Shock-dependent variability of exchange rate pass through in South Africa

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[Preliminary and incomplete. Please do not quote.]

Abstract

Conventional thinking around exchange rate pass-through to inflation generally applies a rule-of-thumb measure, such that all exchange rate movements – be it appreciations or depreciations – ultimately lead to a predetermined change in headline inflation. This paper shows how changes to level of the exchange rate do not lead to fixed *rule-of-thumb* changes in inflation. We show that the shocks that caused the depreciation, taken together with shifts in long-run trend growth - which make up the state of the economy - will also determine the degree of pass through to inflation.

JEL Classification: C11, C18, C30, E50

Keywords: Bayesian VAR, exchange rate pass through, sign restrictions, steady-state prior

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1 Introduction

It is and has always been tempting to associate exchange depreciations with higher inflation. In South Africa the correlation between year-on-year nominal effective exchange rate changes and inflation is around 40% at a years lag, which at first glance seems to suggest a possibly causal relationship. For as long as people have held such views economists have warned of their pitfalls. Exchange rate induced cost-push pressures need not, and in some cases have been shown not, to be inflationary. Why might this be? For one, no cost-push pressure would arise in the first place if exporters to South Africa are willing to absorb the cost of a weaker rand to compete for local market share. Second if exporters have to pass on the higher costs to remain viable, assuming consumers have the choice, they will substitute away from the more expensive imported good. What if they don't have a choice? Then the central bank will likely respond reducing overall demand in the economy preventing the relative price shock becoming a permanent feature of the inflation process.

This highlights a few important things to account for when studying exchange rate pass-through[1]. We must make some attempt to control for factors that inform exporter, producer, and consumer behaviour. We do this by including variables that proxy as much of these concerns as practically possible. We must also allow for feedback effects, such as the central bank anticipating the effect of a relative price shock. We do this by modelling pass-through in a general equilibrium setting. Perhaps most importantly, when considering the *ex ante* effect of a depreciation on inflation we must be mindful of the state of the economy at that time. How constrained are consumers? What are the prevailing international conditions? Is policy unable to act for some reason? *Etcetera*.

Traditionally the first two issues have been tackled successfully in the literature while the third has lacked attention. This is a problem because estimates of pass-through from a good model, based on theory and that allows for feedback effects, is useless if not applied in the context of the current state of the economy (structural and otherwise). A recent working paper from the Bank of England by Forbes, Hjortsoe, and Nenova (2015) introduces a framework to remedy the situation. We borrow heavily from their work, introducing a few small innovations.

To the end of developing a similar framework for South Africa we show that in a standard open-economy model of South Africa, the relationship between exchange rates and domestic prices depends on where the shock that caused the exchange rate to move originated. Using information from the theoretical model we develop a structural vector autoregression (SVAR) framework to address the problem empirically. The estimated model in turn helps us interpret the differing pass-through experiences that have followed three severe exchange rate depreciations over the last decade and a half, and going forward, it provides the tools for a more nuanced and complete take on exchange-rate pass through, which may be useful for both the central bank's inflation forecast and its communication thereof.

The main difference between the model developed in this paper and that of some of the other work on exchange rate pass-through in South Africa post crisis (Jooste and Jhaveri (2014), Mbelu and Kabundi (2016)), is that our model has constant parameters. We concentrate on how the state of the economy and not its parameters has changed.

This paper extends the methodological framework of Forbes and others (2015) by considering in-

[1]There are of course other things to consider as well. For example we consider only a linear model of pass-through, there is however a growing literature on asymmetric pass through, see Aron and others (2014) for a cursory survey.

formative priors on the steady-state of the VAR. More specifically it allows for structural shifts in the steady-states, such as lower (steady-state) potential growth following the Great Financial Crisis. In section 2 we present a DSGE model that gives the theoretical impulse responses necessary to identify our structural VAR. In section 3 we fully explain the empirical methodology employed (split into subsections concentrating on specific issues). Section 4 presents the results. The final section concludes.

2 Theoretical responses to shocks

In order to gain and understanding of the South African economy's macroeconomic response to a variety of shocks, we make use of a small-open economy DSGE model.

2.1 A brief overview of the model's open economy dimensions

Imports, exports and inflation

In the model, households are assumed to consume both domestically-produced and imported consumption goods. They also own capital which they rent to firms, and they make investment decisions by purchasing either domestically-produced or imported investment goods. Households also supply labour to firms.

The consumption basket from which households derive utility can be expressed as follows:[2]

$$C_t = \left[(1-\vartheta_c)^{\frac{1}{\eta_c}} \left(C_t^d\right)^{\frac{\eta_c-1}{\eta_c}} + \vartheta_c^{\frac{1}{\eta_c}} \left(C_t^m\right)^{\frac{\eta_c-1}{\eta_c}}\right]^{\frac{\eta_c}{\eta_c-1}}, \tag{1}$$

where C_t^d and C_t^m denote domestic and imported consumption goods, η_c is the substitution elasticity between the two goods and ϑ_c is the imports share in aggregate consumption. The respective demand functions for the domestic and imported consumption goods are given by

$$C_t^d = (1-\vartheta_c)\left[\frac{P_t^c}{P_t^d}\right]^{\eta_c} C_t \quad \text{and} \quad C_t^m = \vartheta_c \left[\frac{P_t^c}{P_t^{m,c}}\right]^{\eta_c} C_t, \tag{2}$$

where P_t^c, P_t^d and $P_t^{m,c}$ are the prices for CPI, domestic goods and imported goods, respectively. For the imported good, a rise in its price – due to a weaker exchange rate – relative to the overall price level in the economy, would reduce the demand for imports. Allowing $\hat{\pi}_t$ to reflect inflation (*i.e.* the change in the (log) price level), it can be shown that the CPI inflation rate evolves as a weighted average of domestic $\hat{\pi}_t^d$ and imported inflation, $\hat{\pi}m, c_t$

$$\hat{\pi}_t^c = (1-\vartheta_c)\left(\frac{1}{\gamma^{c,d}}\right)^{1-\eta_c} \hat{\pi}_t^d + \vartheta_c \left(\gamma^{mc,c}\right)^{1-\eta_c} \hat{\pi}_t^{m,c}, \tag{3}$$

where $\gamma^{c,d}$ and $\gamma^{mc,c}$ are relative prices of domestic goods to the CPI, and import prices to CPI, respectively.

There are three types of firms that characterise this open-economy setup: (1) domestic producers; (2) importing firms and (3) firms that produce for the export market.

[2]A similar set of equations represent the household's investment basket.

Domestic firms

Importing firms purchase homogenous goods in the world market at the world price P_t^*, and then differentiate them for the domestic market in a local currency price. For these firms, their marginal production costs are increasing in the exchange rate: the weaker the exchange rate, the more pressure to increase the price in the domestic market. The log-linearised Phillips curve for the importing firm is expressed as follows:

$$\begin{aligned}\hat{\pi}_t^{m,c} &= \frac{\beta}{1+\kappa_{m,c}\beta}\left(E_t\hat{\pi}_{t+1}^{m,c}\right) + \frac{\kappa_{m,c}}{1+\kappa_{m,c}\beta}\left(\hat{\pi}_{t-1}^{m,c}\right) \\ &+ \frac{(1-\theta_{m,c})(1-\beta\theta_{m,c})}{(1+\kappa_{m,c}\beta)\,\theta_{m,c}}\left(\hat{mc}_t^{m,c} + \hat{\lambda}_t^{m,c}\right), \end{aligned} \tag{4}$$

where the importing firms' real marginal cost deviation from its steady state is given by $\hat{mc}_t^{m,c} = \hat{s}_t + \hat{p}_t^* - \hat{p}_t^{m,c}$. Here, s_t represents the nominal exchange rate, and $+\hat{\lambda}_t^{m,c}$ is a shock to the importer's markup. The parameters β, $\kappa_{m,c}$ and $\theta_{m,c}$ represent the discount factor, the degree of indexation to past inflation, and Calvo price-adjustment.

Exporting firms purchase a good in the domestic economy, differentiate it for the world market, and sell it at the foreign currency price, P_t^x. For them, production costs are decreasing in the exchange rate: a weaker currency increases the local-currency revenue they earn from selling their goods abroad.

As before, the log-linearised dynamic inflation equation for exported goods can be expressed as follows:

$$\hat{\pi}_t^x = \frac{\beta}{1+\beta}E_t\hat{\pi}_{t+1}^x + \frac{1}{1+\beta}\hat{\pi}_{t-1}^x + \frac{(1-\theta_x)(1-\beta\theta_x)}{(1+\beta)\,\theta_x}\left(\hat{mc}_t^x + \hat{\lambda}_t^x\right), \tag{5}$$

where $\hat{mc}_t^x = \hat{p}_t^d - \hat{s}_t - \hat{p}_t^x$ is the real marginal cost of the exporting firm, and $\hat{\lambda}_t^x$ represents shocks to the exporting firm's markup. The parameters have similar interpretation as before, although we assume that exporters do not engage in backward indexation of prices.

The demand for the exporter's good, $\tilde{X}_t$, in the foreign economy (Y_t^*), can be expressed as follows:

$$\tilde{X}_t = \left[\frac{P_t^*}{P_t^x}\right]^{\eta_f} Y_t^*. \tag{6}$$

Here, a fall in the exporting firm's price (relative to the prevailing world price) that was induced by a weaker exchange rate, would see demand for exports increase.

UIP and the Taylor rule

The exchange rate follows a modified uncovered interest parity (UIP) condition:

$$\hat{R}_t - \hat{R}_t^* = (1-\tilde{\phi}_s)E_t\Delta\hat{S}_{t+1} - \tilde{\phi}_s\Delta\hat{S}_t - \tilde{\phi}_a\hat{a}_t + \hat{\tilde{\phi}}_t, \tag{7}$$

where $\hat{R}_t$ and $\hat{R}_t^*$ are the domestic and foreign interest rates, S_t is the nominal exchange rate, $-\tilde{\phi}_a\hat{a}_t$ is the economy's net foreign asset position, and $hat\tilde{\phi}_t$ is a risk-premium shock. According to this setup, the more indebted the domestic economy becomes in international markets, the more risky lending to that economy becomes, which then puts pressure on the exchange rate to depreciate.

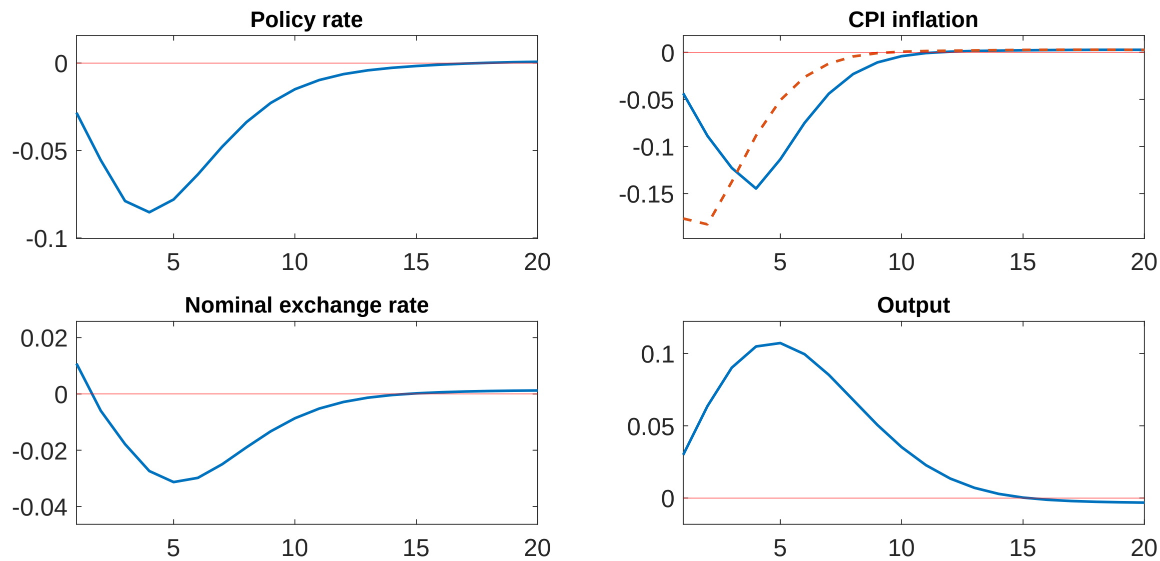
The policy rate, $\hat{R}_t$, is set by the central bank who is assumed to follow a Taylor-type rule where it responds to inflation and output.

2.2 Impulse responses from the theoretical model

Using the model that is outlined above, we aim to uncover the signs of the key variables' reactions to a specific set of structural shocks: (1) a domestic supply shock, (2) a labour shock in the form of a shock to wages (3) a monetary policy shock, and (4) an exogenous exchange rate shock. The signs of these reactions are then used in the next section, where we impose identifying restrictions on the VAR.

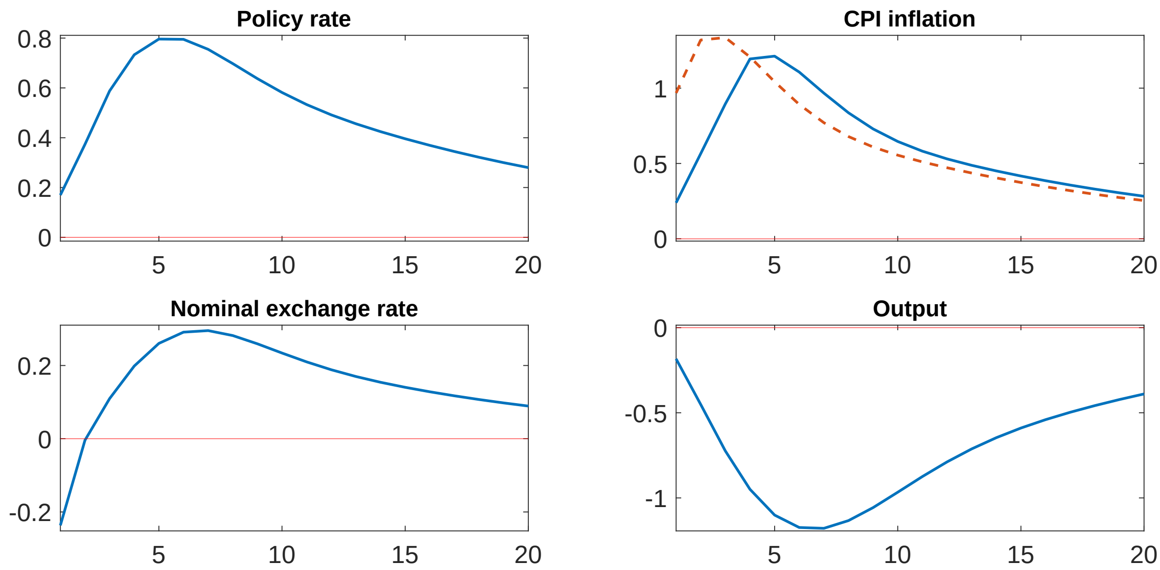
A positive domestic supply shock lowers inflation, but improves output, as more can be produced at a greater level of efficiency. As a result, the repo rate declines in Figure 1. However, the repo rate does not decline to the same extent as inflation, implying that real interest rates are most likely increasing to some extent given the strength in output. The tighter real interest rate leads to an appreciation of the exchange rate.

Figure 1: Domestic supply shock



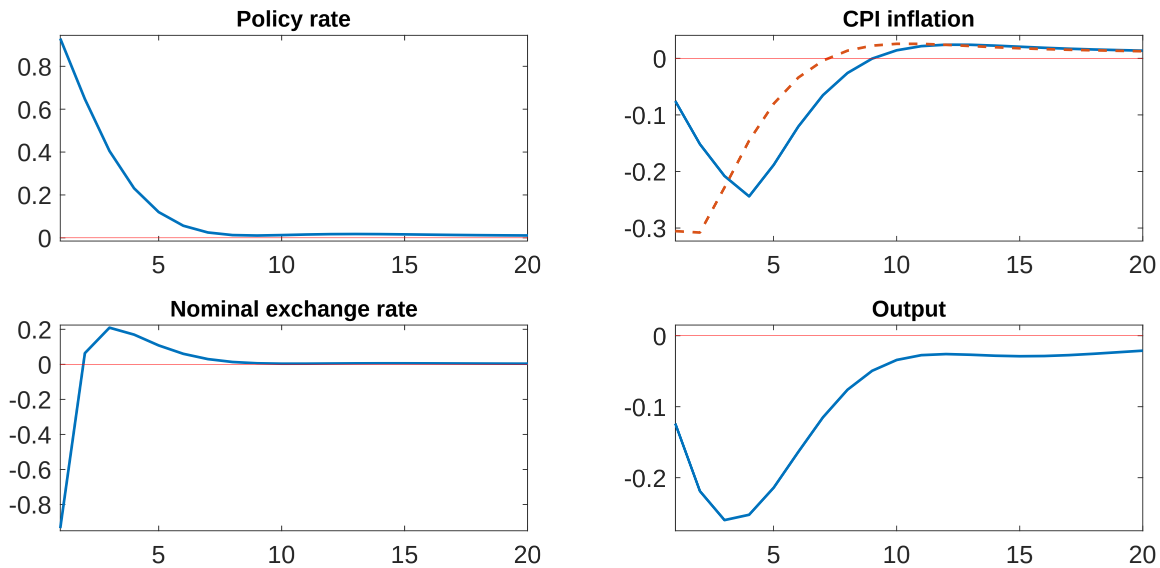
A shock to wages raises the input costs of domestic firms, and therefore puts upward pressure on overall CPI. In itself, this requires a higher policy rate, which allows the exchange rate to appreciate over the initial quarters. However, increasing costs induce firms to produce less, which drags down output. While extremely persistent, this adverse supply shock causes the nominal repo rate to rise to a lesser extent than the rise in inflation, on account of the fall in output. The declining real interest rate implied by this dynamic allows output to recover at the cost of a weaker exchange rate in the outer years.

Figure 2: Labour shock



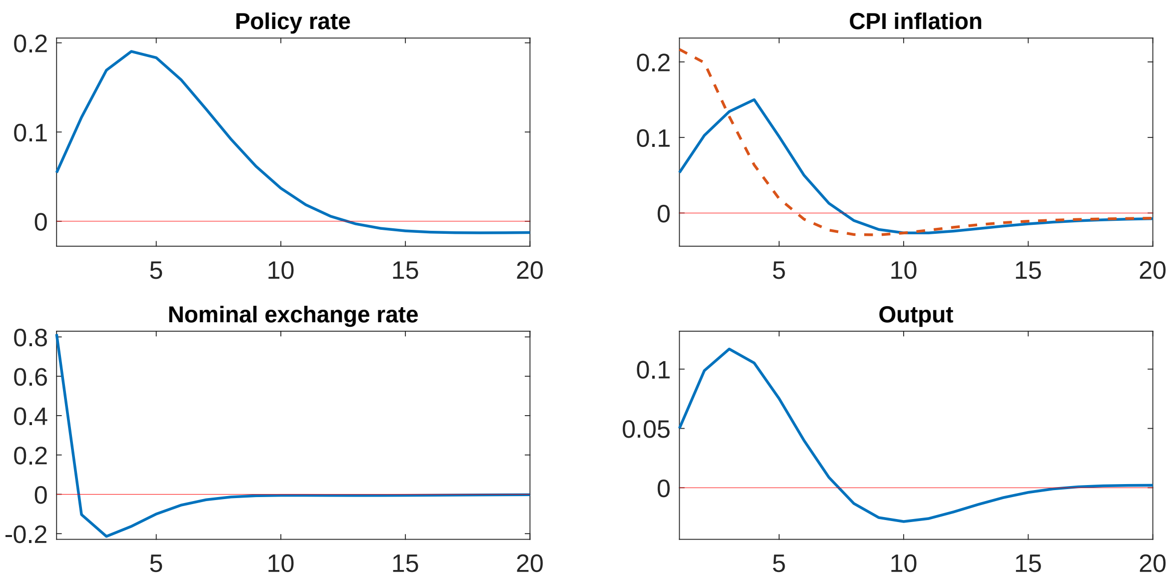
In Figure 3, a shock to the policy rate appreciates the exchange rate, and slows output down. Combined, lower import prices and reduced domestic demand cause a decline in CPI inflation.

Figure 3: Monetary policy shock



An exogenous shock to the exchange rate, as shown in Figure 4, depreciates the exchange rate on impact. The weaker exchange rate raises the import price component of CPI inflation. It also lowers the costs of exporters, which allows them to lower their prices and in so doing increase the foreign demand for our exports. This raises overall output in the economy. Monetary policy responds to higher inflation and output by raising the policy rate.

Figure 4: Exchange rate shock



3 Empirical methodology

The basis of our empirical framework is a vector autoregression of the form

$$A(L)y_t = B_0 x_t + u_t \tag{8}$$

where: $A(L)$ is the lag polynomial such that $A(L) = I_K - A_1 L - \ldots - A_p L^p$, $\{y_t\}_{t=t_0}^{N}$ is a K-dimensional vector of economic time series, B_0 is a coefficient matrix, $\{x_t\}_{t=t_0}^{N}$ is an M-dimensional vector of exogenous non-stochastic regressors (including the constant and dummy variables), and $\{u_t\}_{t=t_0}^{N}$ is a k-dimensional vector of standard form shocks, where $u_t \sim N(0, \Sigma_u)$.

The model is estimated using a mix of Bayesian methods pioneered by Litterman (1986) and Villani (2009). Litterman's parameter shrinkage prior is implemented using the methods for large VARs proposed by Bańbura, Giannone, and Reichlin (2010). The standard hyperparameters, $\lambda_1 = 0.2$ and $\lambda_3 = 1$ are used[3] (Blake and Mumtaz (2012)). The details of the implementation of Villani's steady-state priors are dealt with in the section on trend growth, Subsection 3.3. The Gibbs sampling algorithm was set to 10 000 draws with a burn length of 8 000. A lag length of 2 was used in the final model.

3.1 Data

The first choice made when concerning the data was to limit the sample to 1995Q1 to present (2017Q1). This was done in order to mitigate the need to deal with structural change while the issue of small sample size/over-parametrisation was dealt with using the parameter shrinkage method already discussed. The second was two take on board as many of the recommendations put forward in Aron and others (2014) survey of pass-through estimation in developing and emerging markets that our framework would allow.

[3]In this context λ_2 and λ_4 are not relevant as the natural conjugate prior doesn't allow for the distinction between the standard deviation on "own lags" and the lags of other variables, and the standard deviations on the constant's coefficients of the model are dealt with by the steady-state prior.

We started out by including the smallest set of variables necessary to model a small open economy under an inflation targeting regime. Taking into account the possible choices at our disposal this set consists of real GDP, consumer price inflation, the policy interest rate, and the nominal effective exchange rate. These variables allow us to build a model that can approximate, however crudely, the theoretical New Keynesian model of the economy. Next, to capture the cost and demand conditions of exporters we included world growth and commodity prices. A basket of commodity prices was chosen over competing cost proxies such as oil prices because of the importance of non-oil commodities in the South African context. Finally unit labour costs were added to control for destination country costs. The variables are detailed in Table 1.

Table 1: Time series data

Variable	Transformation	Source	Notes
Real GDP	Log change	Statistics SA	
Targeted CPI (excl. petrol)	Log change	Statistics SA	Linked to CPIX pre-2009
Nominal unit labour costs	Log change	SARB	Total salaries/Real GDP
Repurchase rate	Level	SARB	
Nominal effective exchange rate	Log change	SARB	
Commodity prices	Log change	SARB	Index in USD
World real GDP	Log change	GPM network	Index in USD

Two possibly important variables that were omitted are import and producer prices. However, since the number of parameters to be estimated grows quadratically with each new variable and considering our relatively small sample size, as well as the increase in the complexity of the identification procedure in larger systems, we felt the omission justified.

3.2 Structural identification

A major difficulty in structural VAR modelling is the problem of identification. The most common solution in the exchange rate pass-through literature is to use a recursive ordering of the variables that resembles a distribution chain between importer, producer, and consumer (Bhundia (2002), Ocran (2010)). While this scheme is attractive in its simplicity it doesn't seem to be based on very solid ground. It relies on the timing of the transmission of prices through this chain to characterise the behaviour of the respective agents. Is it reasonable to think that this transmission takes place in neat quarterly steps? Recursive VARs are sometimes considered separately from structural VARs because of the *ad hoc* nature of the theories that underpin them (Stock and Watson (2001)).

In this paper we want to identify a structural model that is consistent with the theory laid out in Section 2. In order to do this we use a combination of sign and zero restriction schemes, the algorithm for which was first presented by Binning (2013), building on the work of Rubio-Ramírez and others (2008). This method of identification also has its problems. The main problem is that while it allows the researcher to disentangle the contemporaneous relationships between variables, it cannot identify a unique model that satisfies these relationships. The result is what is called set identification, you can identify the model only up to a set of competing models that all satisfy the initial restrictions. Unfortunately the theory does not provide any guidance in choosing one of these models above the rest. See Fry and Pagan (2011) for a critical review of the sign restrictions method.

The restrictions employed in the identification of our model are laid out in Table 2. The signs indicate the sign of the cumulative change in the variables after four quarters. The zeros indicate that a shock does not have a permanent impact on the respective variable. That is, any impact that a shock has on a variable with a zero restriction must be transitory in nature.

Table 2: Sign and long-run zero restrictions

	Supply	Demand	Labour	Mon. policy	Exch. rate	Wrld dem.	Wrld sup.
Real GDP	+	+	-	-	-		
CPI	-	+	+	-	-		
ULC	-		+				
Interest rate	-	+	+	+	-		
Exch. rate	-	-	-	-	-		
Commodities	0	0	0	0	0		
World GDP	0	0	0	0	0	0	

First we identify the global demand and supply shock by specifying that only they may effect permanent changes in commodity prices and world output. This assumption comes from the fact that South Africa is a small open economy and therefore domestic disturbances are assumed not to materially impact global variables (at least not in the long-term). World demand and supply are disentangled from each other by specifying that a global demand shock cannot permanently increase real global output.

Domestic supply shocks are identified as simultaneously increasing output and decreasing prices, while domestic demand shocks are identified as simultaneously increasing both output and prices. Positive labour demand shocks are seen to increase the salary of workers (per unit output) as well as consumer prices, while putting negative pressure on output. Monetary policy shocks raise interest rates, putting negative pressure on both output and prices. Finally, exchange rate shocks appreciate the exchange rate leading to decreases in output and prices. The estimated impulse-responses are provided in Appendix B.

3.3 Trend growth

The unconditional mean in context of a stationary VAR is the point to which all variables of the VAR converge in the absence of outside shocks. It is essentially the long-run equilibrium value (or steady-state) of the system. Often the researcher and/or model user has strong priors about these steady-state values (Villani (2009)) and it is thus helpful to be able to incorporate this information into the modelling framework. This is especially true in the sense that it allows for expanding the information set (using off model information) used to estimate the structural aspect of the model.

With the inclusion of dummy variables it is also possible to make allowance for discrete shifts in these steady-states. For example it is possible to allow for a fall in the steady-state of inflation in the inflation targeting era of monetary policy, thus making allowance for regime shifts and other structural changes. In the case of this study we wanted to make specific allowances for the impact of inflation targeting on steady-state inflation, the commodity super-cycle on potential growth, and the various reasons that have led to lower potential growth following the financial crisis.

To this end we have included two dummies that intersect with the SARB dating of the business cycle, the first from 1995Q1 to 1999Q2, and the second from 1999Q3 to 2007Q4. The first dummy coincides roughly with the pre inflation targeting era, and the second coincides with the commodities boom. That leaves as the base case the period following the financial crisis. The priors for the unconditional means for each of these periods was taken as the average of the equilibrium of each variable[4] used in the VAR. The estimates of the equilibriums were taken from various sources. For real GDP we used the potential growth estimated in *A semi-structural approach to estimate South Africa's potential output* (Anvari et al. (2012)). In the case of the nominal equilibrium exchange rate we used the real equilibrium exchange rate originally estimated by de Jager (2012) adjusted by the appropriate inflation differential. Finally, for the neutral nominal interest rate we used the real interest rate equilibrium estimated by Kuhn, Ruch, and Steinbach (forthcoming 2017) adding back the inflation rate to get to a nominal value. For the remaining variables we used an HP filter ($\lambda = 16000$) to estimate the equilibriums, save for inflation which was chosen to directly represent the priors of the researchers. This information is summarised in Table 3.

Table 3: Prior steady-state hyperparameters

	GDP	CPI	ULC	Repo	NEER	Comm.	WGDP
Mean							
2008Q1-2017Q1	2.19	5.50	7.15	8.7	-4.4	-2.09	3.03
1995Q1-1999Q2	0.35	3.00	-0.18	0.58	1.31	-1.27	0.07
1999Q3-2007Q4	1.24	1.0	-1.06	0.60	1.94	11.67	0.42
Standard deviation							
2008Q1-2017Q1	0.25	0.50	1.00	4.00	3.00	4.00	4.00
1995Q1-1999Q2	0.25	0.50	1.00	1.00	3.00	4.00	4.00
1999Q3-2007Q4	0.25	0.50	1.00	1.00	3.00	4.00	4.00

The values in the table for the pre inflation targeting and boom periods are relative to the base case (post financial crisis period). The prior and posterior[5] series plotted against the data can be found in Appendix C, followed by the prior and (estimated) posterior densities.

4 Results

4.1 Pass-through magnitudes from structural shocks

Figure 5 shows the estimation results of pass-through to consumer prices from the model identified shocks. The first thing to notice is that negative demand shocks tend to decrease pass-through. Key to understanding this result is the role of monetary policy. Following sustained negative demand shocks inflation and output growth tend to fall below their trend growth rates, requiring interest rate cuts from the central bank. A side effect of falling domestic interest rates is that the exchange rate depreciates (through the uncovered interest rate parity mechanism). This of course reinforces the monetary policy transmission mechanism[6], but the overall effect is a decrease in inflation observed with an exchange rate depreciation. Non-demand type shocks are more intuitive as depreciations accompany higher rates of inflation.

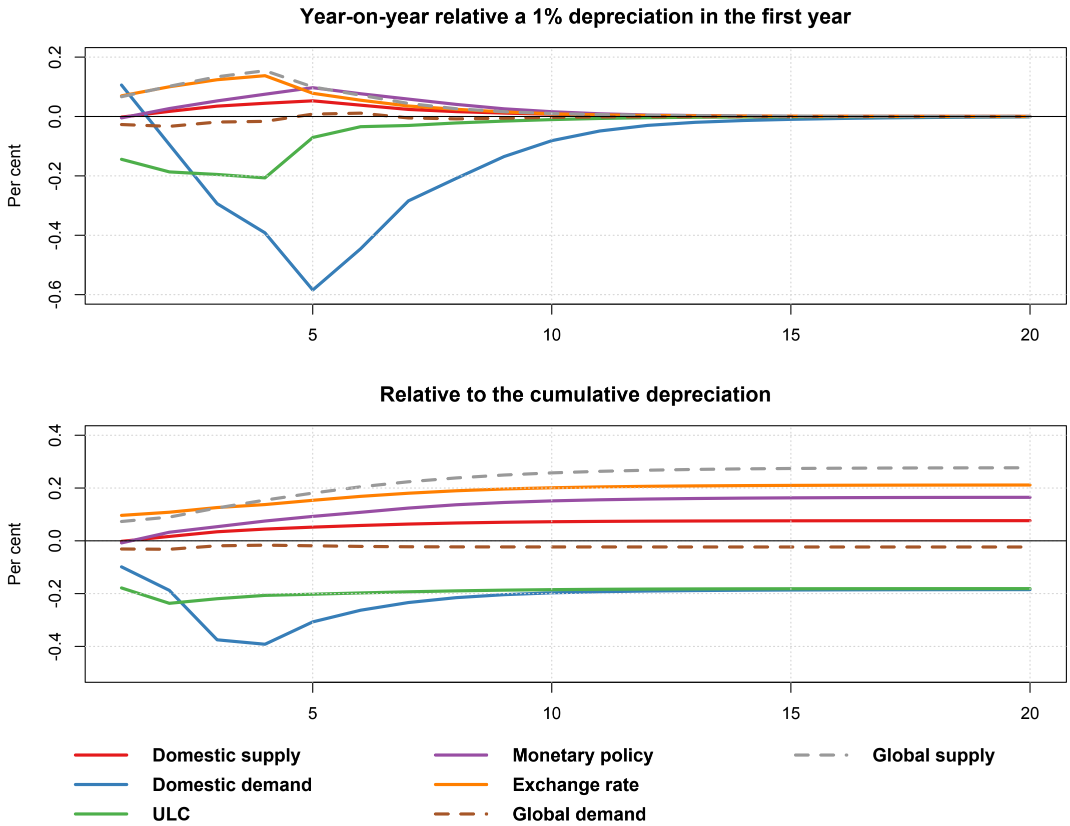
[4] Not including inflation.

[5] The posterior series is taken from the historical decomposition of the estimated VAR

[6] The transmission mechanism is reinforced by a more depreciated rand as it supports export growth and imported inflation, thus causing consumer prices to rise.

The second important thing to take into account are the relative magnitudes of pass-through amongst the various shocks. Most striking of which is the strong pass-through (around 40% after one year) of domestic demand shocks. The reason for this is the relative sensitivity of inflation and the exchange rate to demand shocks. Deviations of inflation from trend have a large demand component while deviations of the exchange rate do not[7], thus a small depreciation in exchange rates (following a demand shock) will be observed with large decreases in inflation. An examination of the historical decompositions Figure 7 and Figure 8 should make this clear. The remaining shocks have pass-through magnitudes onto the year-on-year inflation rate of around 20% or less.

Figure 5: Exchange rate pass-through to consumer prices



The pass-through from exchange rate shocks, which is usually quoted in the VAR literature[8] (Bhundia (2002), Ocran (2010), Aron et al. (2014)), is 13% after one year and 21% cumulatively. This is somewhat on the lower side, but still within range of the survey of the literature done by Aron and others (2014), and in line with the post-financial-crisis literature (Ocran (2010), Chiparawasha (2015), Mbelu and Kabundi (2016))

4.2 A narrative of rand depreciation post crisis

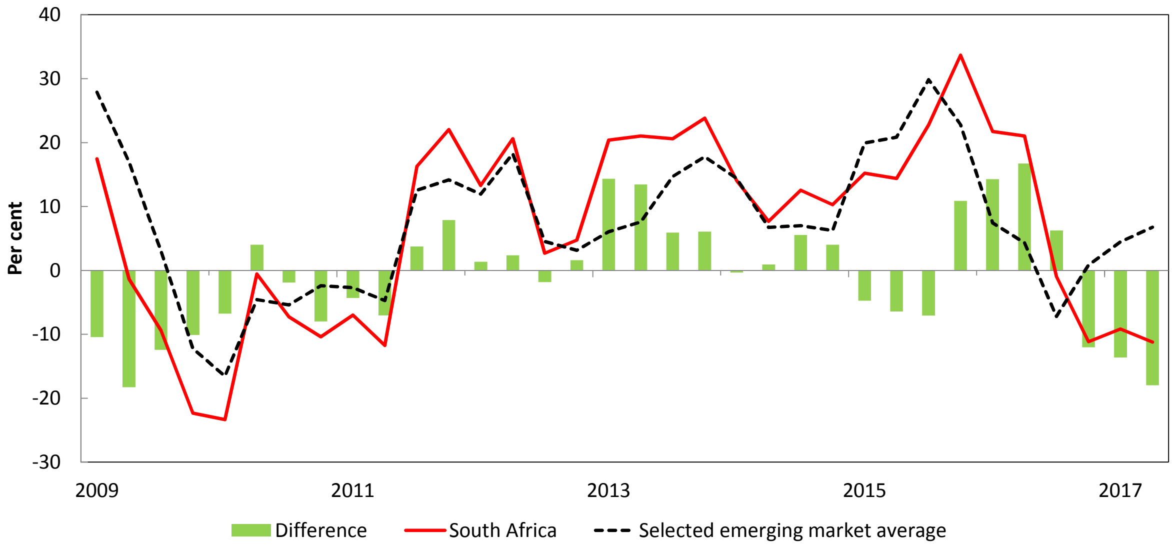
It is now a matter of history that in the wake of the Great Financial Crisis (GFC) the US Federal Reserve embarked on a large-scale program of liquidity injections into the domestic economy (known as quantitative easing (QE)) in support of the ailing financial sector. Not long after it was

[7]The forecast error variance decomposition ascribes 0.6% of the forecast error variance of the exchange rate to demand shocks. On the other hand this number is 2.1% in the case of inflation. Both after four quarters.

[8]Usually in a recursively identified "supply-chain" structure.

joined by the European Central Bank as the European debt crisis unfolded. It is also a well known fact that much of this cash found its way into emerging markets as investors searched for more attractive yields than were available in the advanced economies. At the same time commodity prices and world growth were rebounding from the crash brought on by the GFC (not least of all because of QE). As a result of these events emerging market currencies went through a period of strong appreciation, reaching its strongest in 2010, as can be seen in Figure 6[9]. Turning then to Figure 7[10] you can see that the model associates this appreciation episode with positive global demand (commodity prices) as well as supply shocks (world GDP growth).

Figure 6: Rand/dollar exchange rate



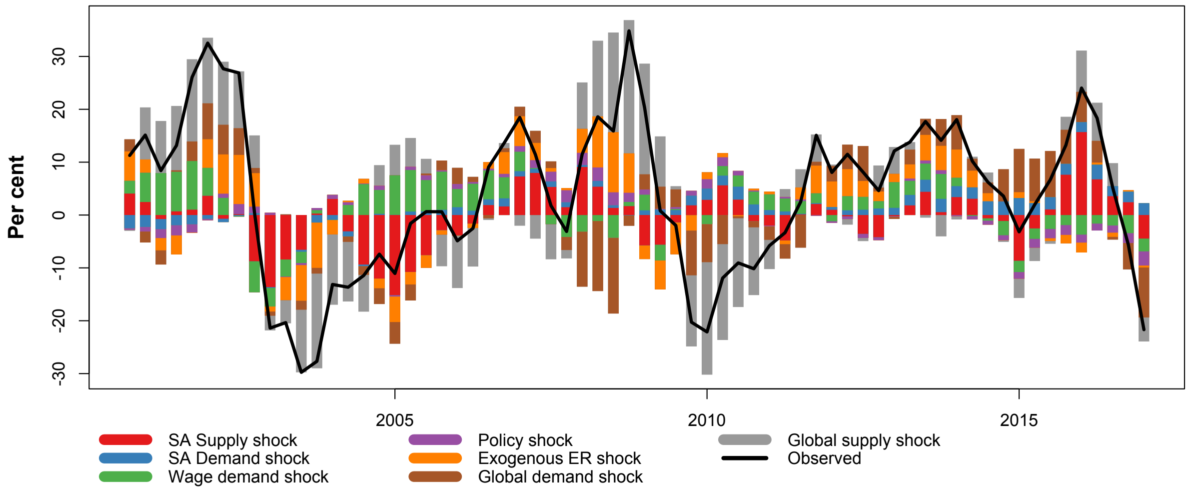
Starting around 2011 this trend began reversing as the carry-trade began to lose momentum. This led to a broad-based depreciation in emerging market currencies that would culminate in the 2013 "taper-tantrum", as the Fed wound down its QE operations. This appears in Figure 7 as exogenous exchange rate shocks applying depreciation pressure on the rand. Domestic factors affecting the strength of the depreciation were: the below trend demand and unit labour cost growth, and other idiosyncratic events that, on average, caused the rand to be outperformed by its peers, refer again to Figure 6. Notably among which was the turmoil in the mining sector[11], which in part led to the exchange rate depreciations observed in 2013.

[9]The average shown in the figure is an equally weighted basket of emerging market currencies including: Brazil, India, Indonesia, Turkey, and South Africa.

[10]Figure 7 and Figure 8 show historical decompositions from the estimated VAR, decompositions for the remaining variables can be found in Appendix A.

[11]The mining sector troubles reached fever pitch with the Marikana Massacre in the second half of 2012.

Figure 7: Nominal effective exchange rate: deviations from trend



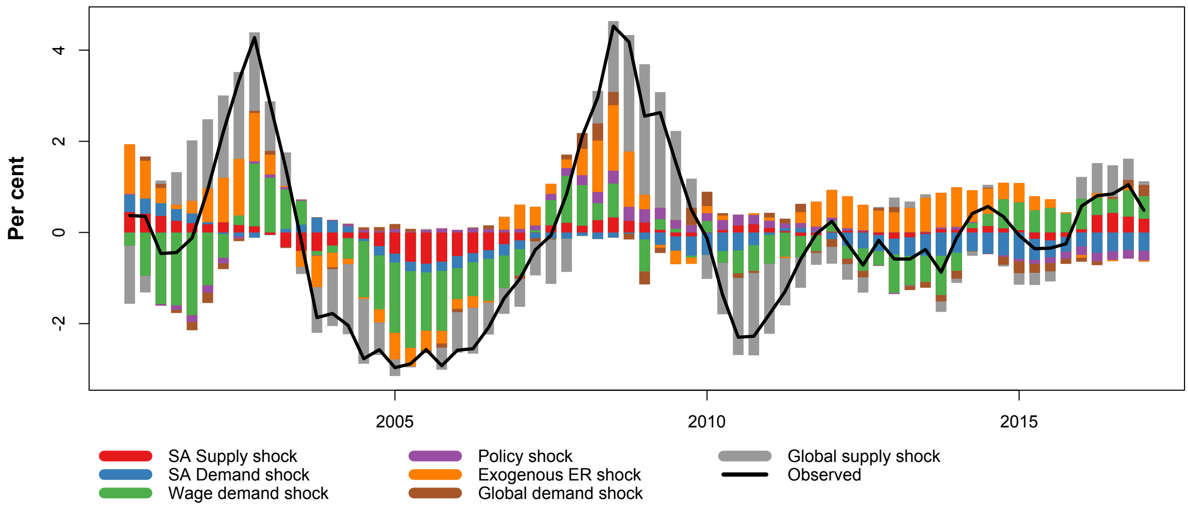
Following this period depreciation pressure subsided. The lull continued through 2014 as the markets corrected before picking up strongly again the following year. The last depreciation episode, before the end of the sample, has been driven overwhelmingly by negative supply shocks. As can be seen in Figure 7, supply shocks have on average been negative post crisis, this shows along with slowing GDP trend growth, how potential growth has been evolving. Likely causes for this include the Eskom crisis and growing political and policy uncertainty[12], both of which have become a serious drag on investment growth.

4.3 Explaining the drop in exchange rate pass-through post crisis

Using the model for our understanding what was driving the exchange rate, we can use the pass-through estimates to explain why pass through fell post crisis. The first thing to notice is that exogenous exchange rate shocks did put substantial upward pressure on inflation, see Figure 8. However unlike during the early 2000s and GFC episodes of high inflation, these exchange rate shocks were not accompanied by large negative global supply shocks. The domestic demand environment was also unambiguously negative. As pointed out at the beginning of this section since domestic demand shocks have such high pass-through, this helped mitigate the effects of the exchange rate shocks. The final reason inflation did not react to the exchange rate depreciation as much as expected is because a lot of the depreciation was being driven by domestic supply shocks, which have little pass-through to inflation.

[12]The large pick-up in supply shocks over 2015 seem to also capture confidence effects to some extent.

Figure 8: Targeted CPI (excl. petrol): deviations from trend



Measuring exchange rate pass-through over these periods as the contribution of the exchange rate to inflation (by way of the pass-through from the realised shocks) over the magnitude of the depreciation, yields: 44% over the period 1999Q4–2002Q4, 32% over the period 2008Q1–2009Q4, and 0.6% over the period 2011Q1–present. Over the same periods the average year-on-year depreciation of the exchange rate was: 14%, 10%, and 7%.

5 Conclusion

While the model presented above is certainly only a rough approximation of reality (one of many available alternatives). It shows that when the following stylised facts are taken into account:

- Theoretically consistent impulse responses
- Trend growth rates that have at least the ability to reflect regime changes
- Outcomes as deviations from these trends caused by structurally identified shocks
- And the importance of the feedback effects of these shocks

One can account for lower exchange rate pass-through post crisis before needing to consider time-varying parameter models. That is, lower exchange rate pass-through is consistent with the behaviour of economic agents averaged over the entire sample.

The lesson is twofold. One, when economic relationships start to break down it is important not only to consider that economic agents may be fundamentally changing their behaviour, but that they may just be reacting to the changed state of the economy. Two, not to blindly apply rule-of-thumb elasticities to changes in observed outcomes, but again to first query how the state of the economy may have changed.

The second lesson has important implications for policy communication. As the SARB has stressed before the pass-through in its core forecasting model remains 20%, but for reasons such as depressed demand the inflation forecasts post crisis have not shown large increases in inflation. As it turns out this has been well justified.

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Appendices

A Historical decompositions (constant omitted)

Figure 9: Real GDP: deviations from trend

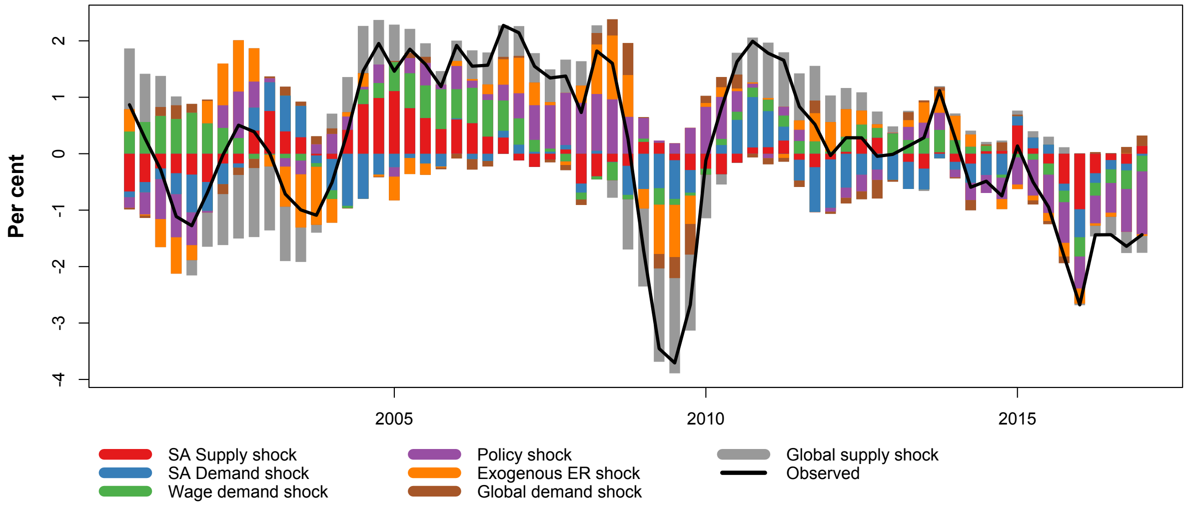


Figure 10: Nominal unit labour costs: deviations from trend

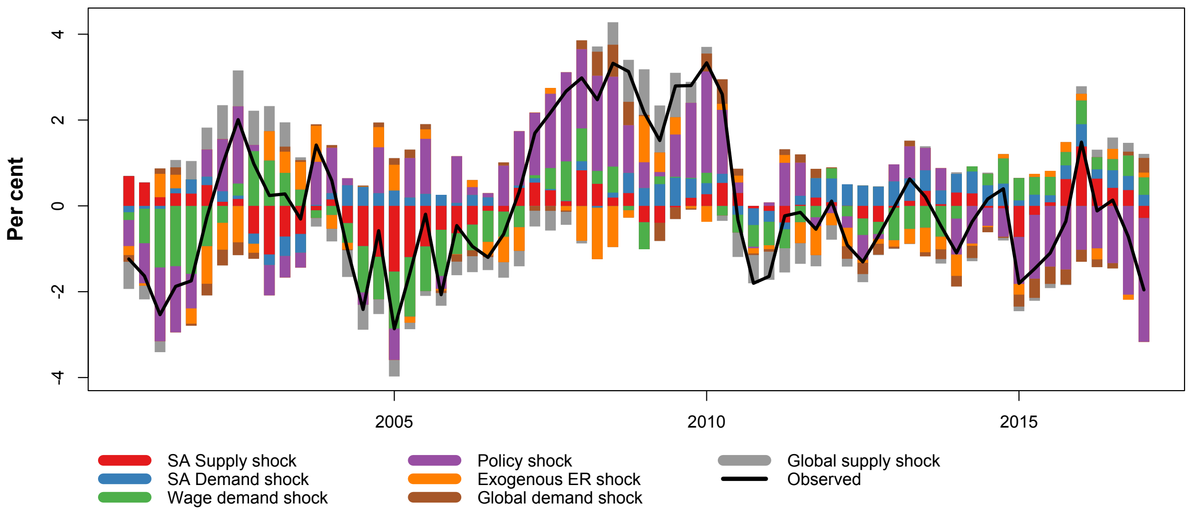


Figure 11: Nominal interest rate (repurchase rate): deviations from trend

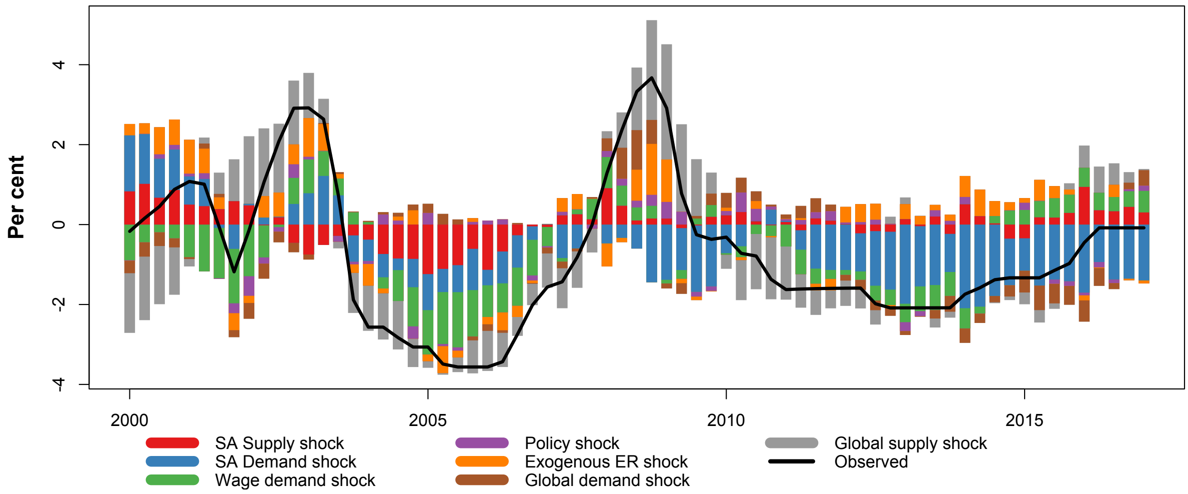


Figure 12: Commodity prices: deviations from trend

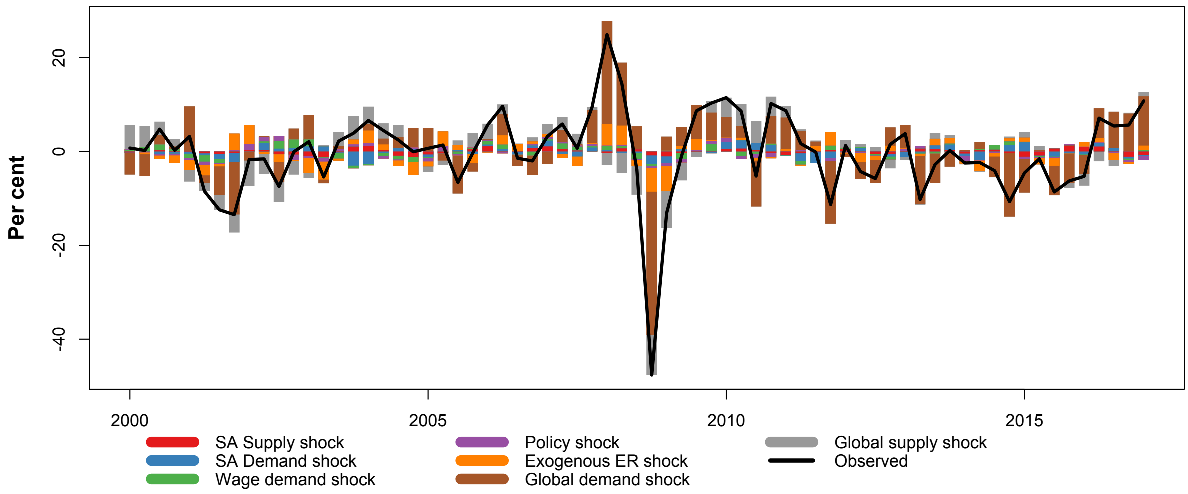
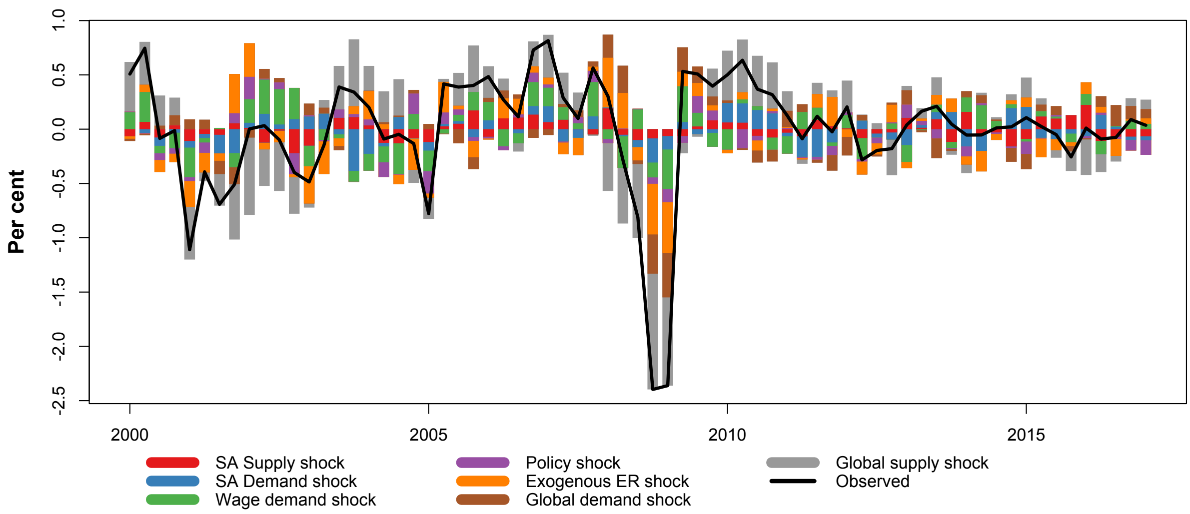


Figure 13: World GDP: deviations from trend



B Impulse-responses: one standard deviation shocks

Figure 14: Domestic supply shock

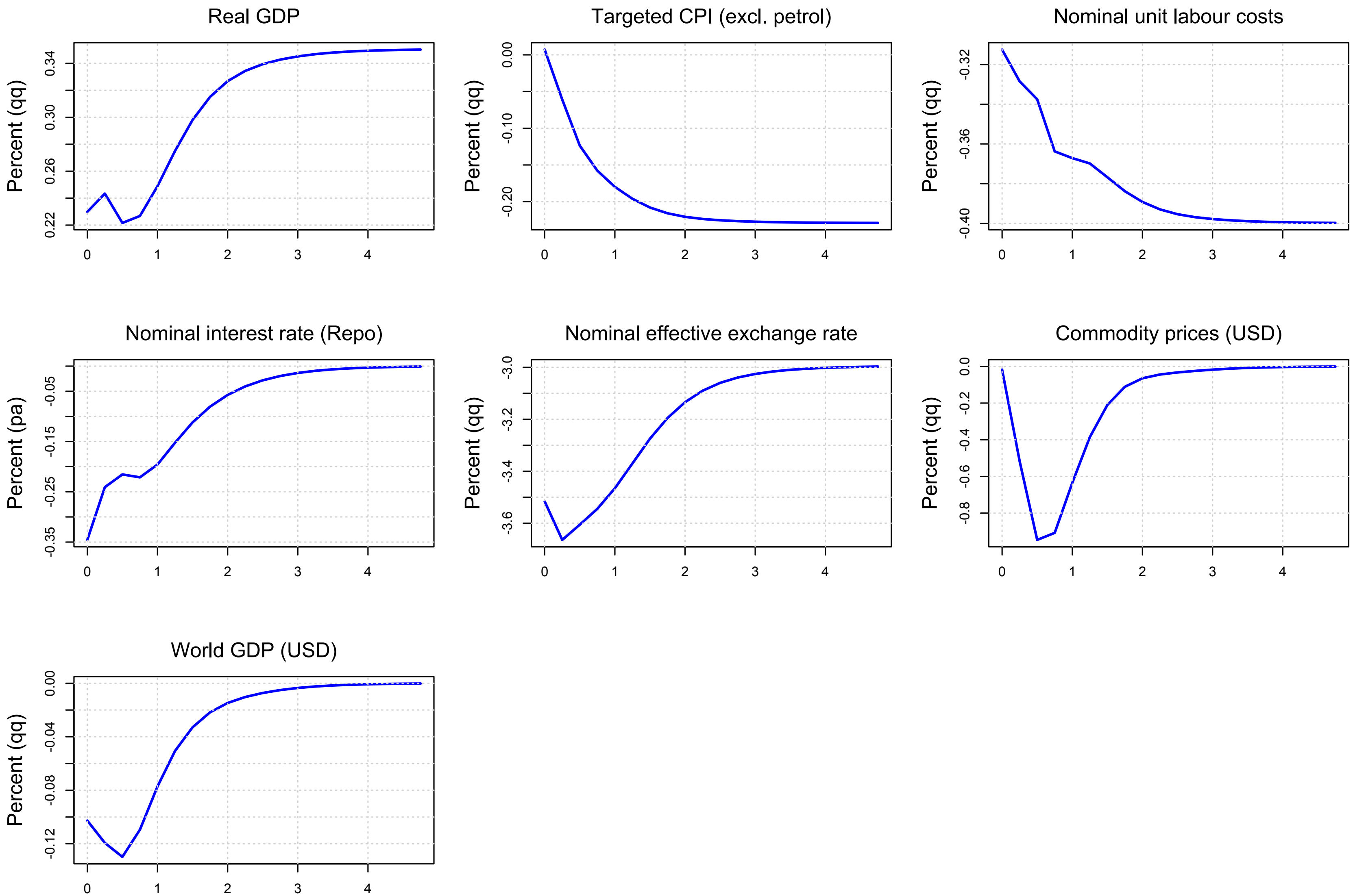


Figure 15: Domestic demand shock

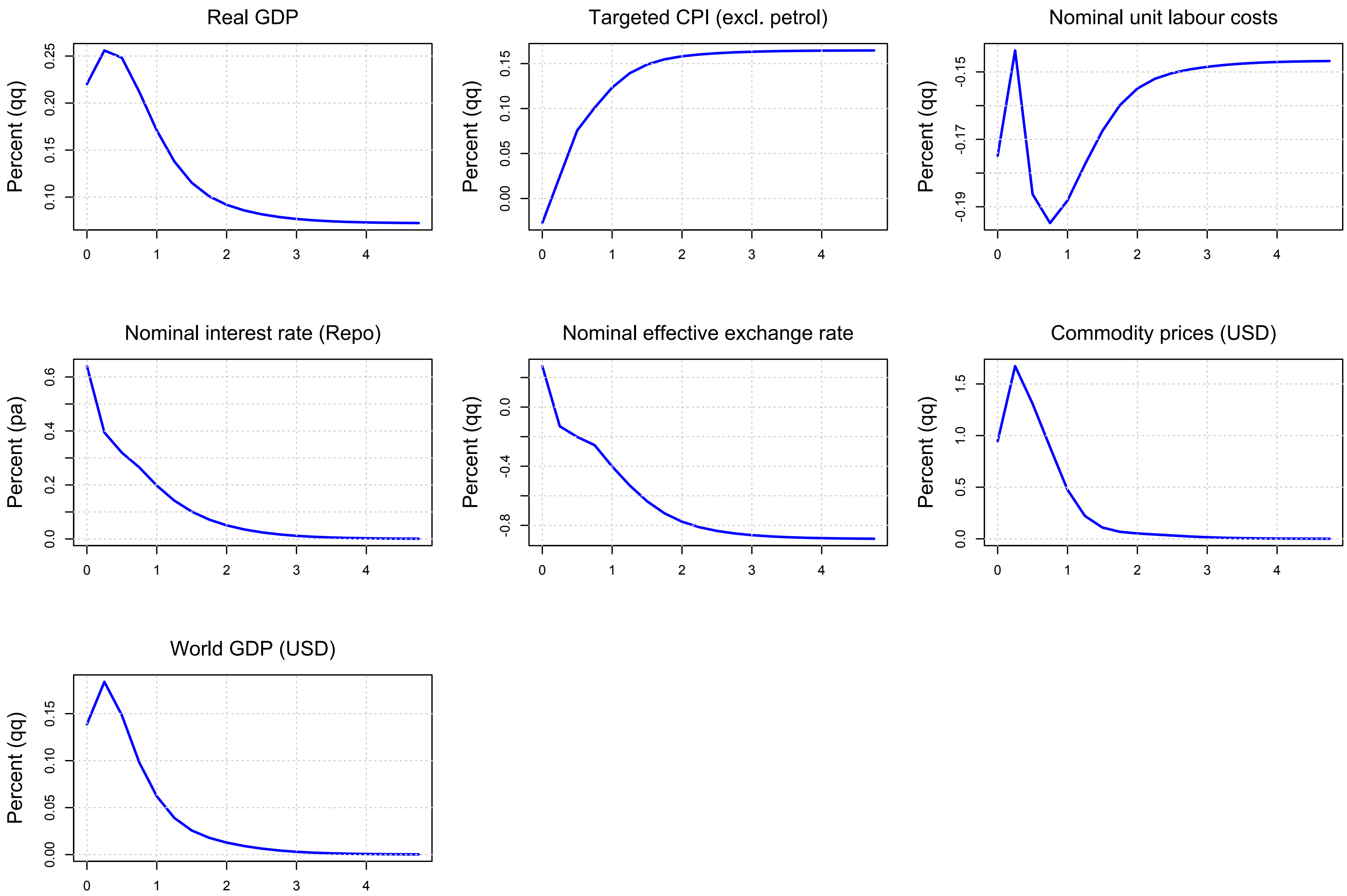


Figure 16: Nominal unit labour costs shock

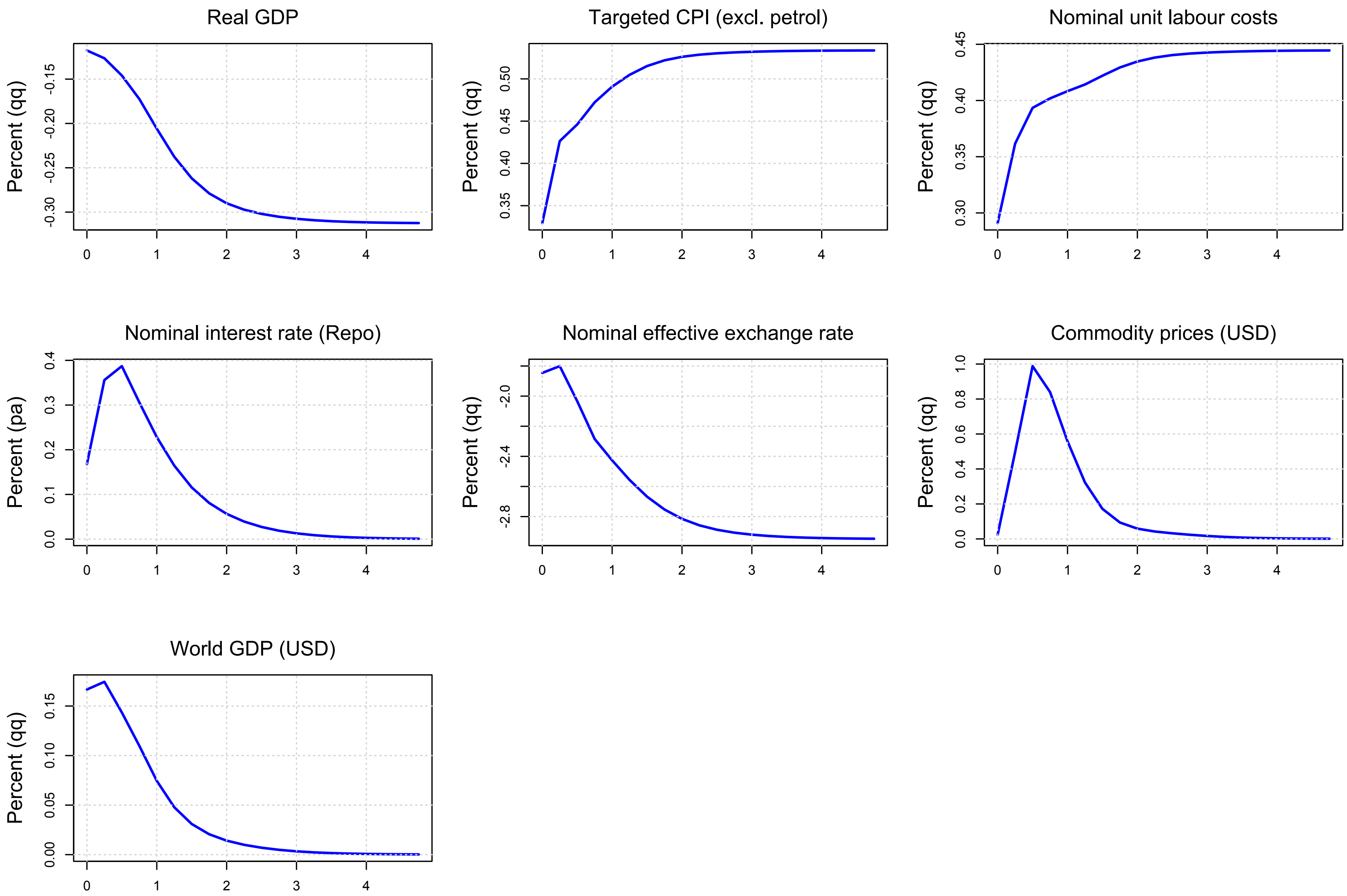


Figure 17: Monetary policy shock

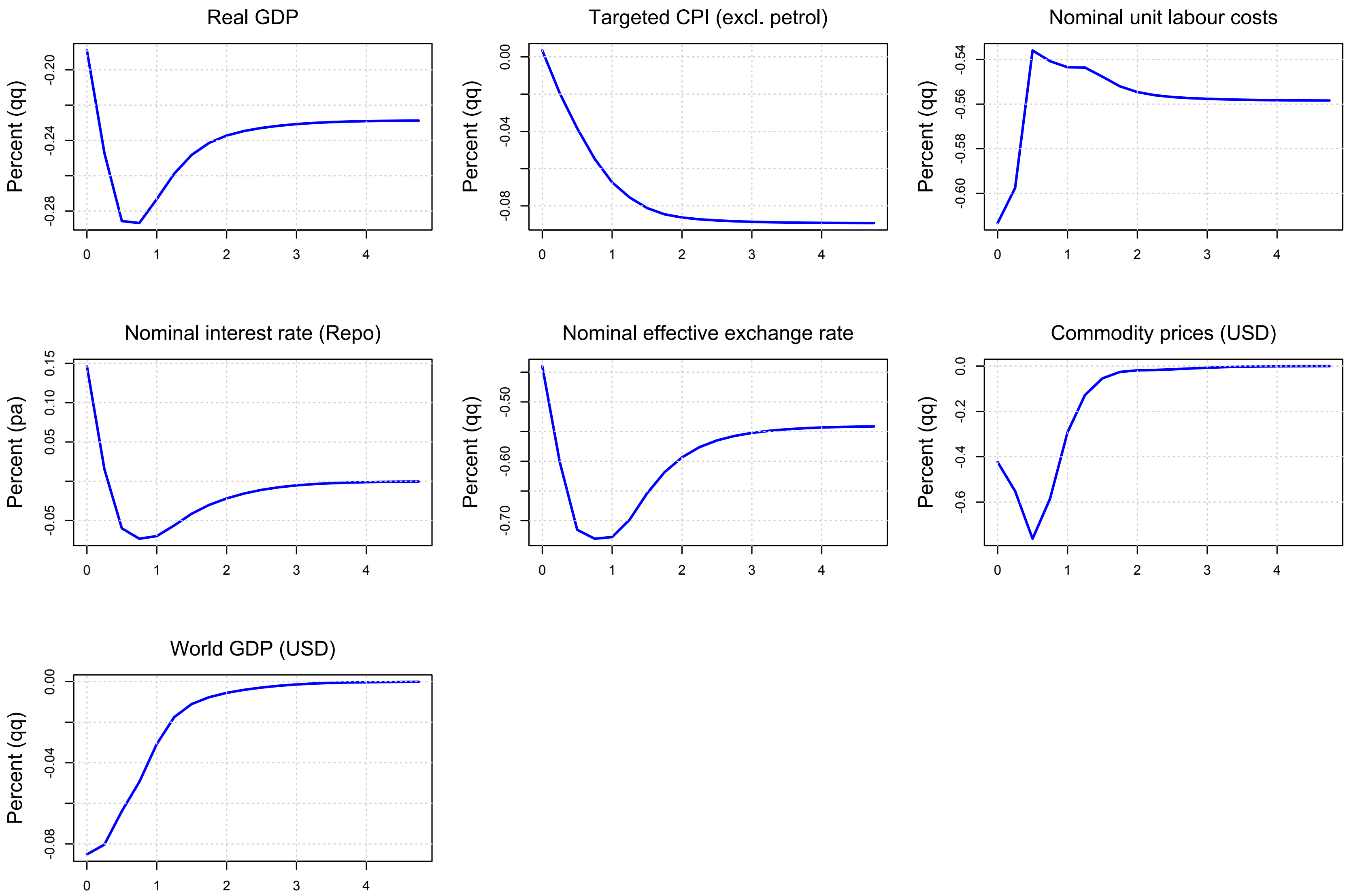


Figure 18: Exchange rate shock

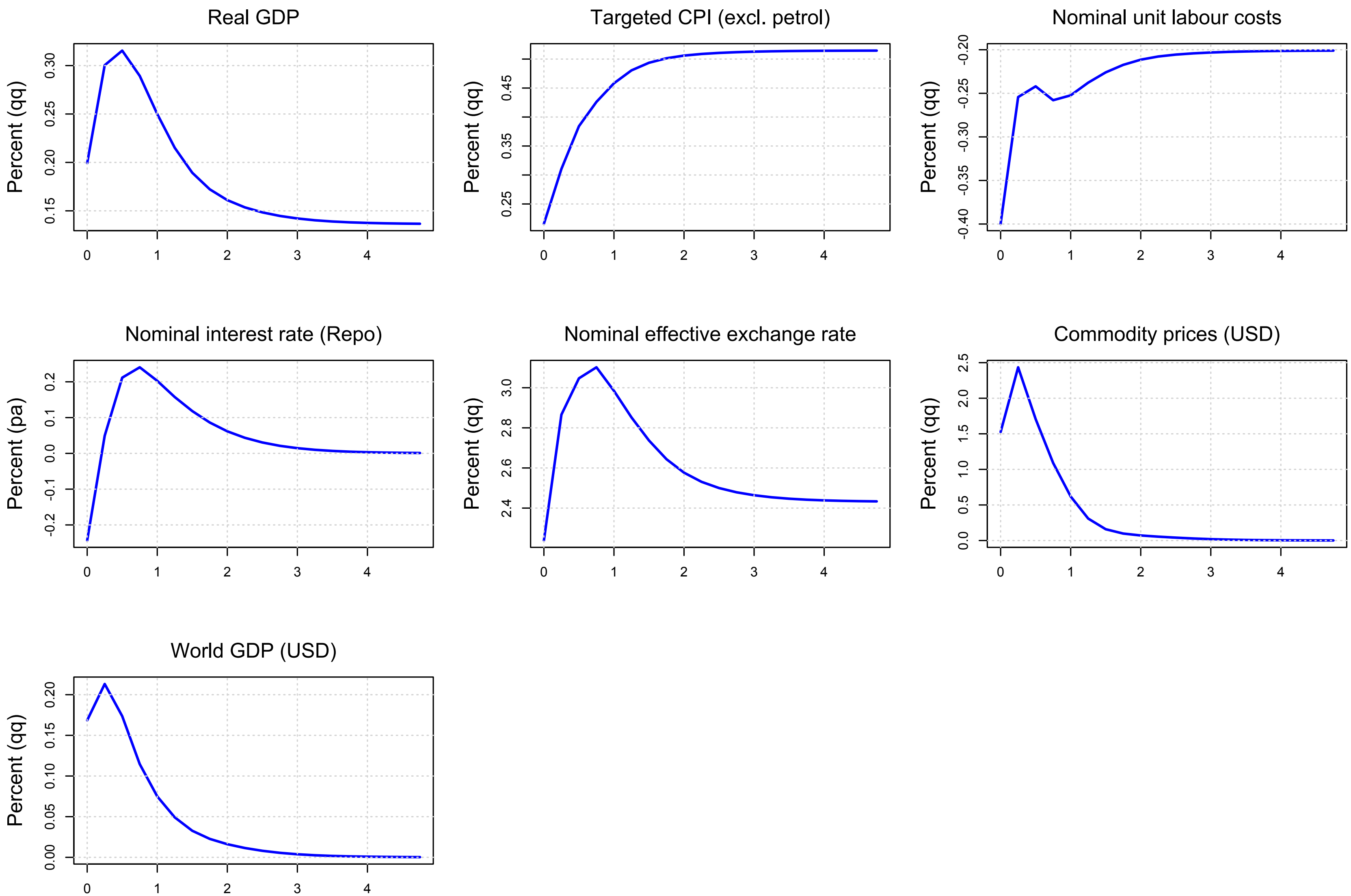


Figure 19: Global demand (commodity price) shock

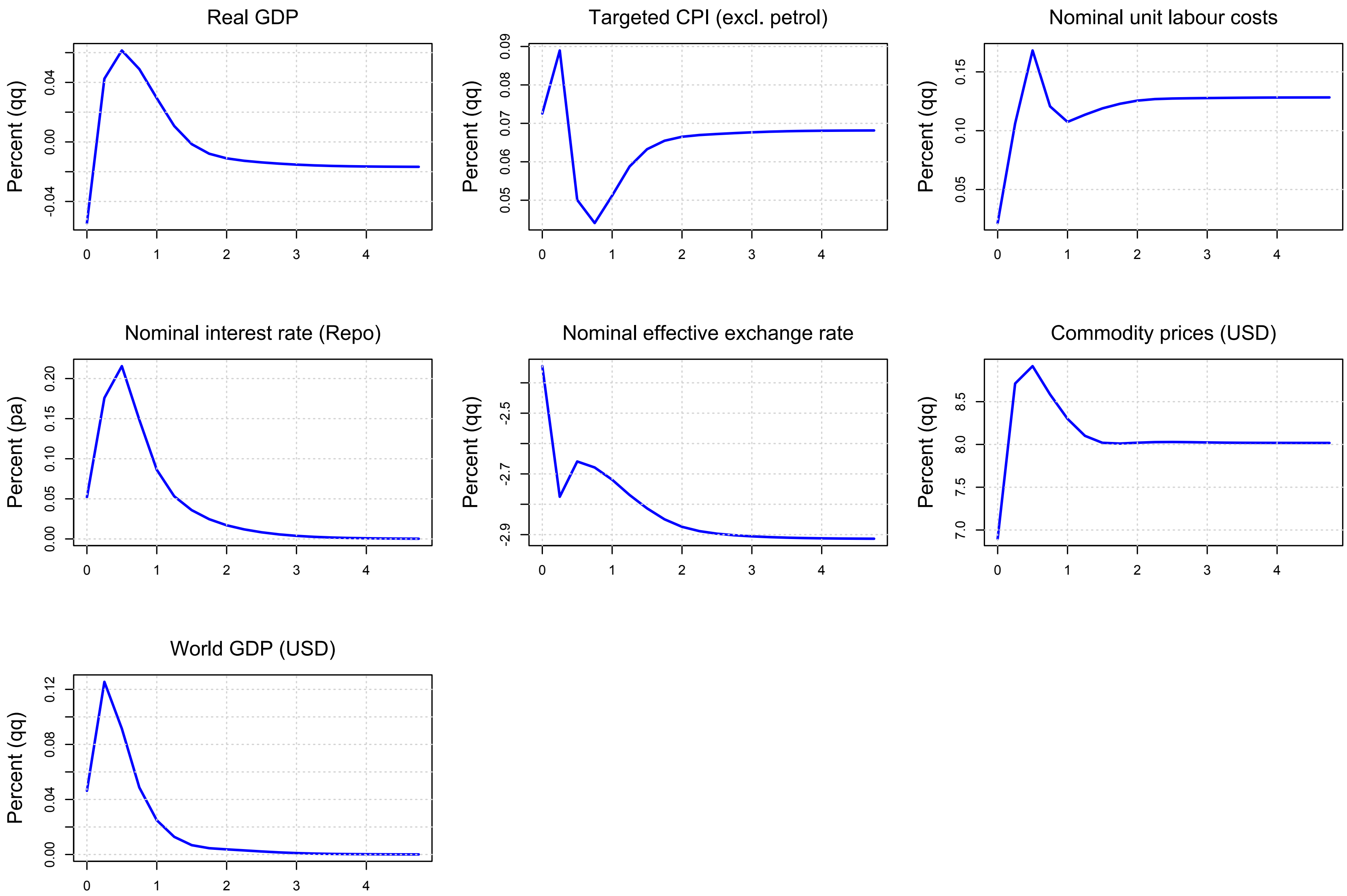
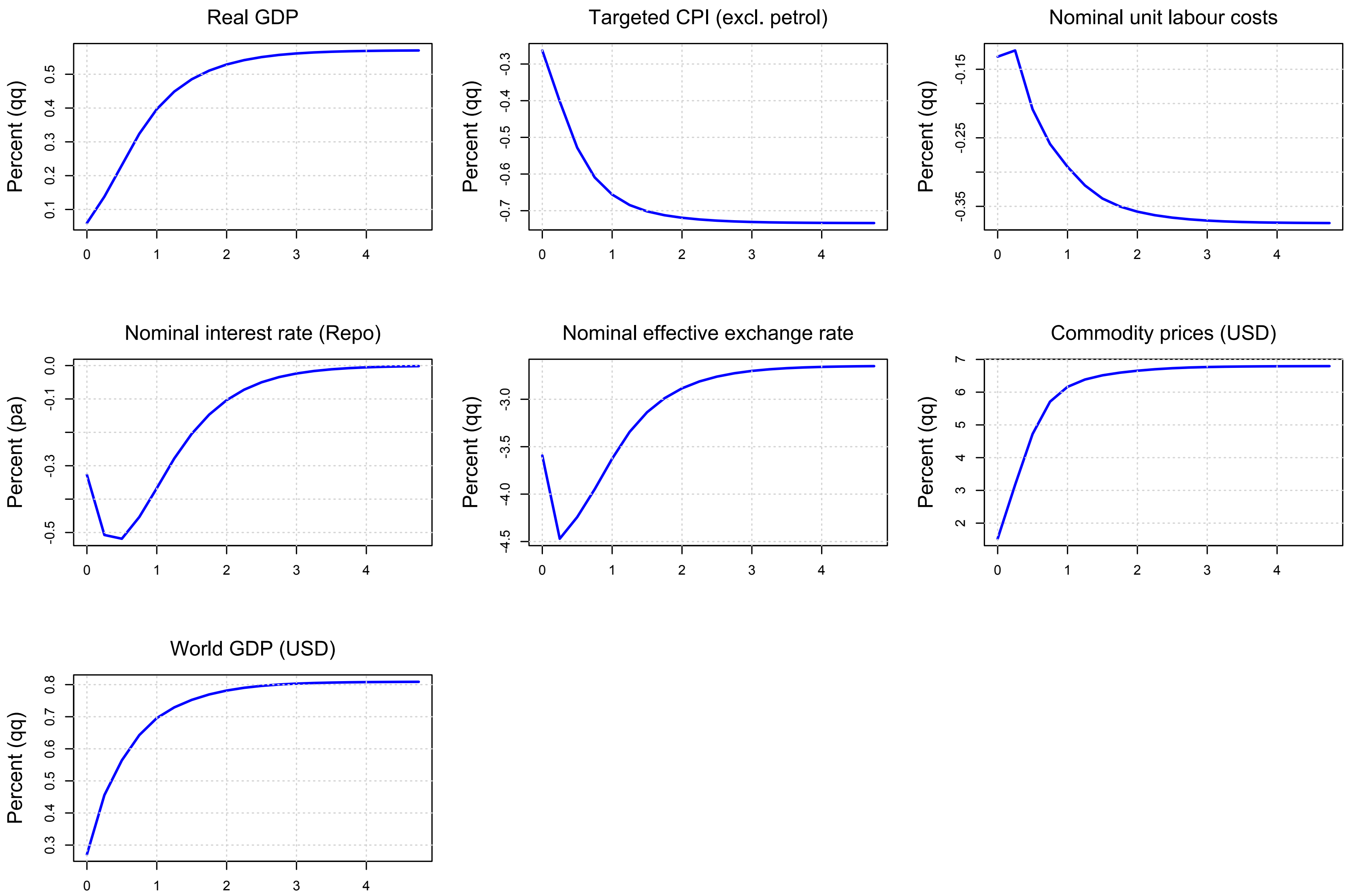


Figure 20: Global supply (world gdp) shock



C Steady-states

Figure 21: Trend growth rates: priors and posteriors

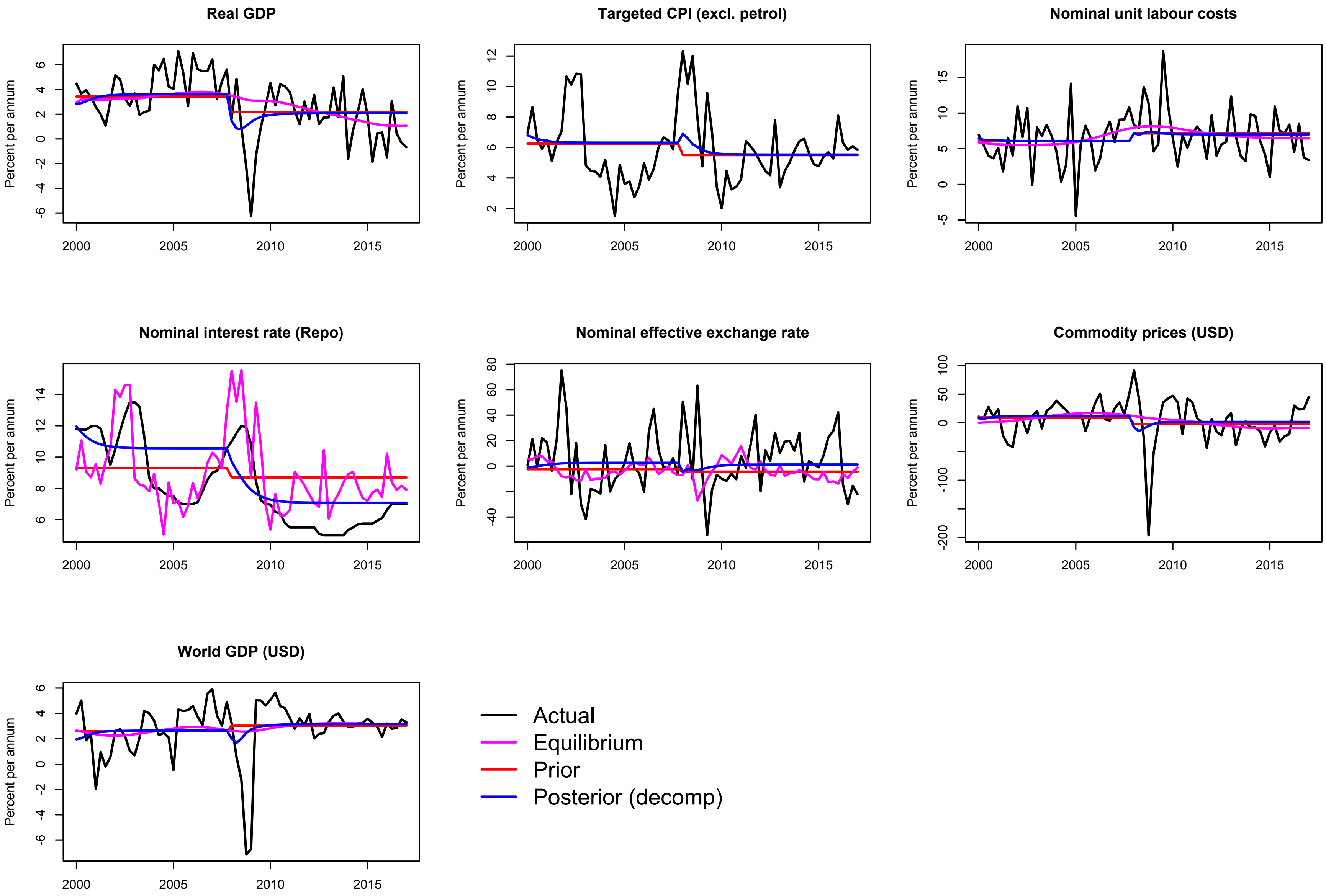


Figure 22: Trend growth rates: prior and posterior densities (1995Q1-1999Q2)

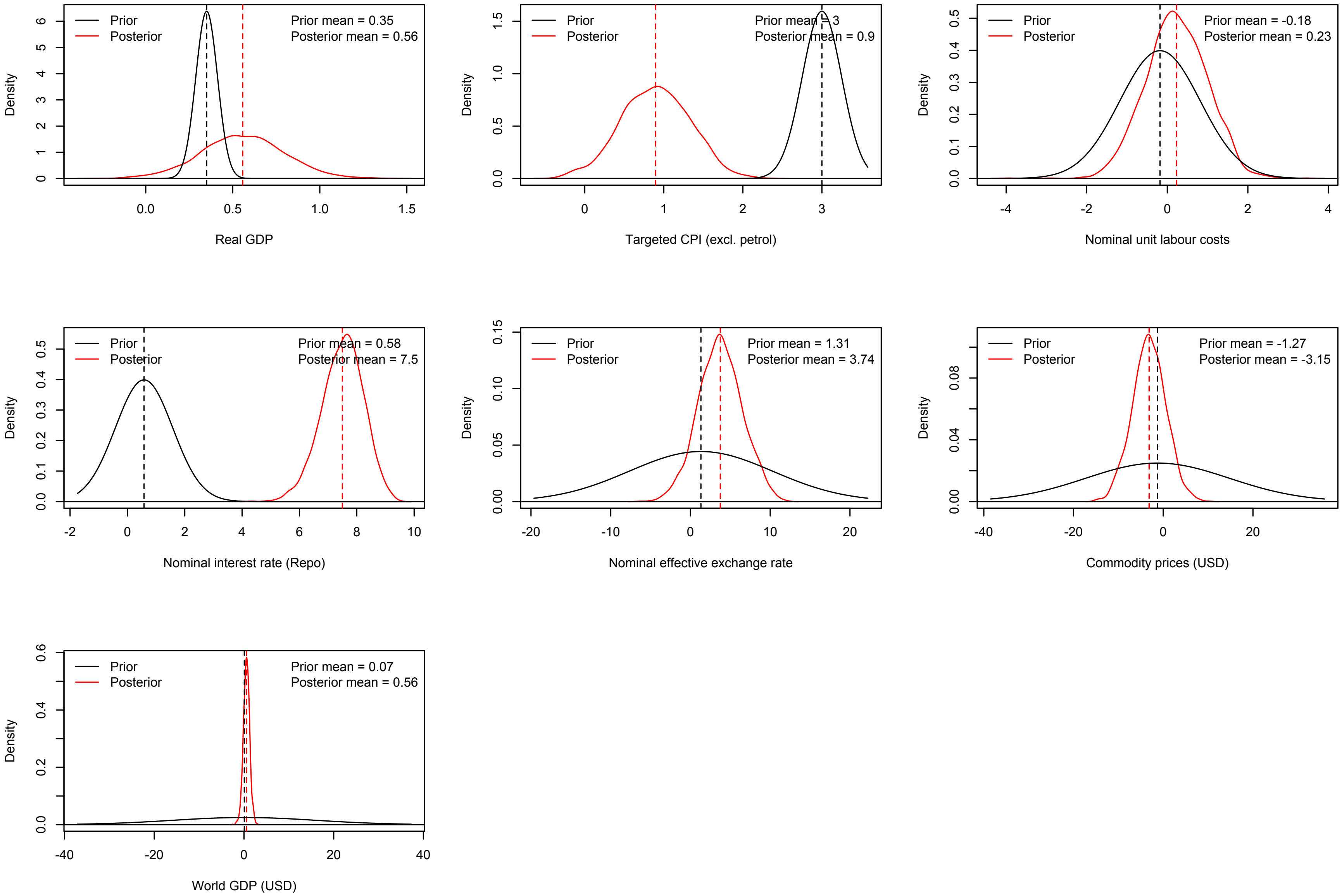


Figure 23: Trend growth rates: prior and posterior densities (1999Q3-2007Q4)

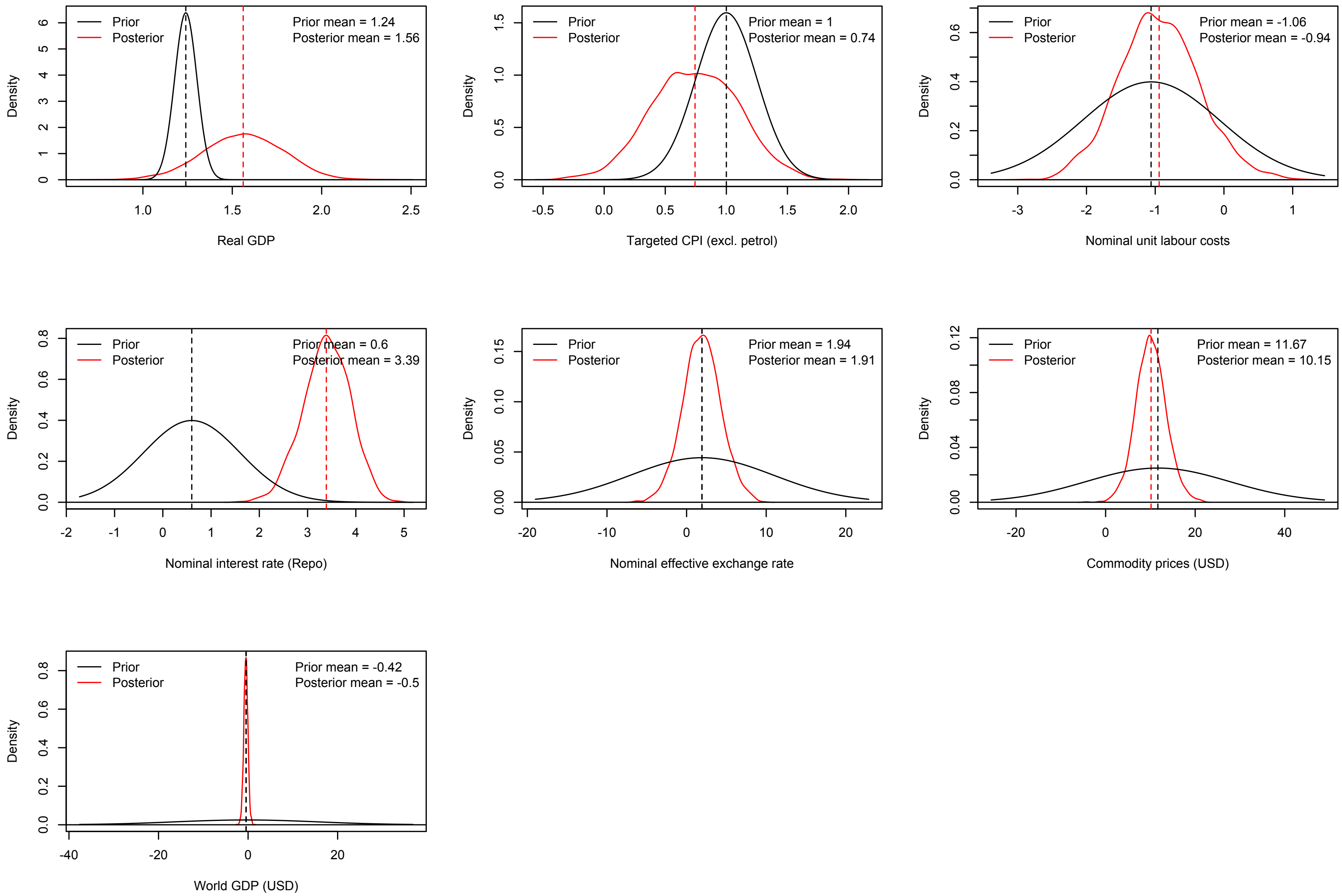


Figure 24: Trend growth rates: prior and posterior densities (2008Q1-2017Q1)