Exchange Rate Impact on Russia's Exports: Some Evidence from an Evolutionary Co-spectral Analysis

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Abstract

The core focus of this paper is to analyze the dynamic interactions between changes in exchange rate (nominal and real terms) and exports to GDP ratio in Russia. To this end, we apply a new approach based on a time varying dynamic coherence function, called, evolutionary co-spectral analysis. Our results put in evidence that coherence pattern differs over time, suggesting that nonlinearities are an important issue when assessing the focal relationship. These observed outcomes change substantially in terms of magnitude when subtracting energy, while differential price stills the major player. We can attribute these findings to the limited effectiveness of exchange rate policy and the inefficiency of sterilization coupled with a lack of competitiveness of banking sector.

Keywords: Exchange rate; exports; time varying dynamic coherence function; Russia.

1. Introduction

Since the breakdown of the Bretton Woods system of fixed exchange rates, questions of the relative importance of exchange rate uncertainty in explaining exports performance still have no widely convincing answers. Despite the huge amount of empirical research on this field, neither the theoretical nor the empirical literature finds a firm evidence with respect to sign. A large stream of literature supported a negative and significant effect of exchange rate volatility on exports (Savvides (1992), Kroner and Lastrapes (1993), Arize, (1997)). Few studies showed that higher exchange rate instability can enhance international trade flows (Assery and Peel (1991), Kiheung and Wooree (1996) and McKenzie and Brooks (1997)). Still other strand of literature reached conclusion suggesting an ambiguous relationship between exchange rate uncertainty and exports (Daly (1998), McKenzie (1998), Egert and Zumaquero (2007) and Bouoiyour and Selmi (2014 a)).

Given the inconclusive results, Coric and Pugh (2010) tackle the issue by meta-analyzing the empirical results of studies published between 1978 and 2003). Using meta-regression analysis, they show that the effect of exchange instability on trade is likely to be adverse when measured in real rather than nominal term and when less developed rather than developing countries are considered, and add that the results of various alternative measures are not robust across models. Based on these outcomes and in order to reach a one-sided conclusion, a new look at the relationship is needed. When reviewing the existing researches, it is striking to observe the absence of works that take into account the possible excess of co-movements between exchange rate variability and exports. There are also no studies that investigate the focal link in Russian case. Hence, we attempt to gauge empirically whether there is interdependence between exchange rate and exports in Russia and if it varies over time, using a time varying dynamic coherence approach extended by Ftiti (2010).

The structure of the article is as follows: In the next section, we update a brief overview of Russia's exchange rate and trade policies. Section 3 presents the empirical methodology. Section 4 reports the main results while the last section concludes and offers some channels whereby a volatile exchange rate may have controversial effects on exports.

2. Exchange rate policy and Russia' exports: Brief background

Since the dismantlement of the Soviet Union, the Russian economy has experienced several dramatic events. As a result, Russia's exchange rate policy has passed through three main regimes in order to mitigate possible detrimental effects, particularly on trade.

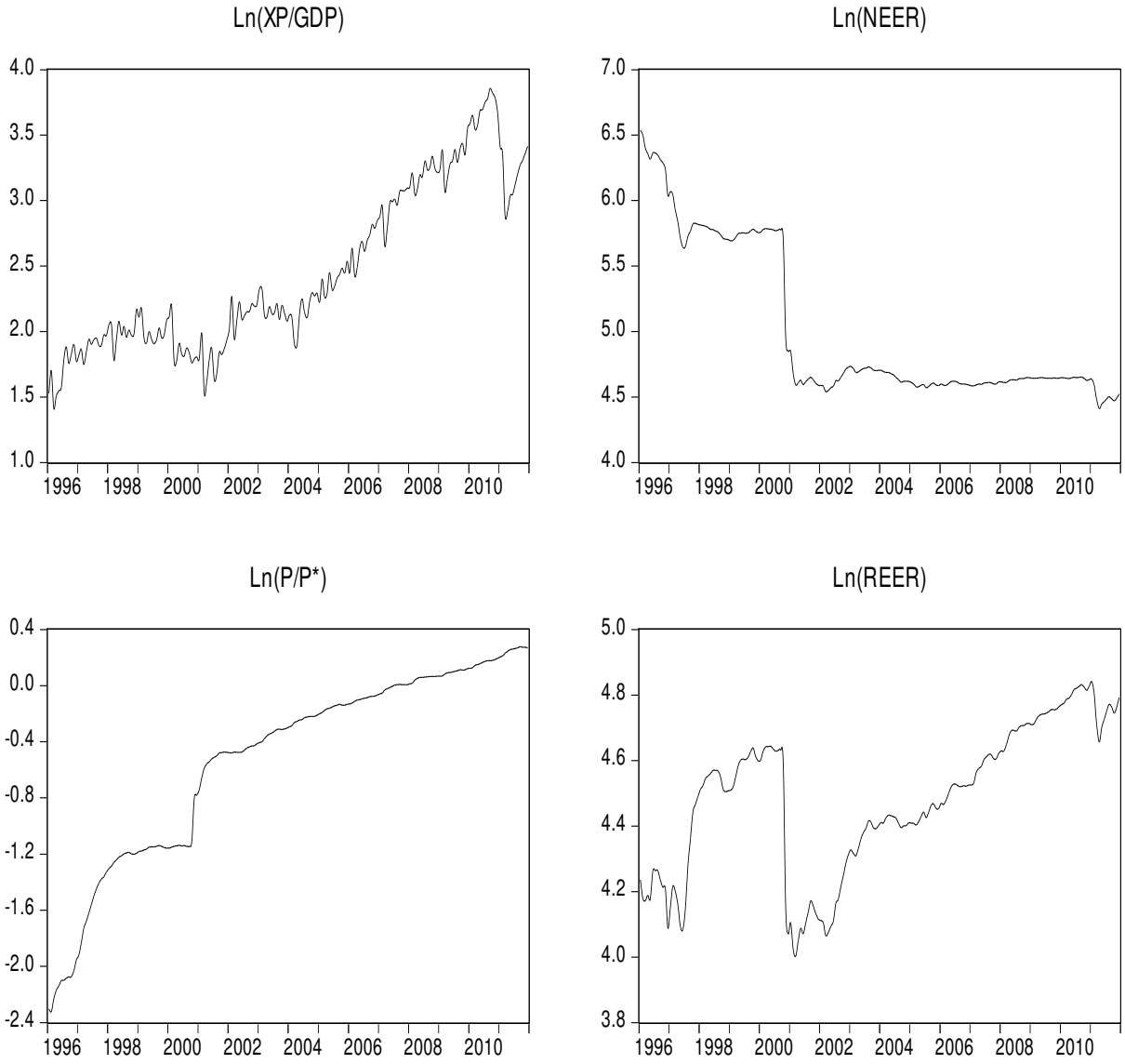
From 1992 to 1997, at which the exchange rate is based on stabilization program the exchange rate instability stills due to the authorities' use of macroeconomic policy as a direct instrument of social welfare provision (Granville and Mallick, 2006). In June 1995, the Central Bank of Russia (CBR) has consistently limited the flexibility of exchange rate by introducing the corridor system that allows the nominal exchange rate to move in a band, within upper and lower limits. In 1997, Russia began operating under a managed float exchange regime in order to keep the depreciation of its currency, especially with the aftermath of Asian crisis (Galkovskaya, 2011).

From the end of 1998 to 2005, the excessive volatile behavior of exchange rate and the positive boost from rising energy prices mainly attributed to the financial crisis of 1998 put the CBR in unfavorable position. In addition, the exchange market underwent 2001 events, leading to a sizeable depreciation of ruble in relation to the U.S. dollar. Fortunately, due to the fiscal discipline and the position of Russia as price taker in international oil market, the ruble remained tightly managed. However, in 2004, the ruble has undergone steady upward pressure owing to the less restrictive capital control regulations.

At the end of 2005 and in order to smooth the excessive volatility of ruble in relation to the major currencies, the CBR introduced a dual-currency basket. The basket composition was fixed at 55% for the US dollar and 45% for the euro. Despite this reform, the global financial crisis has led to a sharp decline in oil prices affecting greatly the current account balance putting then the ruble under downward pressure. In response, Russian monetary authorities changed the exchange rate policy focus towards increasing the flexibility of ruble. This can be an automatic buffer against external shocks.

Figure 1 confirms all the above descriptions. It is well seen that exchange rate has fluctuated widely from 1996 to 2011 either in nominal (differential price (P/P^*) and nominal effective exchange rate (*NEER*)) or in real terms (real effective exchange rate (*REER*)). The policy adopted from mid-2008 has helped to reduce the volatile behavior of nominal exchange rate. In response, exports to GDP have exhibited a sharp instability over the period under consideration. The slight variability clearly observed from 1996 to 2004 has evolved to continuous increase from 2005 to 2011 with a worthy remarkable drop in the end of 2010.

Figure 1. Evolution of exports to GDP ratio and exchange rates



Source: Econstats and International Monetary Fund.

3. Methodology: An evolutionary co-spectral analysis

While such analyses clearly illustrate the implications of excessive exchange rate uncertainty, they do not tell us a lot about the complex relationship between the exchange rate instability and exports performance. Turning to the choice of an adequate framework, our methodology consists on applying evolutionary co-spectral analysis to assess the time varying coherence dynamic between changes in exchange rate and exports to GDP ratio.

The evolutionary co-spectral function is developed recently by Ftiti (2010). It presents an extension of Priestley and Tong (1973). This method allows us to distinguish between short-run, medium-run and long-run dependence between the considered variables. With this new extension, we can differentiate between time periods for decision making and approximate structural changes that can happen over time. In this study, we assess three pair series in a discrete framework, which are respectively changes in nominal exchange rate and the logarithm of exports to GDP ratio, differential price returns and the logarithm of (*XP/GDP)* and changes in real exchange rate and the logarithm of (*XP/GDP)*. To do so, we used monthly data for the period from 1996 to the 2011[1] collected from Econstats™ and International Monetary Fund.

$$r_{NEER_t} = \ln(NEER_t / NEER_{t-1}) \quad (1)$$

Where r_{NEER_t} is the return of nominal exchange rate. We measure the nominal effective exchange rate with nominal parities.

$$r_{(P/P^*)_t} = \ln\left((P/P^*)_t /(P/P^*)_{t-1}\right) \quad (2)$$

Where $r_{(P/P^*)_t}$ is the return of the differential between the national price and the foreign price.

$$r_{REER_t} = \ln(REER_t / REER_{t-1}) \quad (3)$$

[1] The time horizon depends on data availability.

Where r_{REER_t} is the return of real effective exchange rate, which is constructed by dividing the trade-weighted foreign price level index by the corresponding domestic price level index, after prior conversion to a common numeraire using nominal exchange rate.

$$REER_t = NEER_t \times (P / P^*)_t \tag{4}$$

The procedure of the co-spectral approach can be explained precisely by considering a bivariate continuous parameter process $\{X(t), Y(t)\}$, in which each component is an oscillatory process (Priestley and Tong, 1973). Thus, component can be expressed as follows:

$$X(t) = \int_{-\infty}^{+\infty} A_t(w_1) e^{iwt} dZ_x(w_1) \tag{5}$$

$$Y(t) = \int_{-\infty}^{+\infty} A_{t,y}(w_2) e^{iwt} dZ_y(w_2) \tag{6}$$

$$E\left[dZ_x(w_1) dZ_x^*(w_2)\right] = E\left[dZ_y(w_1) dZ_y^*(w_2)\right]; w_1 = w_2 \tag{7}$$

$$E\left[dZ_x(w_1) dZ_y^*(w_1)\right] = d\mu_{xy}(w) \tag{8}$$

Where $(.)^*$ denotes the conjugal function of $(.)$.

Next, the authors consider F_x and F_y as the families of oscillatory functions:

$$F_x \equiv F_y \equiv \{e^{iwt}\} \tag{9}$$

Let $dH_{t,XY}(w)$ denotes a reduced definition of the cross-spectrum (Priestley, 1965). It can be written as follows:

$$dH_{t,XY}(w) = E\left[A_{t,X}(w) dZ_X(w) A_{t,Y}^*(w) dZ_Y^*(w)\right] \tag{10}$$

By virtue of the Caushy-Schwarz equality, we ultimately obtain:

$$\left|dH_{t,XY}(w)\right|^2 \le dH_{t,XX}(w) dH_{t,YY}(w) \tag{11}$$

Then and with respect to the Lebesgue measure, we can write for each *t*:

$$dH_{t,XY}(w) = h_{t,XY}(w) dw \tag{12}$$

Where $h_{t,XY}(w)dw$ is termed as the evolutionary co-spectral function.

As the estimation of the evolutionary co-spectral function needs filters, we extend the choice of Creti et al. (2013)'study by retaining three filters, reflecting respectively the short-term $(\pi/20)$, the medium-term $(4\pi/20)$ and the long-run interdependence $(10\pi/20)$.

Still the coherence function, which is defined as the modulus of the correlation coefficient between $dZ_X(w)$ and $dZ_Y(w)$, which is based essentially on the estimation of the co-spectral function between two process $\{X(t)\}$ and $\{Y(t)\}$.

$$C_{t,XY}(w) = \frac{\left|h_{t,XY}(w)\right|}{\left\{h_{t,XX}(w)h_{t,YY}(w)\right\}^{1/2}} \quad (13)$$

4. Main results

The paper attempts to provide a fresh look into the link between changes in exchange rates (nominal and real terms) and Russia's exports to GDP by assessing it over different and precise horizons. To do so, it seems appropriate to carry out an evolutionary co-spectral analysis for two main reasons: (i) given that the link between exchange rate instability and international trade may vary over time (Bouoiyour and Selmi, 2014 a), it seems interesting to explore whether the co-movements between these variables emerge in a given time frame (i.e. short, medium or long-run); (ii) the fact that there are changes in demand conditions and multiple commodity price regimes due to volatile supply (Bouoiyour and Selmi, 2014 b), it appears crucial to account for the time varying coherence between the concerned variables.

4.1. Preliminary analysis

To investigate the possible effects of exchange rate variability on exports to GDP ratio, we start by a descriptive analysis. The results are summarized in Table 1. We show that the mean of ln(*XP/GDP*) and *NEER* returns are positive and that of changes in (*P/P**) and *REER* returns are negative. All the variables are not highly dispersed from the mean as seen from the standard deviations. The time series under consideration are positively skewed, implying that the asymmetrical distribution is plausible (except (*P/P**) returns). The distribution of these variables is more flattened than the Gaussian distribution, since the coefficient of kurtosis appears superior to 3 (except ln(*XP/GDP*)). The Jarque- Bera statistics of concerned variables (except ln(*XP/GDP*)) reveal high values, indicating that the null hypothesis of normality cannot generally be upheld.

Table 1. Descriptive statistics

	ln (*XP/GDP*)	r_{NEER}	$r_{(P/P^*)}$	r_{REER}
Mean	2.443737	0.010446	-0.013407	-0.002961
Median	2.201105	0.000961	-0.006591	-0.004725
Maximum	3.857144	0.749659	0.020018	0.442058
Minimum	1.411231	-0.081671	-0.307602	-0.135902
Std. Dev.	0.629801	0.062946	0.028203	0.042518
Skewness	0.589835	8.822581	-6.624960	6.011560
Kurtosis	2.067322	101.0212	64.13263	64.74716
Jarque-Bera	18.09207	79356.02	31302.07	31658.13

4.2. Evolutionary co-spectral analysis

Our empirical assessment resulting from the co-spectral approach as computed from Equation (13) between exchange rate returns (*NEER*, (*P/P**) and *REER*) and the exports to GDP ratio are well depicted in Figures 2, 3 and 4. We clearly observe a time varying dynamic coherence between the pair time series under consideration. These graphs indicate a divergence between the short-run, the medium-run and the long-run interdependence.

4.2.1. Changes in nominal effective exchange rate and exports to GDP ratio

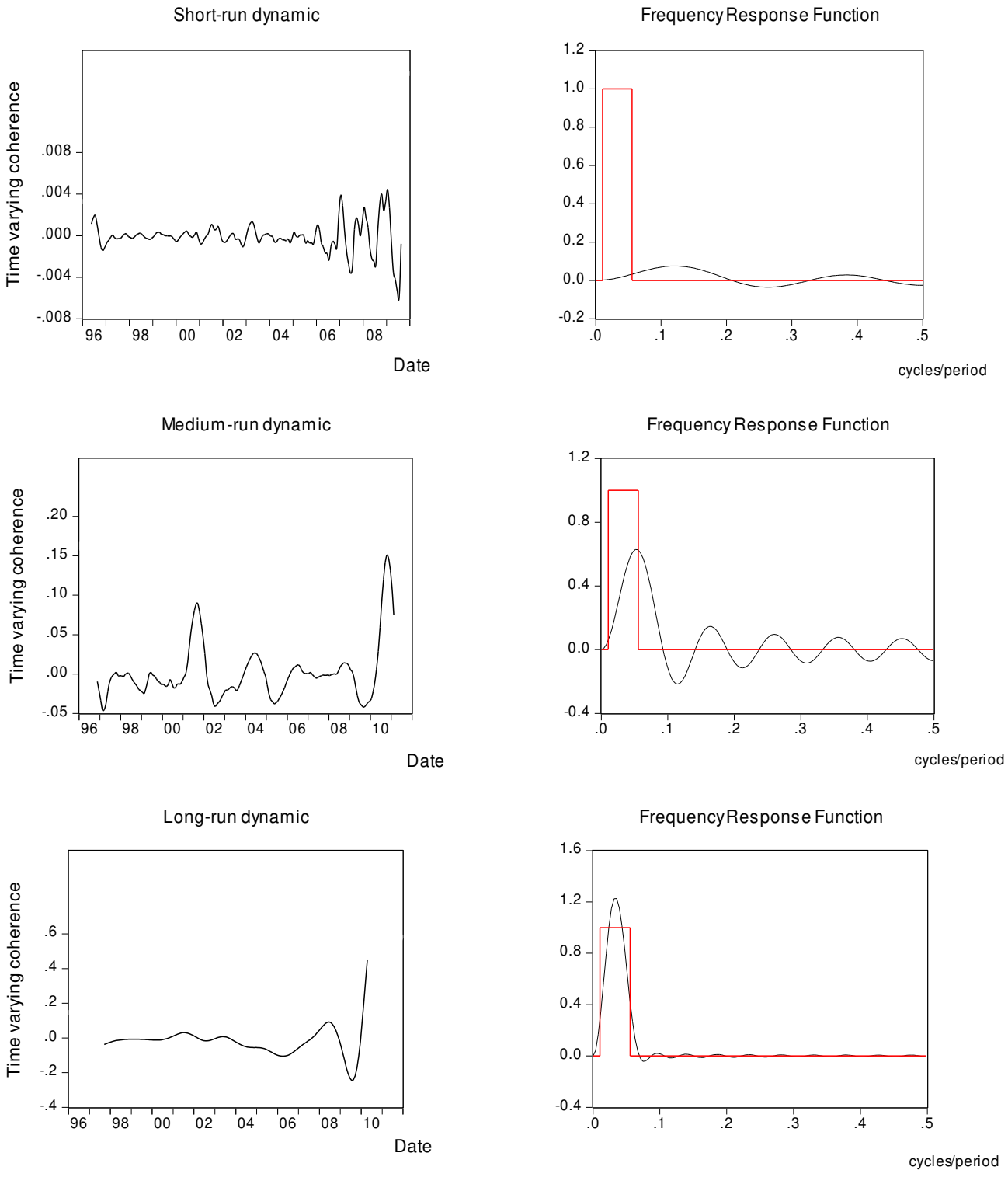
The relationship between changes in nominal effective exchange rate and exports to GDP appears minor in the short-run and stronger in the medium and the long-run (Figure 2). The interdependence does not exceed 0.5% in the short term, while in the medium and long terms, it reaches respectively 15% and 40% (right side of Figure 2). This implies that ratio exports to GDP react heavily to persistent changes in nominal exchange rate and weakly to transitory changes. It is also worthy notable that the dynamic interaction raises slightly after the Asian crisis and more intensely with the aftermath of the current financial crisis[2]. These last results may be owing to

[2] It seems important to note here that on the one hand the current crisis is very deep compared to the Asian crisis and 11 September 2001 event. On the other hand, the possible effects of the crisis, which began in 2008, continue to operate. It certainly takes more time to disappear.

the two respective factors. Firstly, after the Asian crisis, the Russian government worries about possible crisis of the ruble. To cope with this unfavorable situation, monetary authorities announced a package of measures including an increase in the official discount from 50% to 150 % and a devaluation of ruble by 32.8% (Beck and Barnard, 2009). This has mitigated the volatility of nominal exchange rate. Secondly, the recent financial crisis and the shift to more flexible exchange rate policy as response has been accompanied with limited monetary tools (Beckmann and Czudaj, 2013), sterilization of excess liquidity through deposit operations and increased dollarization sustaining the aggravation of exchange rate instability (Figure A.1, Appendix).

When subtracting energy's share from the total of exports, the considered variables become less interdependent over time (0.01% in the short-run, 0.02% in the medium-run and 0.04% in the long-run, Figure A.2, Appendix). Not surprisingly, being a country dependent on exports of raw materials – especially petroleum oil– Russia has to deal with significant exports uncertainty relating to commodity price developments in international markets (Laneila and Ponomarenko, 2012). Intuitively, in the absence of mature and competitive financial market and well developed banking system, the impact of Bank currency interventions and the exchange rate policy tools on exchange rate remain weak.

Figure 2. Time varying dynamic coherence between nominal effective exchange rate returns and exports to GDP ratio (ln(*XP/GDP*))



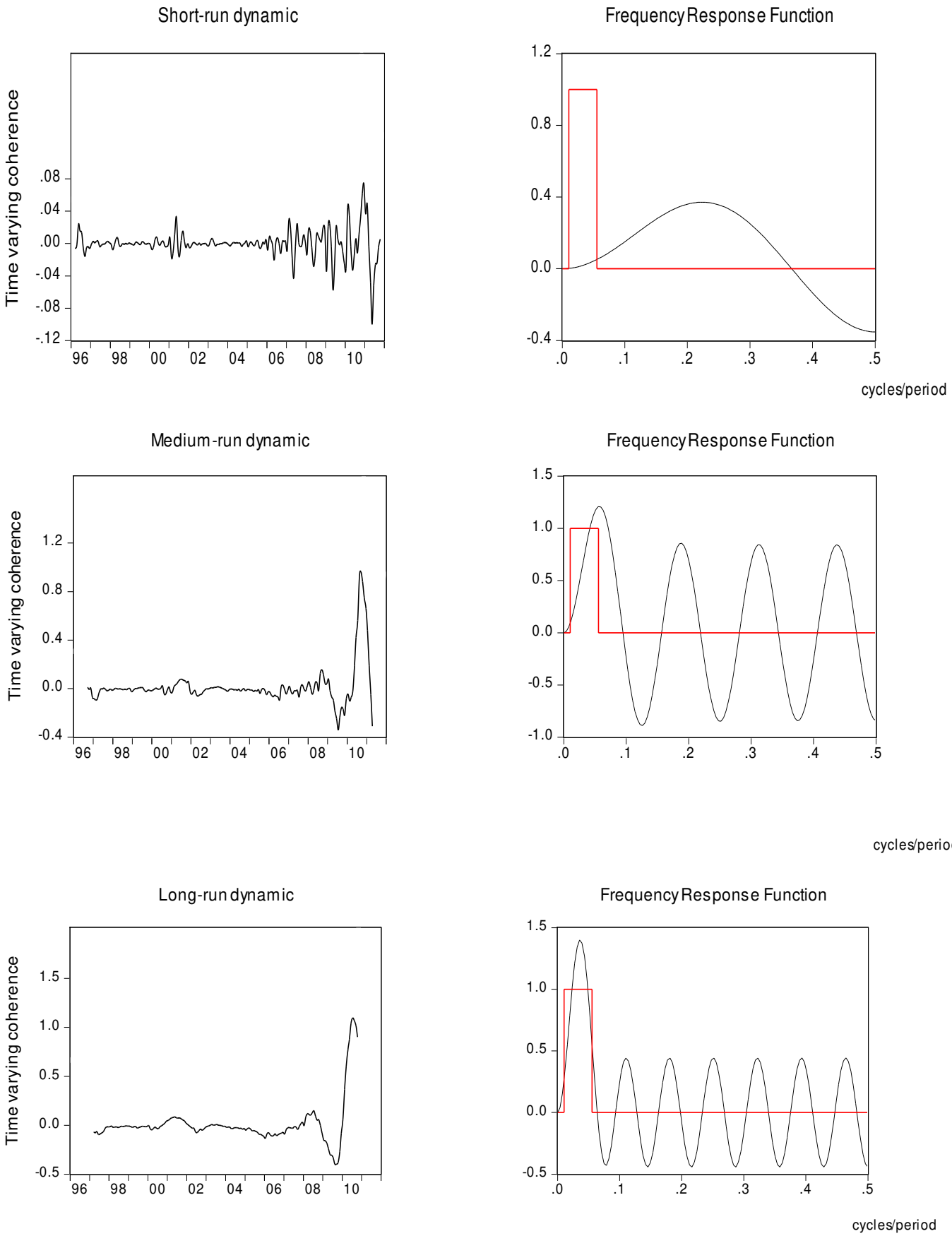
4.2.2. Changes in differential price and exports to GDP ratio

The coherence dynamic between changes in differential price and the ratio exports to GDP appears stronger in the long-run and much less important in the short-run (Figure 3). We observe that the time varying dynamic between (P/P^*) variability and exports seems more intense than that of the nominal exchange rate instability. We find that the short-run interdependence of changes in (P/P^*) and (*XP/GDP*) amounts 4% (Figure 3), while the interaction between changes in *NEER* and (*XP/GDP*) is about 0.5% (Figure 2). In the long-run, the effect of differential price returns becomes stronger compared to those of *NEER*, with respective percentages 90% and 40%. This implies that the adjustment in real exchange rate will come through changes in differential price more than those of nominal exchange rate. This may be mainly attributed to the lack of the effectiveness of CBR exchange rate policy. It is also well shown that the (P/P^*) is widely affected by persistent shocks, while the *NEER* is more impacted by transitory shocks.

In addition, when subtracting energy, the coherence dynamic between the two variables becomes much less strong (0.4% in the short-run, 0.6% in the medium-run and 0.3% in the long-run, Figure A.2, Appendix). This may be owing to the great oil dependency of Russia's trade (the share of oil in the total of exports is about 64.3%[3]) and to the occurrence of nonlinearities, which may stem from exogenous external shocks (Beckmann and Czudaj, 2013). Obviously, the energy market is a large market relative to other commodities and the assumption of financial speculation may be evident. The demand and supply shocks in the global oil market often entailed offsetting changes in oil inventories to reinforce then changes in oil prices, yielding to changes in differential prices, threatening then export performance (Alquist and Kilian, 2010).

[3] For more details about the composition of trade in Russia, see the Observatory of Economic Complexity : http://atlas.media.mit.edu/country/rus/

Figure 3. Time varying dynamic coherence between differential price returns and exports to GDP ratio (ln(*XP/GDP*))

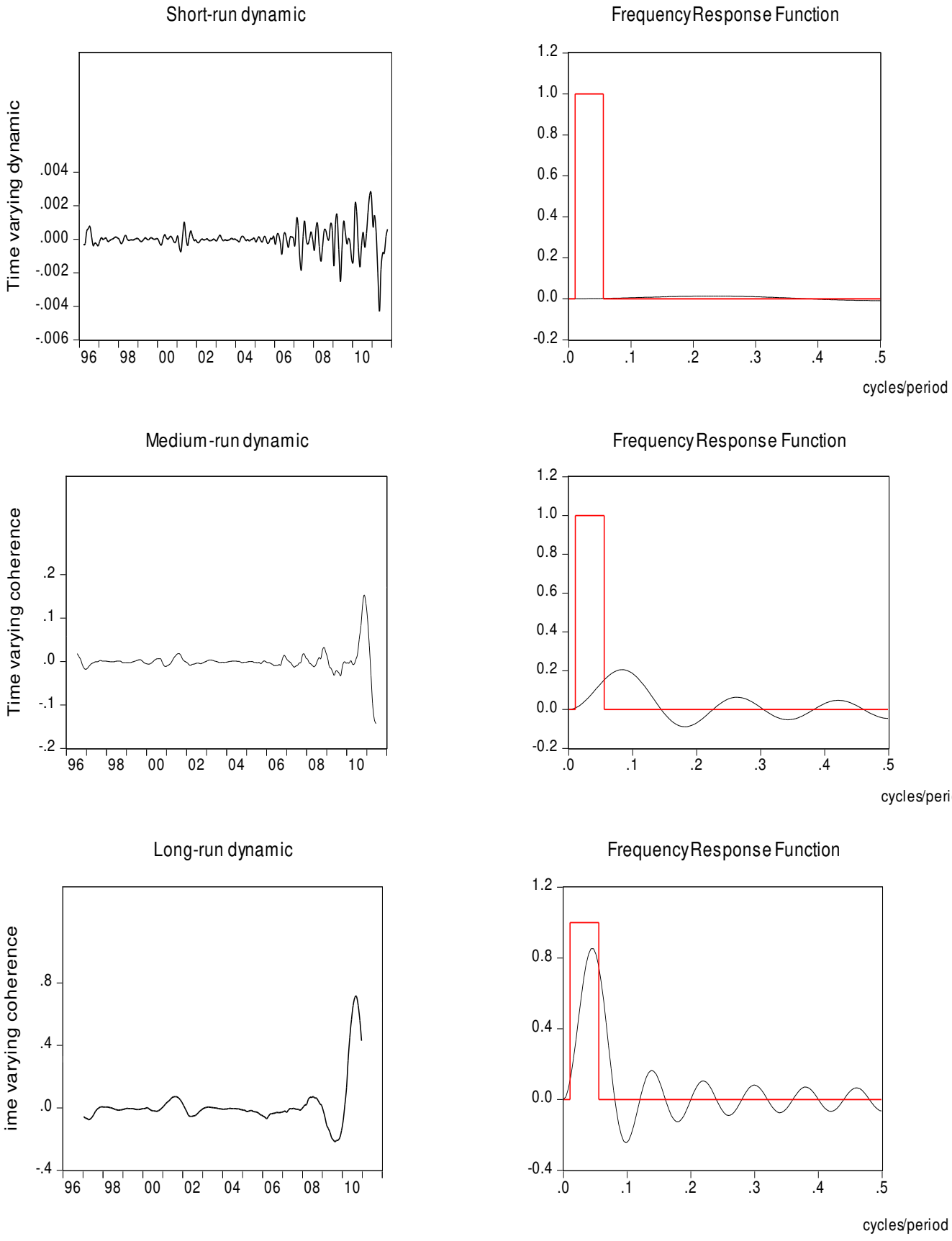


4.2.3. Changes in real effective exchange rate and exports to GDP ratio

Our results reported in Figure 4 reveal a high interdependence between real exchange rate returns and the ratio exports to GDP in the long-run, which amounts 80% compared to 0.3% in the short-run and 20% in the medium-run. Interestingly, from the response functions, we find that the *NEER* succeed to smooth the *REER* in the short term, while in the medium-run the smoothing appears less evident. Nevertheless, the shocks persist in the long-run even after 05 periods.

When subtracting energy's share, the degrees of interdependence between the studied variables decrease considerably in terms of magnitude (0.1% in the short-run, 0.3% in the medium-run and 0.2% in the long-run). At any case, we show that the nominal effective exchange rate succeed to smooth the real exchange rate in the short-run. This smoothing appears less obvious in the medium-run, while the shocks persist in the long-run (left side of Figure 4). It is also well seen that the effects of Asian crisis and September events are more visible than that of current crisis, which dissipates especially in the long-run (right side of Figure A.4, Appendix), inversely for our results with energy (right side of Figure 4). The observed persistence versus the dissipation underlines the occurrence of nonlinearities.

Figure 4. Time varying dynamic coherence between real effective exchange rate returns and exports to GDP (ln(*XP/GDP*))



5. Conclusion and some economic implications

This paper attempts to analyze the time varying dynamic coherence between changes in exchange rate (nominal and real terms) and exports to GDP ratio in Russia. The results reveal that the evolutionary co-spectral approach carried out in this study effectively enhance our understanding on the focal relationship. We show interesting results that may have important economic implications.

While there is clearly significant interaction between changes in exchange rate and exports to GDP ratio, this nexus appears hardly to be pinpointed. The exports react weakly to changes in nominal exchange rate and heavily to those of differential price, even though the dynamic coherence seems much more important in the medium and the long terms than in the short-run. This means that the nominal exchange rate succeed to smooth the real exchange rate in the short-run and fail in the long-run. The results change substantively in terms of magnitude when subtracting energy, but the changes in differential price still the major player. Being a country highly dependent on energy's exports, Russia has to deal with significant volatility in export earnings relating to commodity price developments in international markets. Given these circumstances, the CBR has fought against two evils: a strengthening ruble and rapid inflation. Russian Monetary authorities have given preference to currency interventions. However, the exchange rate policy seems not effective to overcome external shocks. More accurately, the tools at the CBR's disposal to sterilize the ensuing increase in ruble supply have proved inadequate to control real exchange rate in the long-run.[4]Additionally, the interest rate policy of the CBR has not been very effective[5], nor has the emitting bonds, as regards the absorption of extra liquidity (Starr (2005) and Lainela and Ponomarenko (2012)).

Cognisant of the strong interdependence dynamic between changes in differential price and exports to GDP ratio compared to those of nominal exchange rate, especially in the medium and the long terms and the periods of crisis, Russia should implement an accurate strategy through various reforms. Firstly, policy makers should be aware that the adjustment process is different over time (i.e. the

[4] The set of monetary tools was limited to currency interventions and sterilisation of excess liquidity through deposit operations used in parsimony, proving to be of low efficiency (Vdorinchenko and Voronina, 2009).

[5] The CBR' interest rates do not have adequate effect on interbank market coupled with the lack of competitiveness of banking sector. It stills to be narrow due to mutual distrust among banks.

need to account for nonlinearities when analyzing the exchange rate-Russia' exports nexus). Secondly, the policies should not concentrate on massive Bank currency interventions in the face of an oil price shock as they will most likely to fail. Thirdly, Russia should continue to be prepared to tackle with the possible short-run problems triggered by nominal effective exchange rate uncertainty, while, at the same time, continue to decrease its dependency on energy prices and its Europe's dependency in the long-run by improving exports destined to Asia through proactive reforms. Thirdly, policy measures that enhance the effectiveness of exchange rate policy may have a save heaven role to control the spiral involving increased dollarization. The Central bank should take additional steps forward in expanding monetary policy tools. This can underpin the importance of considering the benefits from the interaction of an efficiently robust banking system with deep financial markets and strengthened institutional arrangements to promote financial stability and economic growth and to foster the confidence of exporters. Finally, a trade diversification (both products and partners) can improve the ability to react quickly and effectively to external shocks.

References

Alquist R. and Kilian L. (2010) "What do we learn from the price of crude oil futures?" Journal of Applied Econometrics 25, p. 539–573.

Arize, C. (1997) "Conditional exchange rate volatility and the volume of foreign trade: evidence from seven industrialized countries" Southern Economic Journal, 64, 235-254.

Asseery, A., and Peel, D. A. (1991), "The effects of exchange rate volatility on exports." Economics Letters, 37, p. 173-177.

Baffes, J. (2007) "Oil Spills on Other Commodities." Resource Policy, 32(3), p.126-134.

Beck, R. and Barnard, G. (2009) "Towards a Flexible Exchange Rate Policy in Russia." OECD Economics Department Working Papers 744.

Beeckmann, J. and Czudaj, R. (2013) "Is There a Homogeneous Causality Pattern between Oil Prices and Currencies of Oil Importers and Exporters?" Ruhr paper n° 431.

Bouoiyour, J. and Selmi, R. (2014 a) "Exchange Volatility and Export Performance in Egypt: New Insights from Wavelet Decomposition and Optimal GARCH Model." Journal of International Trade & Economic Development, Forthcoming.

Bouoiyour, J. and Selmi, R. (2014 b) "Commodity price uncertainty and manufactured exports in Morocco and Tunisia: Some insights from a novel GARCH model." Economics Bulletin, 34(1), p. 220-233.

Ćorić, B. and Pugh, G. (2010) "The effects of exchange rate variability on international trade: a meta-regression analysis." Applied Economics, 42, p. 2631-2644.

Creti, A., Ftiti, Z. and Guesmi, K. (2013) "Oil price impact on financial markets: co-spectral analysis for exporting versus importing countries." EconomiX Working Papers 2013-11, University of Paris West.

Daly, K., (1998) "Does Exchange Rate Volatility Impede the Volume of Japan's Bilateral Trade? ", Japan and World Economy 10, p.333-348.

Egert, B. and Zumaquero, M. (2007) "Exchange Rate Regimes, Foreign Exchange Volatility and Export Performance in Central and Eastern Europe: Just Another Blur Project?" William Davidson Institute Working Papers Series n°782, University of Michigan.

Ftiti, Z. (2010) "The macroeconomic performance of the inflation targeting policy: An approach based on the evolutionary co-spectral analysis (extension for the case of a multivariate process)." Economic Modelling, 27, p. 468–476.

Galkovskaya, V. (2011) Does nominal exchange rate have a predictive power for oil and gas prices? The case of Russia. Research Paper 62. http://opensiuc.lib.siu.edu/gs_rp/62

Granville, B. and Mallick, S., (2006) "Does inflation or currency depreciation drive monetary policy in Russia?" Research in International Business and Finance, 20, p.163–179.

Kiheung, K. and WooRhee, L. (1996), "The impact of Korea's exchange rate volatility on korean trade," Asian Economic Journal, 10, p. 45–60.

Kroner, K. and Lastrapes, W. (1993), "The impact of exchange rate volatility on international trade," Journal of International Money and Finance, 12, p. 293–318.

Lainela, S. and Ponomarenko, A. (2012), "Russian financial markets and monetary policy instruments." Working paper n°2 of Bank of Finland (BOFIT).

McKenzie, M. D. and Brooks, R. D. (1997), "The impact of exchange rate volatility on German – US trade flows, Journal of International Financial Markets, Institutions and Money, 7, p. 73–87.

McKenzie, M-D. (1998) "The Impact of Exchange Rate Volatility on Australian Trade Flows." Journal of International Financial Markets." Institutions and Money 8, p.21- 38.

Priestley, M. B. (1965) "Evolutionary spectra for non stationary process." Journal of Royal statistic society, 27, p. 204-237.

Priestley, M. B. and Tong, H. (1973) "On the analysis of bivariate non-stationary processes." Journal of royal statistic society. 35, p. 135-166.

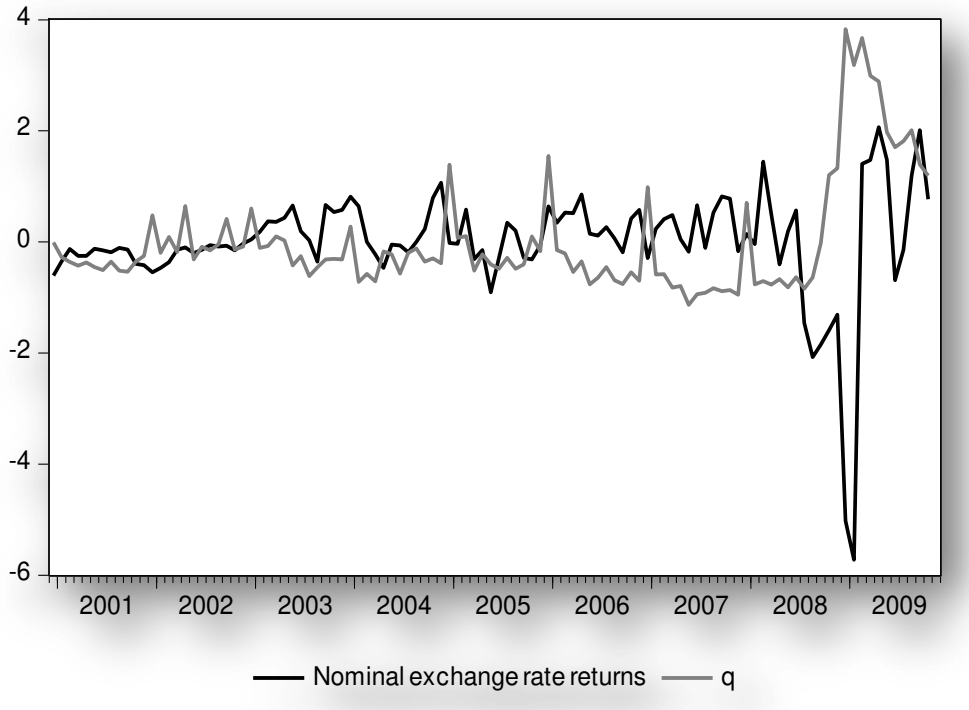
Savvides, A. (1992) "Unanticipated exchange rate variability and the growth of international trade." Weltwirtschaftliches Archiv, 128 (3), p. 446–463.

Starr, M.A. (2012) "Does money matter in the CIS? Effects of monetary policy on output and prices." Journal of Comparative Economics, 33, p. 441-461.

Vdovinchenko, A. and Voronina, V. (2009) "Monetary policy rules and their application in Russia." Economic Research Network of Moscow, Working paper n° 04/09.

Appendices

Figure A.1. Changes in nominal exchange rate and dollarization



Notes: *q:* the degree of dollarization, which is equal to *(IC/M2).N*, where *IC:* the volume of foreign currency supplied by commercial bank; *M2* is the monetary aggregate; Source: Econstats™.

Figure A.2. Time varying dynamic coherence between nominal effective exchange rate returns and exports to GDP ratio (ln(XP/GDP))
<u>without energy</u>

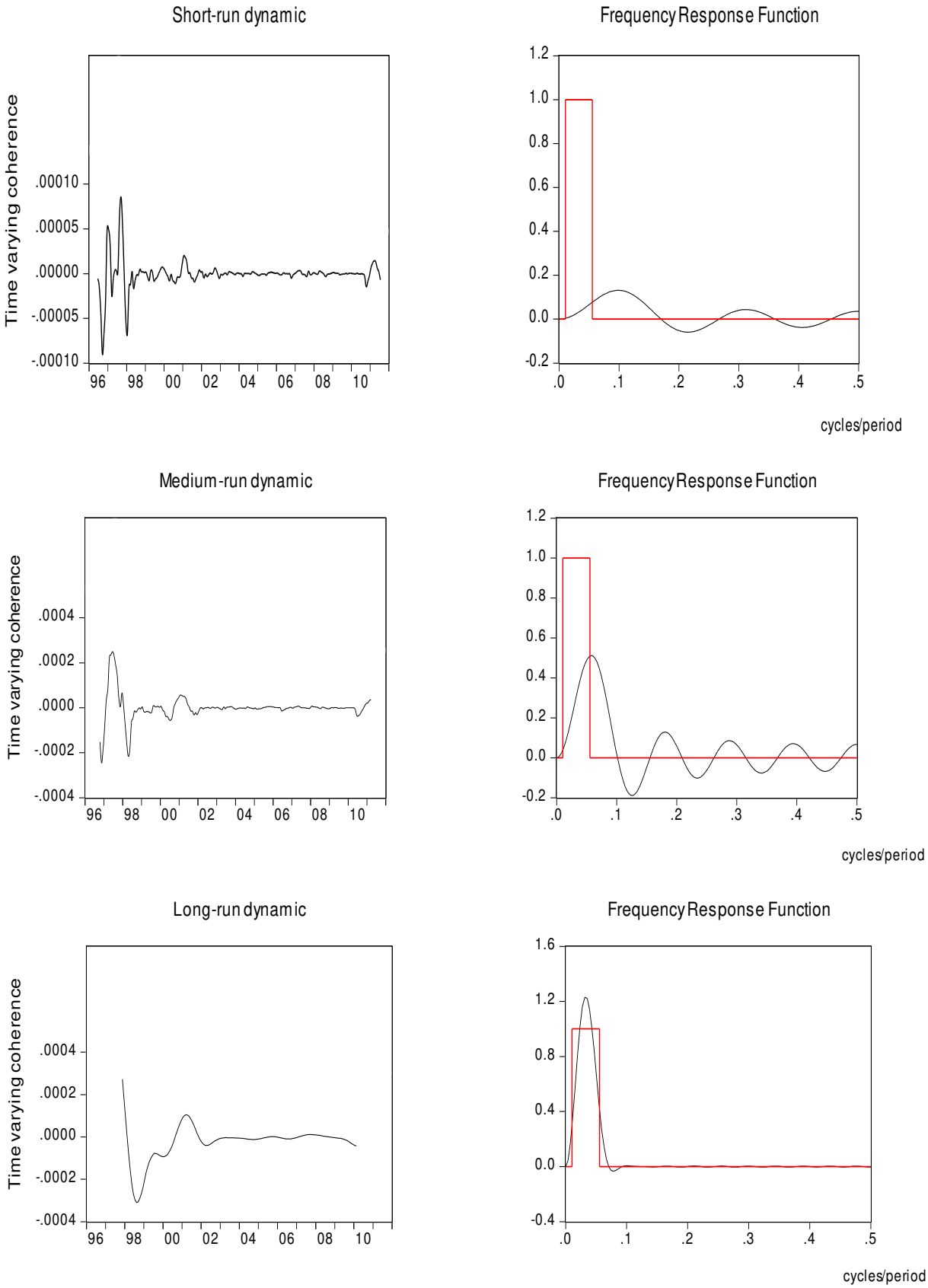


Figure A.3. Time varying dynamic coherence between differential price returns and exports to GDP ratio (ln(XP/GDP))
<u>without energy</u>

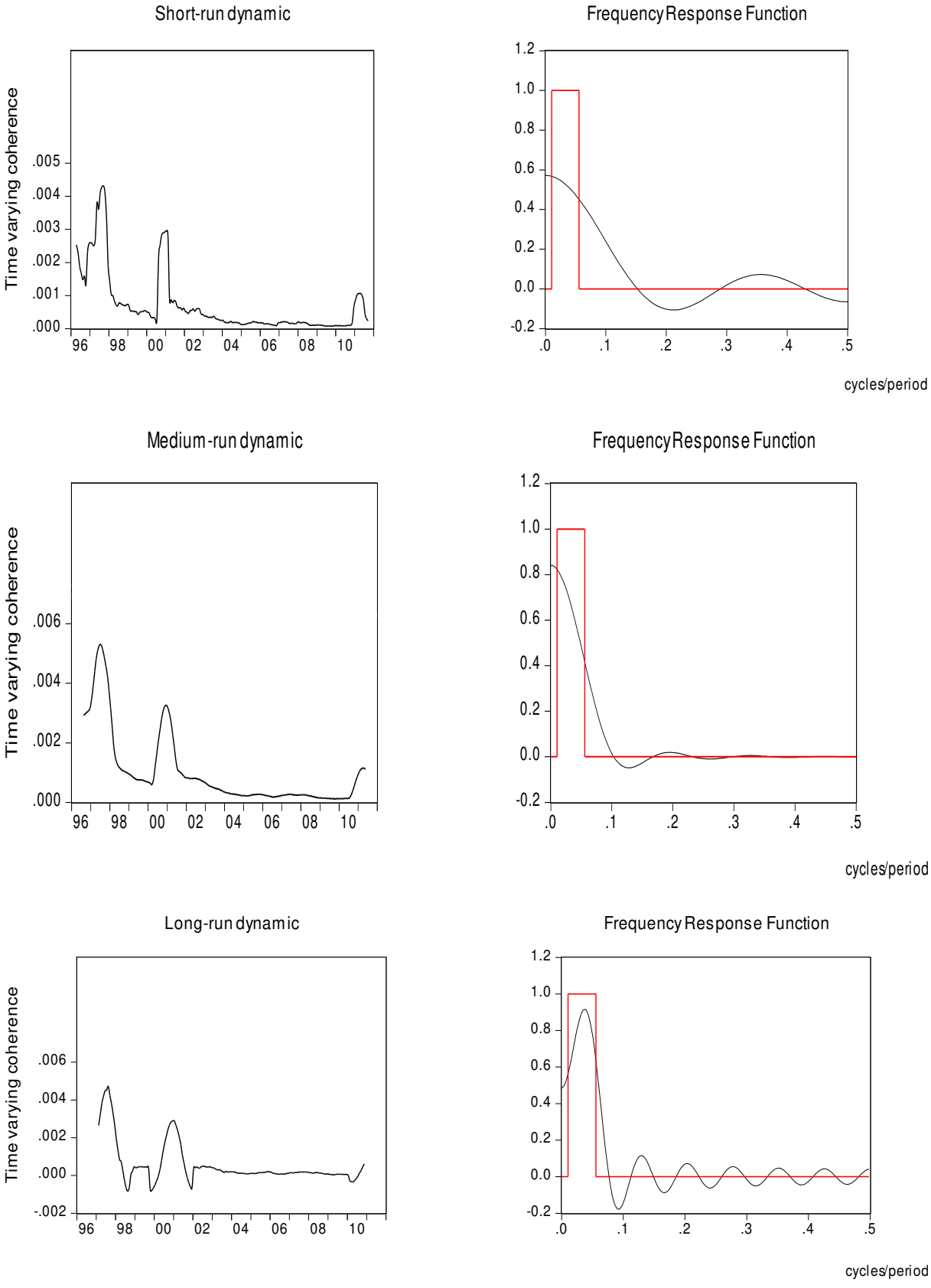


Figure A.4. Time varying dynamic coherence between real effective exchange rate returns and exports to GDP ratio (ln(XP/GDP)) without energy