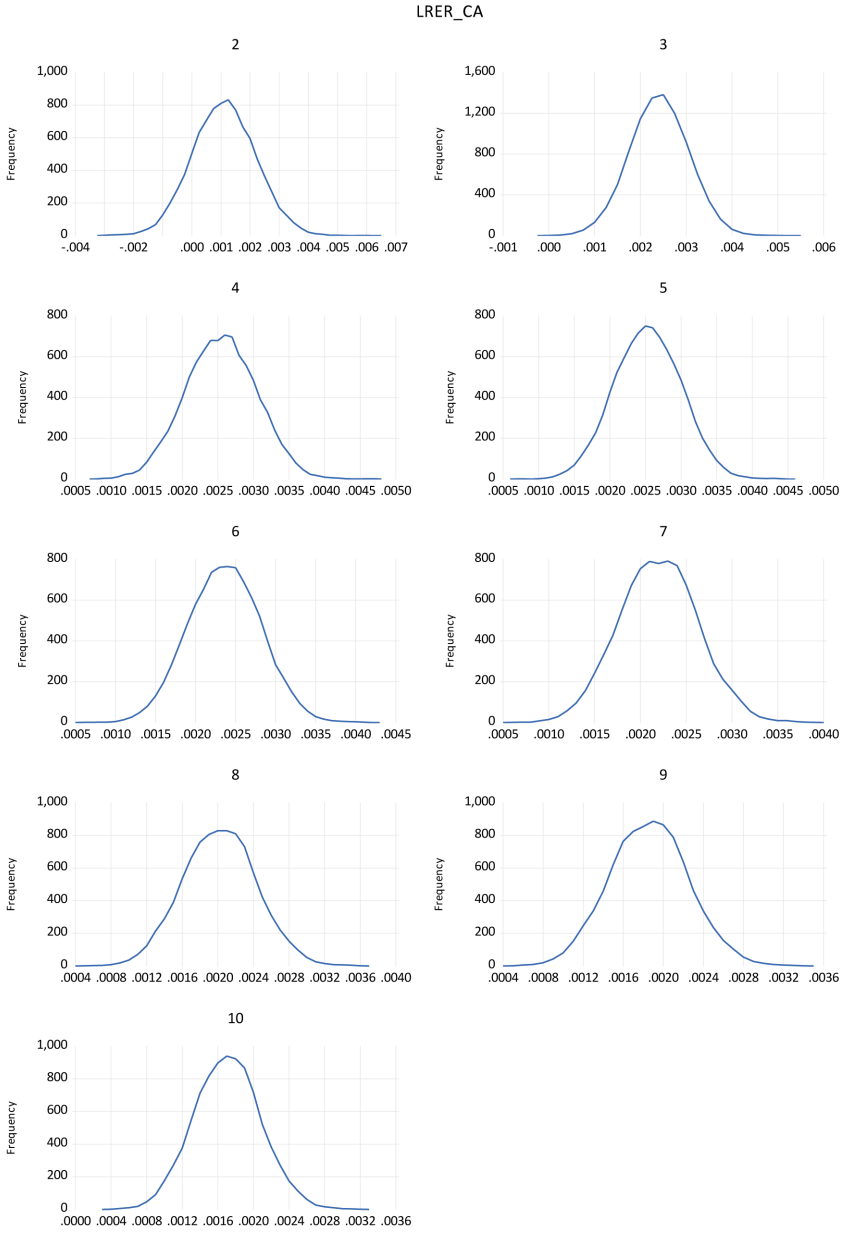
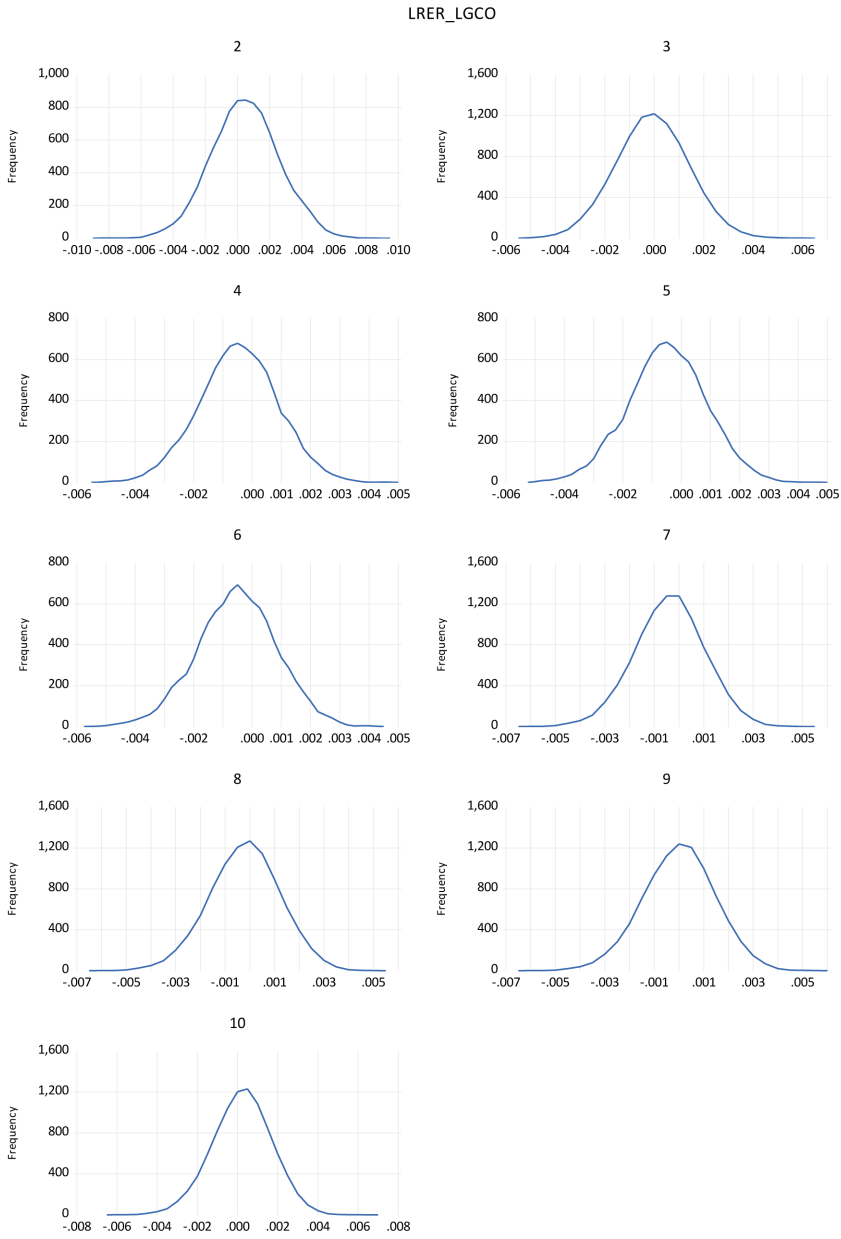


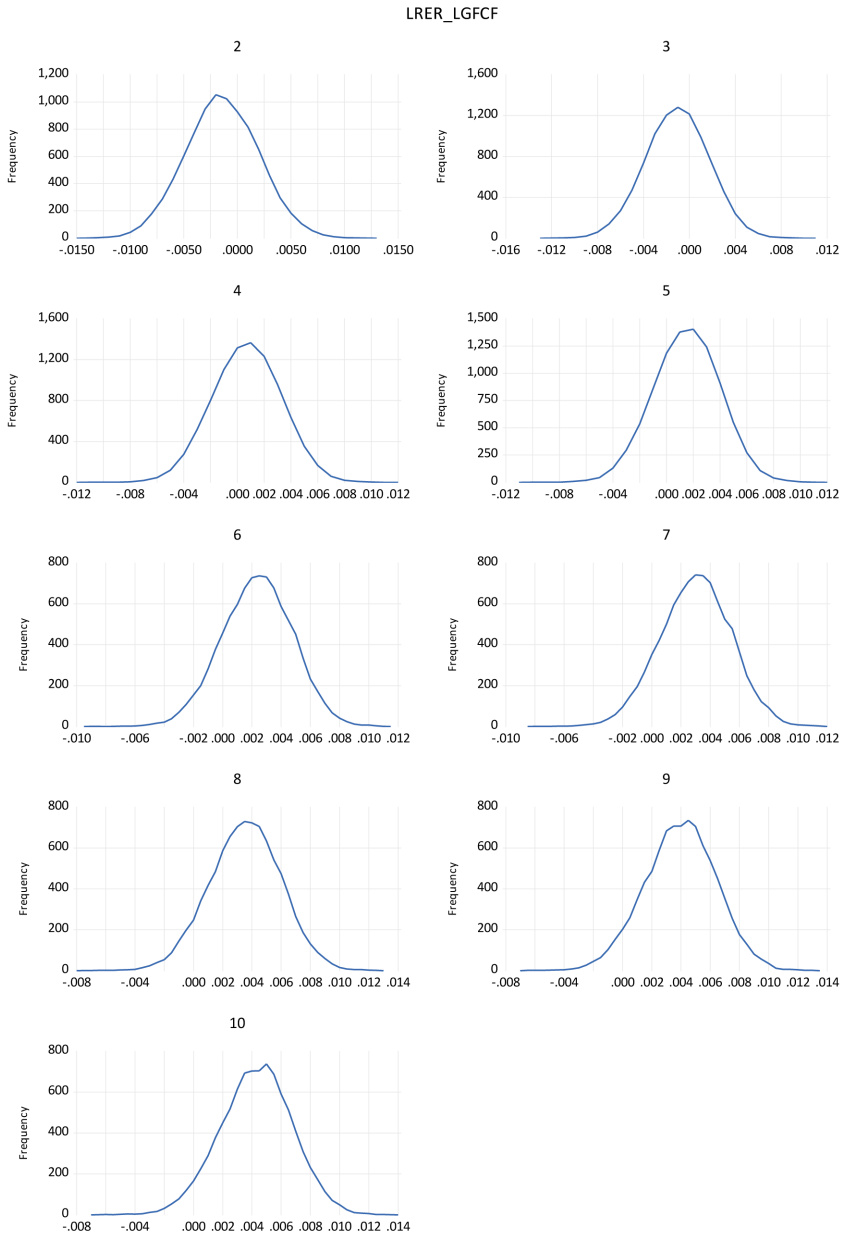
Figure 2 (d). IRFs. Response to Generalized One S.D. Innovations
Response of LRER to LY



Appendix: IRFs' posterior distributions




LRER_LGCO
2
3
4
5
6
7
8
9
10
Frequency


LRER_LGFCF
2
Frequency
1,200
1,000
800
600
400
200
0
-.0150 -.0100 -.0050 .0000 .0050 .0100 .0150
3
Frequency
1,600
1,200
800
400
0
-.016 -.012 -.008 -.004 .000 .004 .008 .012
4
Frequency
1,600
1,200
800
400
0
-.012 -.008 -.004 .000 .002 .004 .006 .008 .010 .012
5
Frequency
1,500
1,250
1,000
750
500
250
0
-.012 -.008 -.004 .000 .002 .004 .006 .008 .010 .012
6
Frequency
800
600
400
200
0
-.010 -.006 -.002 .000 .002 .004 .006 .008 .010 .012
7
Frequency
800
600
400
200
0
-.010 -.006 -.002 .000 .002 .004 .006 .008 .010 .012
8
Frequency
800
600
400
200
0
-.008 -.004 .000 .002 .004 .006 .008 .010 .012 .014
9
Frequency
800
600
400
200
0
-.008 -.004 .000 .002 .004 .006 .008 .010 .012 .014
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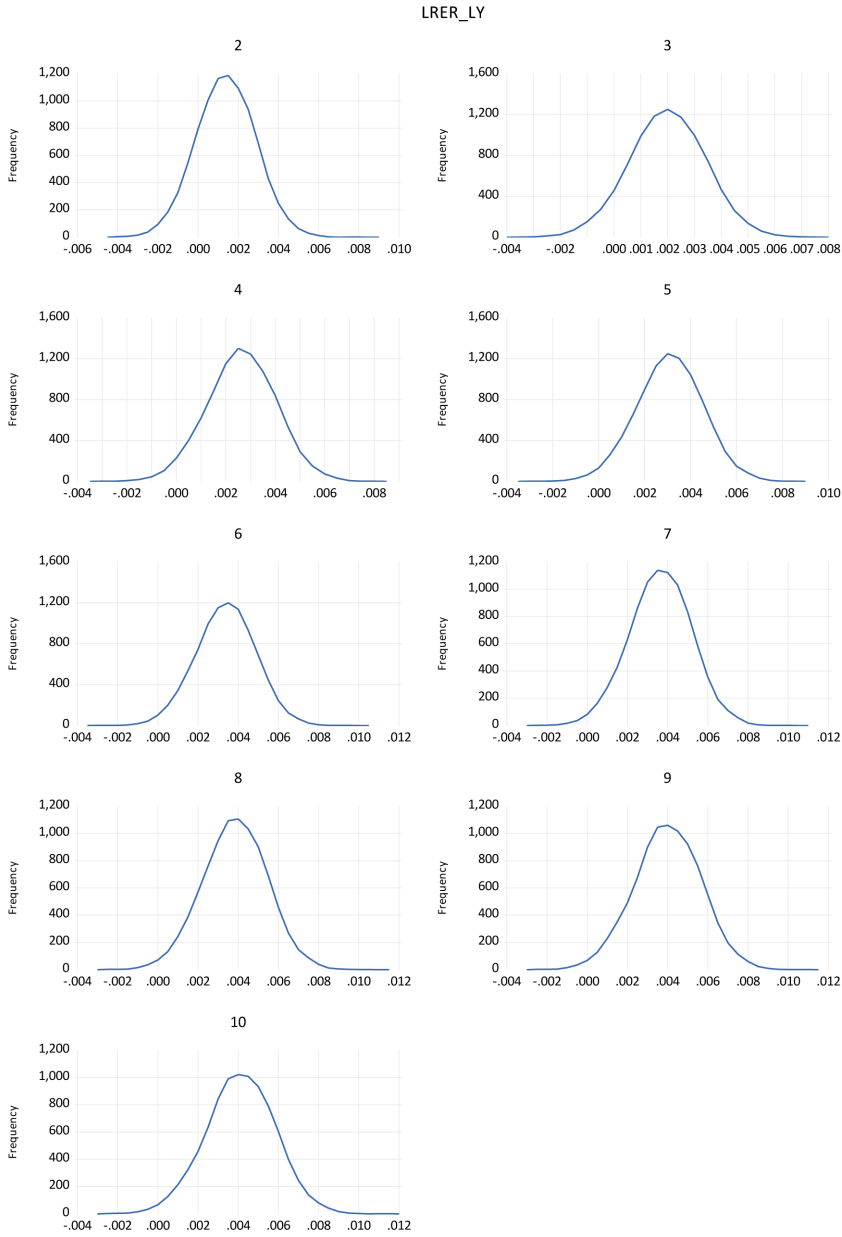
-.008 -.004 .000 .002 .004 .006 .008 .010 .012 .014


LRER_LY
2
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Frequency