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Monetary Policy, Long Real Yields and the Financial Crisis

Laura Moretti

Center for Financial Studies
Goethe University ■ House of Finance
Grüneburgplatz 1 ■ 60323 Frankfurt am Main

Tel: +49 69 798-30050
Fax: +49 69 798-30077
www.ifk-cfs.de ■ info@ifk-cfs.de

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Center for Financial Studies
Goethe University ▪ House of Finance
Grüneburgplatz 1 ▪ 60323 Frankfurt am Main

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Fax: +49 69 798-30077
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MONETARY POLICY, LONG REAL YIELDS AND THE FINANCIAL CRISIS

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Laura Moretti
Center for Financial Studies

Abstract

This paper investigates the role of monetary policy in the collapse in the long-term real interest rates in the decade before the onset of the financial crisis using a sample of five advanced economies (United States, United Kingdom, the euro area, Sweden and Canada). The results from an estimated panel VAR with monthly data show that, while monetary policy shocks had negligible effects on long-term real interest rates, shocks to the long-term real interest rates had a one-to-one effect on the short nominal rate.

Keywords: monetary policy, long-term real interest rates, panel VAR.
JEL classification: E43, E52, E58.

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1. INTRODUCTION

A number of observers have argued that an excessively expansionary monetary policy played a crucial role in setting the stage for the financial crisis that erupted in August 2007. Under this view, a long period of low short-term nominal interest rates led to the development of financial imbalances whose resolution resulted in the crisis.

On one hand, some have contended that interest rates were simply set below the appropriate level, given the state of the economy. In particular, Taylor has argued in a series of papers (e.g., Taylor 2007, 2008 and Smith and Taylor 2008) that the Federal Reserve set interest rates below the level implied by the Taylor Rule (Taylor 1993), which historically has helped stabilize the US economy. Under this interpretation, central banks made a policy error.

On the other hand, the adoption of explicit or implicit inflation targeting was criticized because it led central banks to focus too narrowly on inflation and to disregard broader developments in asset markets and in the financial sector. Under this view, the notion of gearing monetary policy solely, or mainly, to inflation was flawed. Instead, it has been suggested that central banks need to adopt a broader perspective in setting interest rates.[1]

Whatever its causes, the low level of interest rates may have triggered or amplified the asset price bubble in two complementary ways. Most obviously, a reduction in short-term interest rates and borrowing costs might have led financial institutions to raise leverage in order to increase returns at the cost of higher risk. Doing so is compatible with standard portfolio analysis that holds that investors select a portfolio and borrow or lend at the risk-free rate to achieve a desirable risk/return exposure. Alternatively, the decline in nominal interest rates and expected returns might provide investors with incentives to raise returns by holding riskier assets (See Rajan 2005).

In this paper, I focus on the gradual but cumulatively large decline in long-term real interest rates that was observed in the industrialized countries and that contributed to setting the stage of the recent financial crisis as claimed. This fall is important for two

[1] See Frankel (2012) and Reichlin and Baldwin (2013) for an analysis of the pros and cons of inflation targeting.

reasons. First, lower long-term real interest rates will have reduced the discount factors used to price a wide variety of financial assets, leading them to appreciate sharply in value. Thus, it seems eminently plausible that the decline in real rates played an important role in the financial crisis. Second, standard macroeconomic models suggest that monetary policy cannot explain this fall in real yields since monetary policy has at most temporary effects on real variables.[2] In fact, it seems implausible that a change in the federal funds rate – a nominal overnight rate – can have depressed 10-year real interest rates over a ten or fifteen year period. In turn, this suggests that monetary policy played little role in setting the stage for the crisis.

While most of the studies focus on the US, this paper extends the analysis of Gerlach and Moretti (*forthcoming*) and investigates the role of monetary policy in determining long-term real interest rate in five economies – Canada, euro area, Sweden, the United Kingdom and the United States – that followed different monetary policy regimes. In particular, I estimate a panel VAR with monthly data over the period January 1998 to July 2007. Feasible Generalized Least Squares (FGLS) are used to control for potential unobserved factors common to the economies in the sample by taking into account the correlation between the same variables across countries.[3] Finally, I compute IRFs using a mean group estimator, in the spirit of Pesaran and Smith (1995), to accommodate potential cross-country heterogeneity.

The results of the panel VAR show that the effect of a shock to long-term real interest rate has a positive and statistically significant effect for the first 16 months, while the effect of a monetary policy shock to long-term real interest rate is negligible and statistically not significant. The results confirm the findings in Gerlach and Moretti (*forthcoming*) and show that a monetary policy shock does not depress long-term real interest rates, while the reverse holds. The results are a common feature of all the countries in the panel and seem

[2] See also Bernanke (2013) and Gerlach and Moretti (forthcoming).
[3] See Gambacorta et al. (*forthcoming*).

to suggest that the decline in the long-term real interest reflects developments in the *global real interest rate* rather than the consequence of monetary policy decisions.[4]

A strand of the literature associate the steady decline in the long-term real interest rate with an increase in global imbalances. In a widely quoted speech, Bernanke (2005) argues that savings-investment imbalances in different parts of the world economy led to large capital flows from emerging market economies and from oil exporters to advanced economies, in particular the US. He suggests that the decline in the long-term real interest rate was associated with the increase in the global savings ("global saving glut") relative to investment.[5] Similarly, Caballero et al. (2008a and 2008b) and Caballero (2009) argue that the main driving force was the increase in demand of safe assets by emerging markets after the Asian crisis. [6]

However, Obstfeld and Rogoff (2009) note that long-term real interest rates started to fall in the second half of 2000 and that it was not the result of an increase in global savings since they fell by 1.8% of world GDP between 2000 and 2002. Instead, the initial decline in the long-term real interest rate is more closely related to the deterioration of the high-tech sector and to the perception of lower future productivity, which was also reflected in the fall of equity values after the "dot-com" crash. Subsequently, the increase in the global saving rate[7] helps explaining the relative low long-term real interest rates, despite the monetary policy tightening beginning in 2004. Also Laibson and Mollerstrom (2010) point out that the theory of a global saving glut is not supported by the data and argue that asset price movements, in particular the bubbles in equity and residential real estate markets, provide a better explanation of the international financial flows.[8]

Interestingly, these two strands of the literature may be closely connected. In fact, if long real interest rates fall, nominal interest rates can be expected to fall along the term structure as well. Obstfeld and Rogoff's analysis therefore suggests that the low level of

[4] See King and Low (2014) for an analysis of the generalized decline in the real rates around the world.
[5] See also Moëc and Frey (2006).
[6] See also Forbes (2010) and recently Prasad (2014).
[7] Global savings accounted for 22.6% of World GDP during the period 1987-1994, to 22.0% during 1995-2002 while they steadily increase from 20.9% to 24.4% between 2003 and 2007 according to IMF data.
[8] See also Eichengreen (2014) for a summary of the debate on the cases of the decline of the long-term real interest rate.

policy-controlled interest rates before the crisis may have reflected low real interest rates triggered by external factors, rather than an elementary monetary policy mistake.[9]

However, the hypothesis that the crisis resulted from too expansionary monetary policy has been criticized because the federal funds rate was not unusually low given the state of macroeconomic conditions. Bernanke (2010) performs a simple VAR exercise and shows that the unusual aspect of the economic developments before the crisis was not an abnormally low level of the federal funds rate, but the extraordinarily strong increase in house prices, given the state of the macro economy and the stance of monetary policy. He goes on to suggest that changes in the structure of mortgage finance might have played a role in accounting for the strong rise in property prices. Gerlach and Moretti (*forthcoming*) show, estimating a four-variable VAR and studying a simple New Keynesian model, that monetary policy did not trigger the decline in the long-term real rates, but rather reacted to real side developments.

Moreover, Justiniano et al. (2013) estimate the short-term and long-term real interest rate (RIR) gap[10], and show that, according to the latter measure, monetary policy was not too loose in the period 2002-2006 in contrast with what is suggested by the short-term RIR.[11]

In this paper, I do not attempt to estimate the long-term real yields. Instead, I analyze the role of monetary policy in determining the observed low long-term real rates and the possibility that central banks reacted to the fall in the long-term real rates determined by external factors using a sample of five industrialized countries in the decade before the financial crisis.

The paper is organized in 4 sections. Section 2 reviews the behavior of real indexed yields before the crisis; Section 3 discusses the methodology, the identification and the results of a simple four-variable panel VAR. Section 4 concludes.

[9] See also the discussion in Wolf (2008).
[10] The real interest rate gap is defined as the difference between the ex-ante real interest rate – the nominal interest rate minus expected inflation – and the equilibrium real interest rate. See also Justiniano and Primiceri (2010).
[11] For other studies tackled the estimation of the real interest rate, see Neiss and Nelson (2001), Laubach and Williams (2003), Clark and Kozicki (2005) and Edge et al. (2008), among others.

2. PRELIMINARY ANALYSIS

In this section I review and discuss the behavior of long term real (indexed)[12] and of short nominal interest rates in Canada, France[13], Sweden, the United Kingdom and the United States during the decade or so before the crisis.

It is desirable to look at data for several countries because under the hypothesis that global factors depressed long real interest rates and that these, in turn, led central banks to cut policy-controlled interest rates, I would expect the empirical work to detect strong commonality in the behavior of real interest rates. In particular, one would expect the behavior of indexed yields and policy-controlled interest rates to be similar across countries.

Figure 1 shows the evolution of long-term real yields for the countries in the sample. Several aspects of the figure warrant comments. First, there are differences in level of the different series. While economic factors may lead to such differences, as discussed below, dissimilarities in market liquidity resulting from issuing size and potential buy-and-hold behavior may also play a role. Second, there is a clear tendency for the long-term real interest rates of all the five economies to decline in the sample period. Thus, while they were around 4% in the beginning of the sample, they fell to around 1.5% by 2005, fluctuated during financial crisis, and fell subsequently to about 0.5%.

Figure 2 presents the scatter plots of the first differences of the five series. These are highly correlated: estimated correlations coefficients range between 0.50 and 0.72 and the first principal component explain 69% of the variance of the data. Since the data are monthly, these correlations are very high. Overall, the review of the time series behavior of the indexed yields indicate that long real interest rates are closely correlated in these economies. In fact, it appears reasonable to argue that real rates in these countries largely reflect developments in the *global real interest rate*, which has declined sharply since the

[12] The yields are "generic" 10-year yields from Bloomberg. The average maturities vary from 8.5 years in the United States to 15.7 in Canada.

[13] I use the French indexed yields as a proxy for the euro area. The French real yield is indexed to the French CPI. There is also a real yield indexed to the euro area wide HICP, but since data are only available since January 2001, and since the two series almost coincide (correlation 0.986 in the period January 2001 to August 2011) in the period during which both are available, I use the former series.

late 1990s, with some country-specific fluctuations superimposed. Recently, King and Low (2014) estimate the "world" real interest rate and document its steady decline since the late 1990s. It is easy to see that the fall in long-term real yields across the world would have had a large impact on the pricing of large variety of financial assets by reducing the discount factors used to price them.

Figure 3 presents the evolution of the federal funds rate, which is used to capture the short nominal interest rate in the US, and of the 10-year Treasury Inflation Protected Securities (TIPS) as a measure of long real yield. As the figure shows, the Federal Reserve cut the federal funds rate aggressively after the "dot-com" crash in 2000 and maintained them at 1% until June 2004, when interest rates were gradually increased to 5.25% in June 2006. Interestingly, movements in long real interest rates show little correlation with changes in the federal funds rate. In particular, between 2004 and 2006 the long-term real interest rate initially declined despite the monetary policy tightening.[14] Instead, the most striking aspect of their behavior is the fact that they fell by half from about 4% in 2000 to around 2% in 2005, when they rose somewhat, before falling again to less than 1% by 2011.

Figure 4 presents the one-month interbank rate as a measure of the stance of monetary policy in the UK together with the ten-year real yield. As in the case in the US, there is little short-run correlation between the two series. However, again the figure shows that the long real interest rates fell sharply in the decade before the crisis from 3.7% in 1997 to 1.3% in early 2006, and to less than 0.5% by 2011.

Figure 5 presents the monthly Eonia rate, as a measure of the stance of monetary policy in the euro area, together with the ten-year yield on the French indexed bond (OAT).[15] It is noteworthy that French long real interest rates also fell gradually by more than half in the years before the onset of the crisis from high of about 4% in early 2000 to 2.4% in the summer of 2005.

[14] The observed decline in the long-term nominal and real interest rate was labeled the "Greenspan Conundrum". See Greenspan (2005).
[15] For the explanation on the choice of using long-term rates indexed to the French CPI see footnote no. 14.

Figure 6 presents the analogue time series plots for Sweden. In this case, there is also a sharp decline in long indexed yields from about 4%, around the turn of the millennium, to below 2%, in 2007-8 when the crisis struck. A further decline in long real yields in the period 2008-2011 is readily apparent also in this case. Interestingly, the figure shows that the short nominal and the long indexed yields declined together until early 2006 when policy was tightened sharply.

Finally, Figure 7 displays the behavior of the policy rates in Canada together with the long indexed yields. Also in this case the indexed yields fell from about 4% in the beginning of the sample to below 2% when the crisis struck, and declined subsequently further to below 1% by the end of the sample.

Overall, the Figures 3 – 7 show that long indexed yields and short nominal interest rates declined gradually in the sample period under consideration. However, there were large fluctuations in the stance of monetary policy that did not seem to induce movements in long real rates. In the next paragraph, a more formal discussion of the joint behavior of these interest rates is carried out.

4. A PANEL VAR ANALYSIS

The collapse in long-term real yields raises two questions. First, did the relaxation of monetary policy across the world after the bursting of the "dot-com" bubble in 2001 depress long real yields? Second, how did the decline in the long real yields impact on short nominal rate?

Gerlach and Moretti (*forthcoming*) analyzes the case of the United States and concludes that the monetary policy shocks had a negligible effect on long-term real interest while shocks to the latter had a one-to-one effect on federal funds rate. This paper extends the analysis to a panel of five countries (United States, United Kingdom, euro area, Sweden and Canada) in order to verify whether the same relationship holds for other industrialized countries.

A panel VAR approach allows me to obtain more efficient estimates relative to country-by-country estimations by exploiting also the cross-sectional dimension of the data. Following Gambacorta et al. (*forthcoming*), I use a Feasible Generalized Least Square estimator (FGLS)

to take into account the correlation amongst the residuals across countries in order to control for (unobserved) factors that are common to all the economies in the sample. Moreover, following Pesaran and Smith (1995), I use a mean group estimator, which allows me to obtain consistent estimates even with dynamic models without imposing homogeneity in the coefficients across countries. The steps used to estimate the panel VAR are analyzed in the subsection 4.3.

4.1 SPECIFICATION

The following four-variable VAR model is estimated:

$$Y_{i,t} = \alpha_i + \beta_i A(L) Y_{i,t} + \gamma_i C_t + B_i \varepsilon_{i,t} \quad (1)$$

where $Y_{i,t}$ is the vector of endogenous variables, α_i a vector of constants, $A(L)_i$ a matrix polynomial in the lag operator L, C_t the dummy variables and B_i the contemporaneous impact matrix of the mutually uncorrelated disturbances.

The vector of endogenous variables comprises four variables: the growth rate of economic activity[16], the growth of the price index[17], the short-term nominal interest rates[18] and the long-term real interest rate discussed above. The matrix C_t include dummies to account for effects of the terrorist attacks on the World Trade Center on September 11, 2001, which led central banks to cut interest rates rapidly, and for "Y2K," the perceived risk that the new millennium would lead to widespread failures of software, triggering a surge of liquidity and higher short-term money market rates.

While inflation, the growth rate of economic activity and the short-term interest rate[19] are likely to be stationary, Figure 1 shows that the real interest rates declined over the sample and that they are non-stationary. Indeed, unreported Phillips-Perron tests fail to reject the

[16] For the USA, I compute the growth rate over twelve months using the Coincident Economic Activity Index (source FRED), for the UK I use the interpolated quarterly real GDP using the Chow-Lin procedure while for Sweden, Canada and the Euro Area the monthly Industrial Production index (source OECD).
[17] For the USA, I use the growth rate over 12 months computed using monthly Personal Consumption Expenditures (source FRED), for the Euro Area I use the Harmonized Index of Consumer Prices (changing composition, not seasonally adjusted, overall index, source ECB), while for the UK, Sweden and Canada the Consumer Price Index (source OECD).
[18] For the USA I use the Federal Funds rate, for the Euro Area Eonia, for the UK the monthly Libor, for Sweden the monthly average of the repo rate and for Canada the monthly average of the policy rate.
[19] See Gerlach and Smets (1995).

hypothesis of a unit root. Since Figures 3 to 7 suggest that both interest rates declined steadily over the sample as one would expect given that central banks sought to stabilize inflation, it seems plausible that they are cointegrated.

Since the presence of cointegration would have important implications for how to estimate the VARs, I performed Johansen trace and maximum eigenvalue tests of the hypothesis that there is no cointegrating vector. The trace tests reject that hypothesis at the 0.05 level for all countries in the sample except Sweden, for which only the maximum eigenvalue test does at the 0.10 level.[20] As a consequence, it is appropriate to estimate the system in levels, treating it as an unrestricted version of the vector-error correction model that is implied by the fact that the variables are cointegrated.[21]

4.2 IDENTIFICATION

In order to identify the shocks, I use a standard recursive scheme. Following the literature on the monetary transmission mechanism, I order the long-term real interest rates after the economic activity, inflation and the policy rate. Implicitly, I assume that changes in the policy rate do not impact on economic activity or inflation instantaneously because of policy and transmission lags, but that the converse may be true. The ordering of the long-term real yield after the policy rate is tantamount to assuming that monetary policy does not respond immediately to innovations in the long-term real interest rate, and thus attributes any within-period correlation between the two variables to responses of long-term real yields to federal funds rate. Note that this assumption maximizes the explanatory power of monetary policy for long real yields.[22]

There are several reasons why central banks react slowly to changes in the economic environment. Economic variables, in particular those stemming from financial markets, typically display some short-run volatility. Given the risk that change in a variable will be undone next month, policy makers therefore tend to wait for a while before responding to them in order to avoid adding to volatility in the economy. Furthermore, many central

[20] In the case of the UK, the test rejects that hypothesis only when including 4 lags.
[21] See Lütkepohl (2005, Corollary 7.1.1, p. 289).
[22] However, the residuals are virtually orthogonal so the choice of identifying ordering is irrelevant. Not surprisingly, the highest correlation (0.09) is between the federal funds rate and the yield on TIPS.

banks are hesitant to set monetary policy in response to changes in asset prices because they embed expectations of the future conduct of monetary policy. Responding to them therefore can entail a risk of circularity (see Bernanke and Woodford,2004).[23]

By contrast, financial markets react immediately to new information, including information about the central bank's future monetary policy intention, since it contains information about future returns on a wide range of financial assets. Consequently, one would expect that the long real interest rate reacts to monetary policy shocks. Indeed, Beechey and Wright (2009) find that five and ten year TIPS yields rise in response to a tightening of monetary policy, using intra-day data.[24] However, Gürkaynak et al. (2008) show that monetary policy surprises have no statistically significant effect on the ten-year TIPS using daily data.

Beechey and Wright (2009) also demonstrate that TIPS yields rise in response to macroeconomic news that indicate that real economic activity is strengthening, potentially providing a reason for central banks to tighten monetary policy in responses to rising indexed yields. However, it is a usual identification assumption that a monetary policy shock affects the real economy with delay. However, surprise real-side news move both the monetary policy interest rate (short term interest rate) because they move the output gap, and the long term real interest rate as showed by Beechey and Wright (2009).

In order to verify the robustness of the results, I conduct the estimates also by ordering the long-term real rates before the policy rates. The results (not reported) show that the choice of ordering is irrelevant.

4.3 RESULTS

The panel VAR is estimated on monthly data starting in January 1998[25] and ending in July 2007, the month before the start of the financial crisis, and includes five industrial economies: Canada, the euro area, Sweden, the United Kingdom, and the United States.

[23] A final reason, which is not applicable in the current case, is that data on many economic variables are available only with long delays and may be subject to repeated revisions. This naturally makes policy makers hesitant to react to the most recent data.
[24] Interestingly, the inflation component falls, dampening the overall effect on the nominal interest rate.
[25] The data on long-term real interest rate for the Euro Area are available only since 1998.

Based on the usual lag-length selection criteria, the estimations include three lags of the endogenous variables.[26]

The mean group panel VAR is estimated in several steps. First, I estimate each equation in the reduced form VAR at the individual country-level using FGLS in order to take into account the correlation among the residuals of the same endogenous variables across countries (i.e. between all output residuals, between all price residuals, etc.). Second, the shocks are identified using a standard recursive scheme (Choleski decomposition). Following the bulk of the large VAR literature on the monetary transmission mechanism, I order the monetary policy rate after economic activity and inflation. Finally, impulse response functions are computed for each country and repeated by means of bootstrapping for 10000 times to derive the confidence intervals (in the figures the 10^{th} and 90^{th} percentiles of this exercise are reported). I then average the impulse response functions from the individual economies to get a mean group impulse response function and I report the results in the background of the individual country figures.

In the interest of brevity, I discuss only the responses to shocks to the policy rate and to the yield on 10-year real yields. Figure 8 shows that a monetary policy shock raises the short term nominal interest rates by about 10 basis points on impact and that the effect increases for about 6 months before returning to zero after about 18 months. The results are very similar also at the individual country level.

In Figure 9, it is possible to see instead how the long-term real yield does not respond to an increase in policy rates. Nevertheless, at the individual country level there are some slight differences. In particular, the impact is small, but statistically significant, for Canada, while it is not significant in all the other countries.

Figure 10 reports the impact of a shock to the long real interest rate on the yield of long-term real interest rates. The effect on impact is about 10 basis points, but it is very persistent remaining positive after 2 years.

[26] The selected lag length for US, Canada, UK and EZ is 3, for Sweden is 2. I select the same number of lags for all countries in the panel.

More interestingly, Figure 11 shows that after a shock to the long-term real interest rates, the policy rate increases gradually and remains positive for about 16 months before returning to zero. It is possible to notice some differences in the individual country results. In particular, for the UK the response of the policy rate is positive but short lived returning to zero after 2 periods. In the US and Canada the effect lasts for about 10 periods, while in Sweden and euro zone the effects are long lived.

Overall, the estimated panel VAR of the five economies in the sample suggests that monetary policy shocks have no effect on long-term real interest rates, but that movements in long real interest rates induce one-to-one responses of the short nominal interest rate after some period of time.

7. CONCLUSIONS

This paper reviewed the behavior of long-term real interest rates in the period before the financial crisis. I first documented that these fell sharply between the late 1990s and the start of the crisis in all the industrialized countries in the sample. Then, using a panel VAR analysis, I show that the decline in the long real rates could not have been triggered by loose monetary policy. On the other hand, monetary policy seems to have responded to the decline in the long real rates, which appears to reflect development in the *global real interest rate*.

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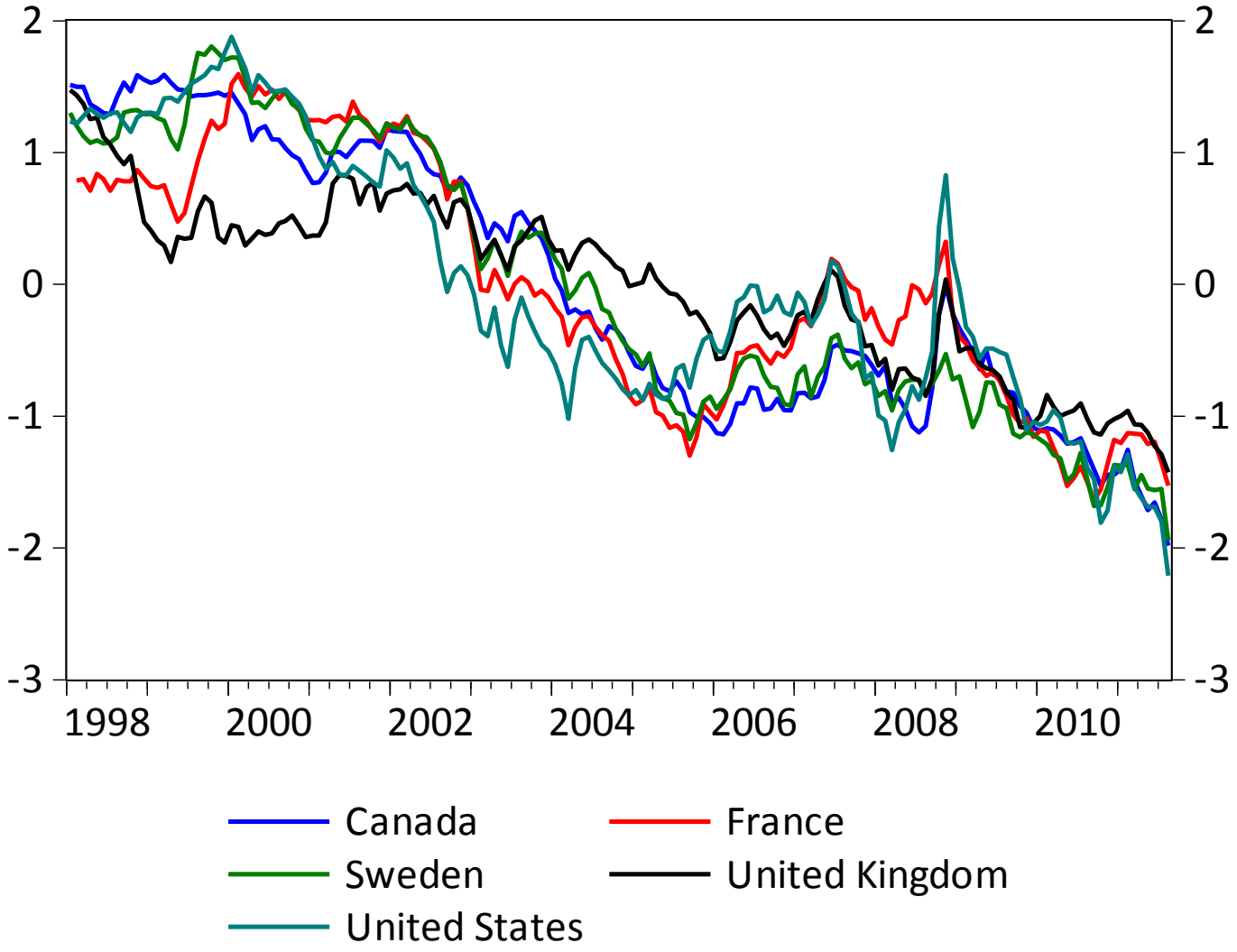

Figure 1: The evolution of the long-term real rates in the countries in the sample.

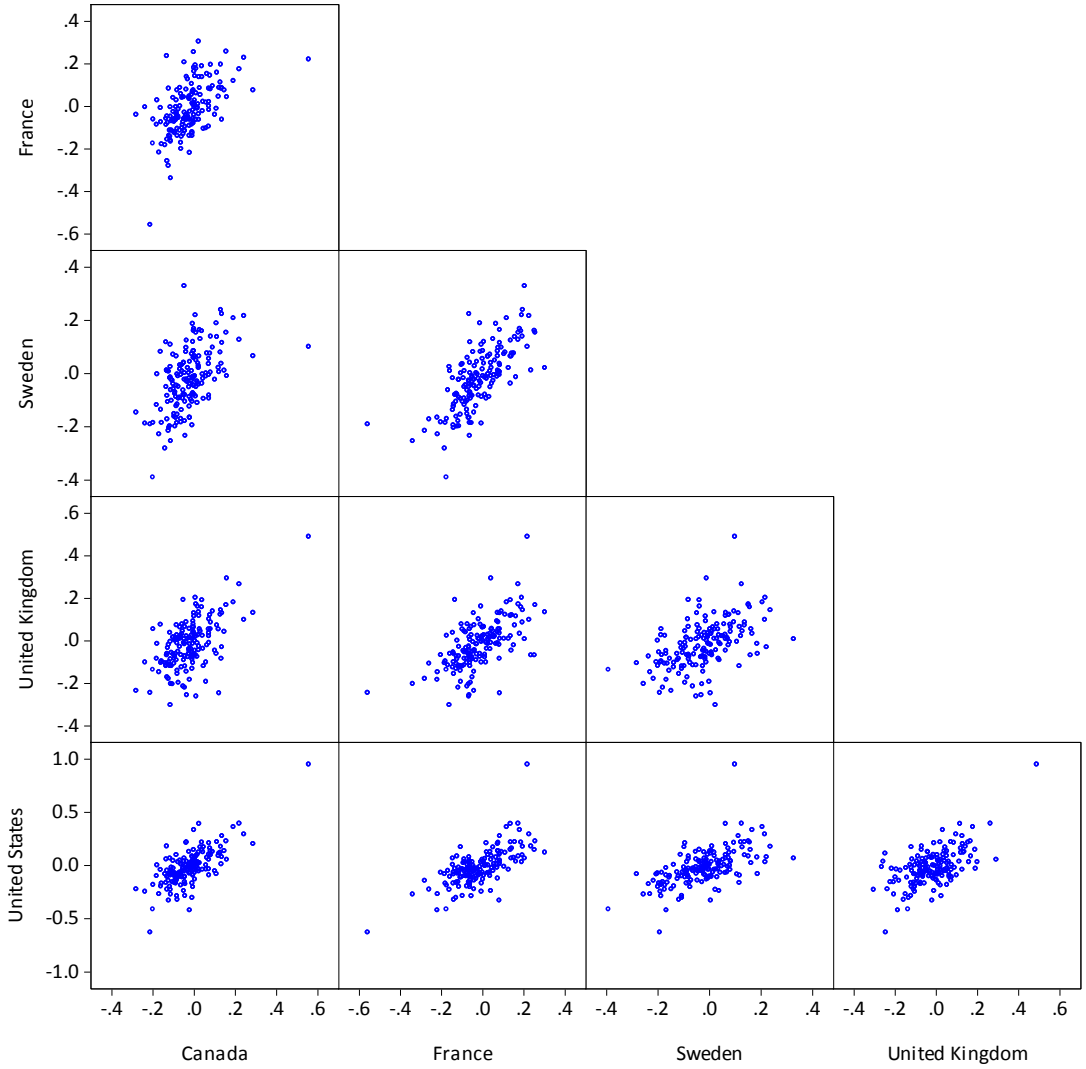

Figure 2: Scatter plots of the first differences of the long-term real rates of the countries in the sample.

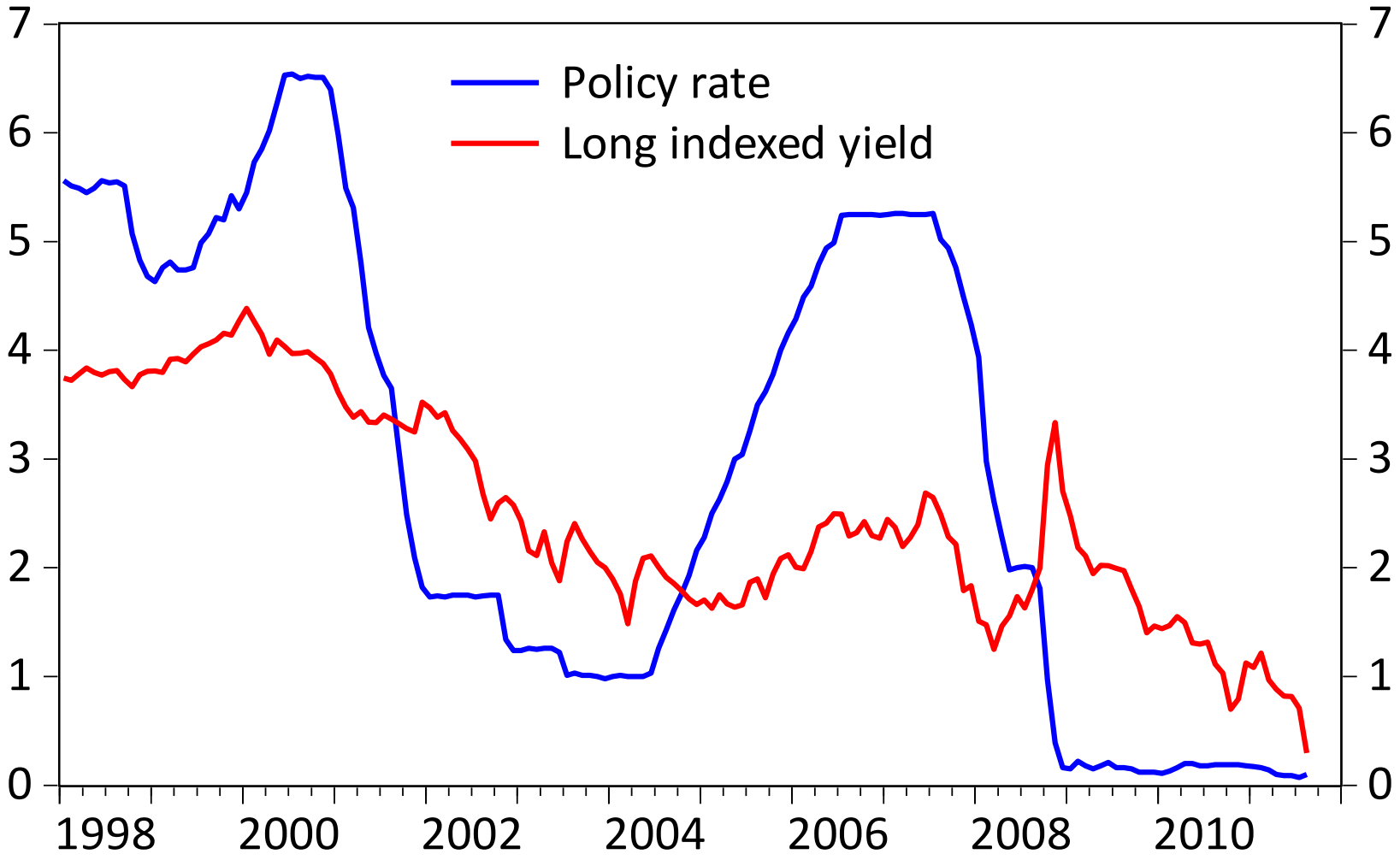

Figure 3: The evolution of the federal funds rate and of the Treasury Inflation-Protected Securities (TIPS).

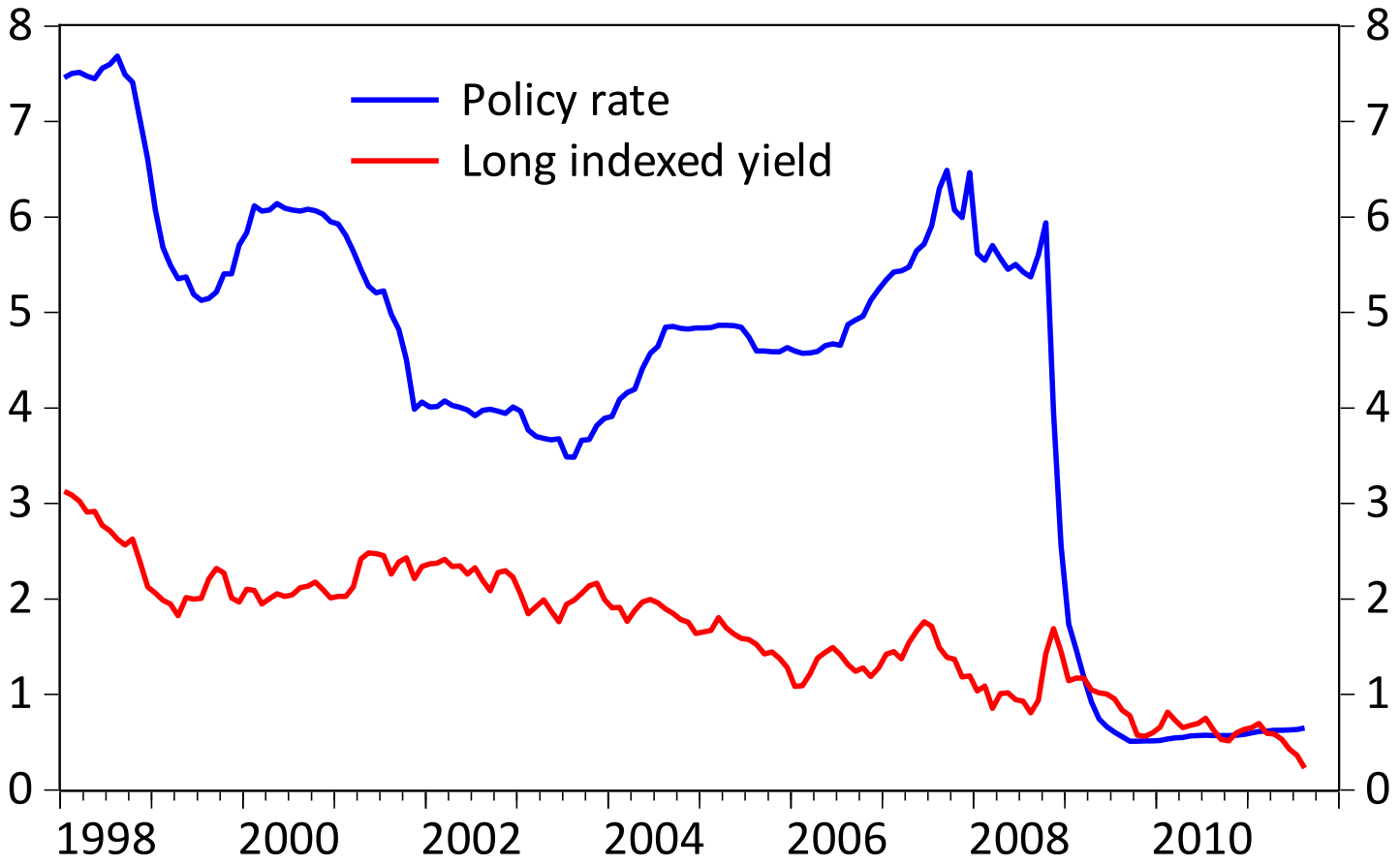

Figure 4: The evolution of the one-month interbank rate, as a measure of the policy stance in the UK, and of the ten-year real yield.

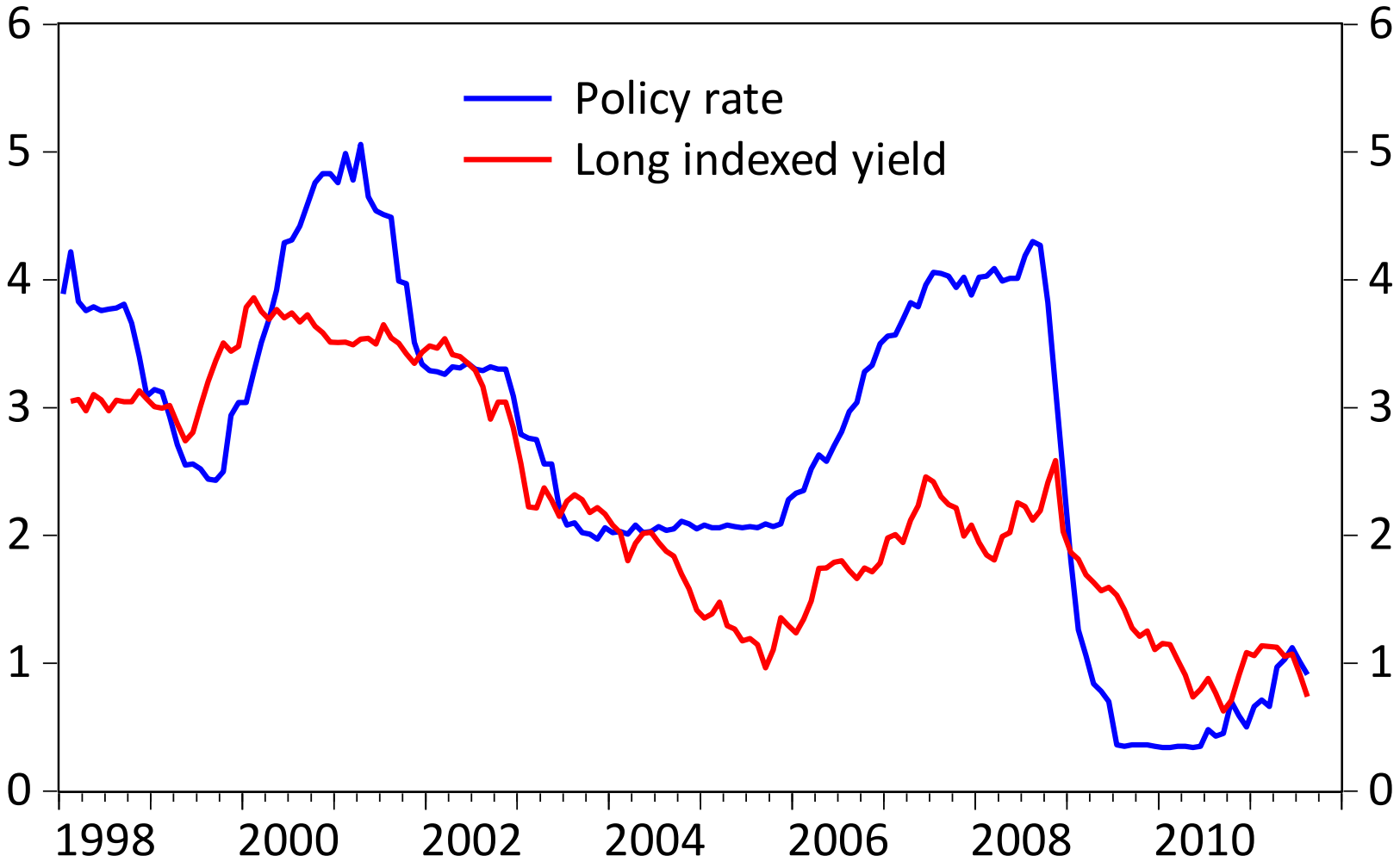

Figure 5: The evolution of the monthly EONIA (Euro OverNight Index Average) and of the yield on the French indexed bond (OAT).

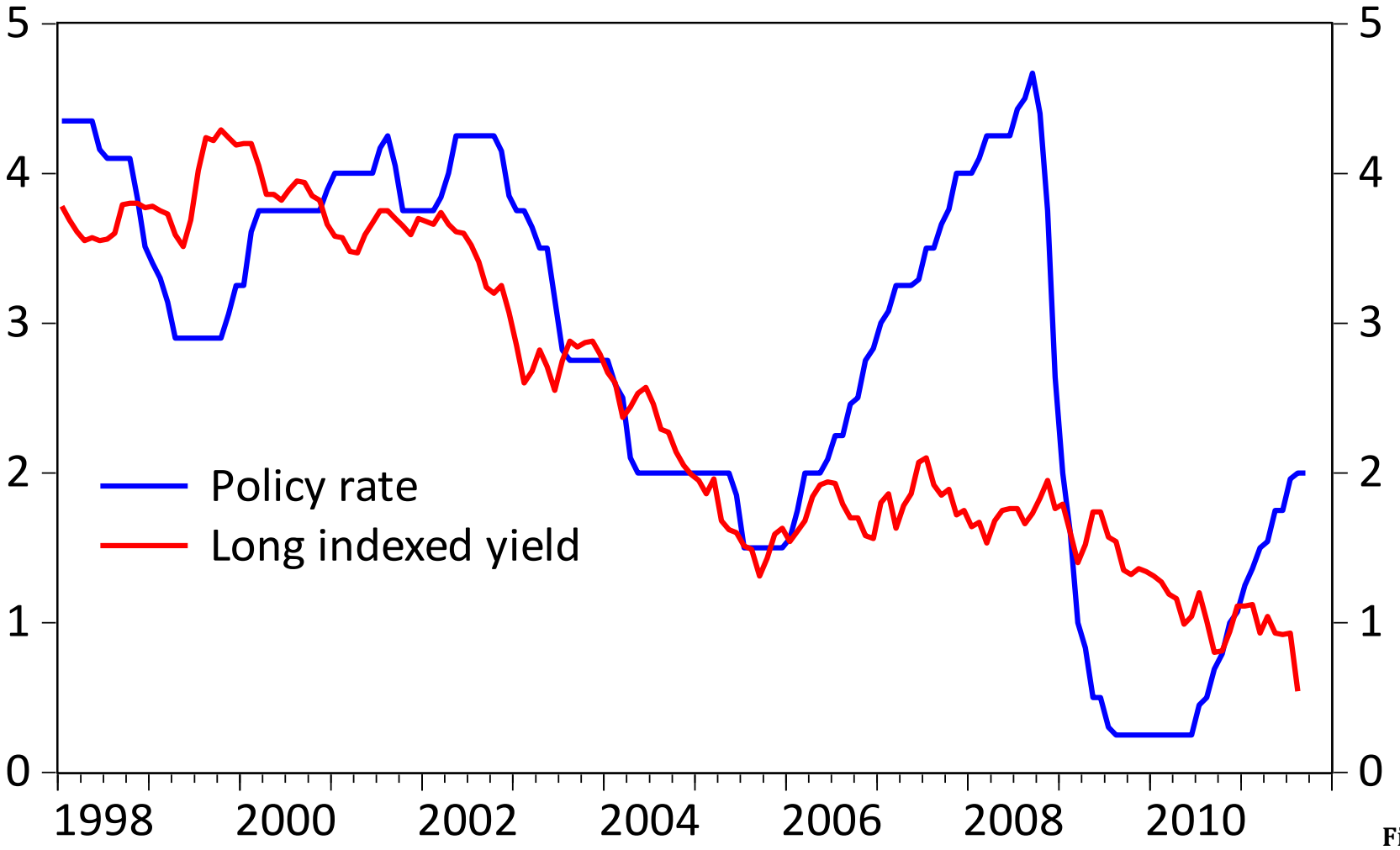

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Figure 6: The evolution of the Repo rate (source Riksbank) and the ten-year long-term real rates.

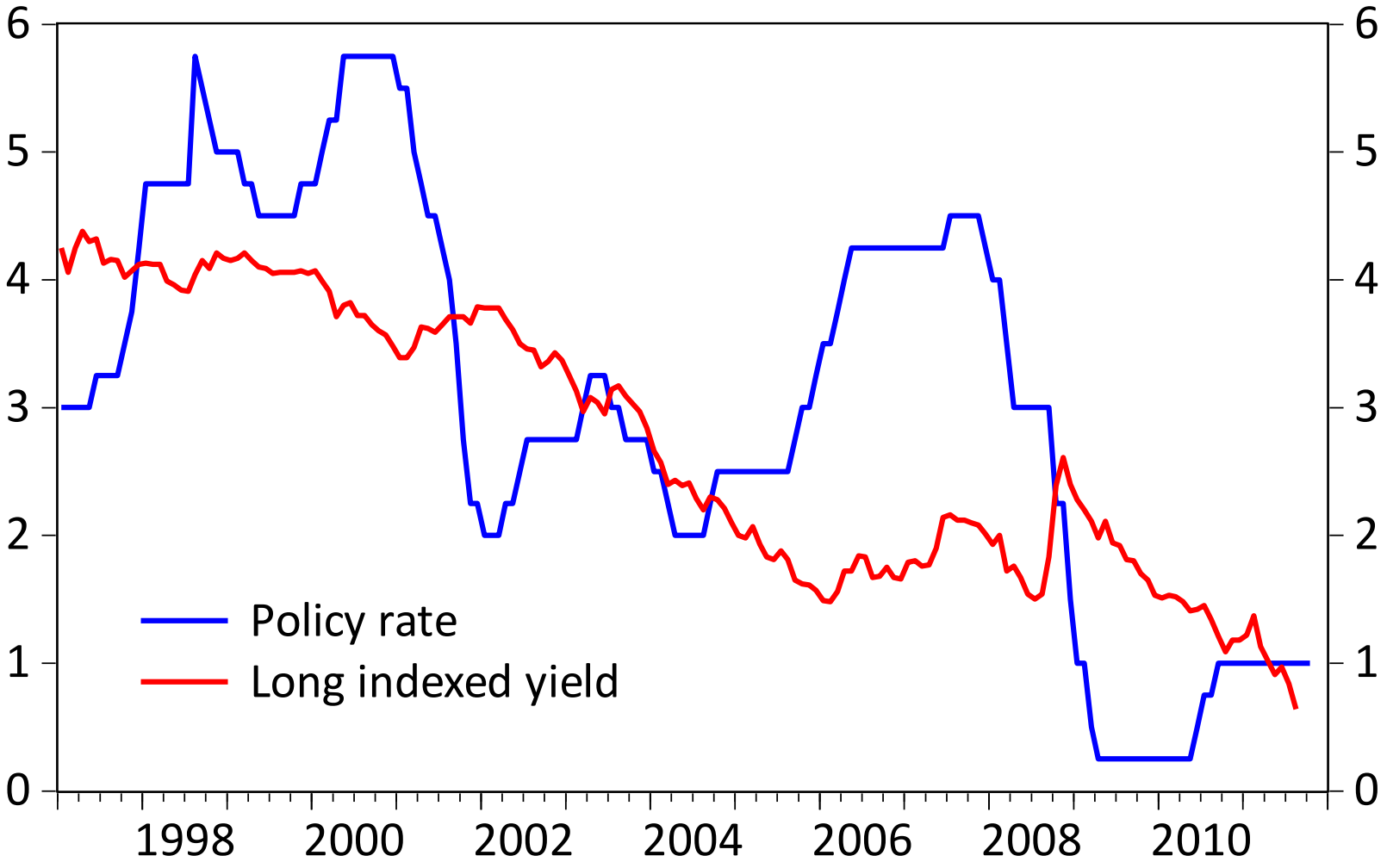

Figure 7: The evolution of the Canadian policy rates and of the ten-year long-term real rates.

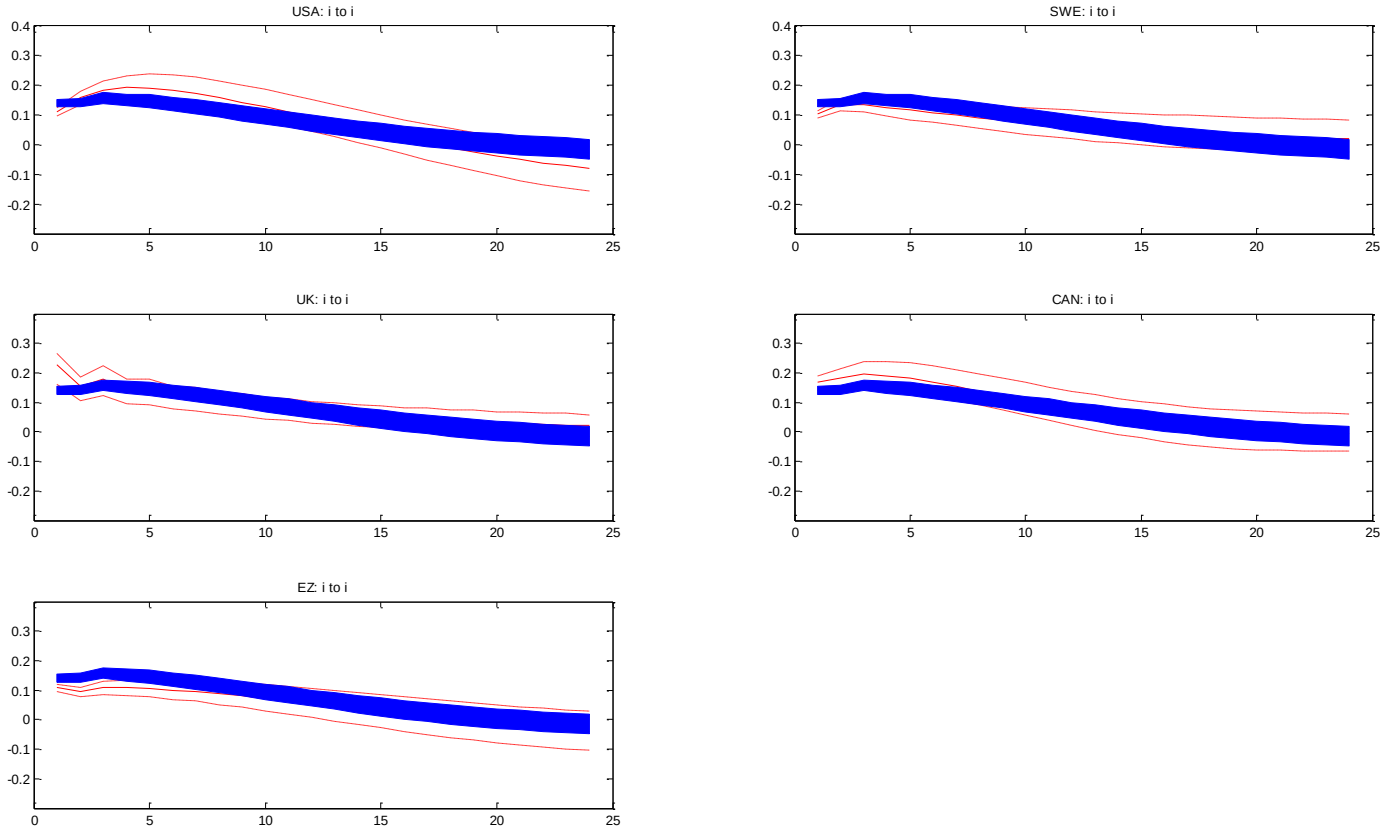

Figure 8: IRFs of to a policy interest rate shock: individual countries and mean group panel VAR estimations.

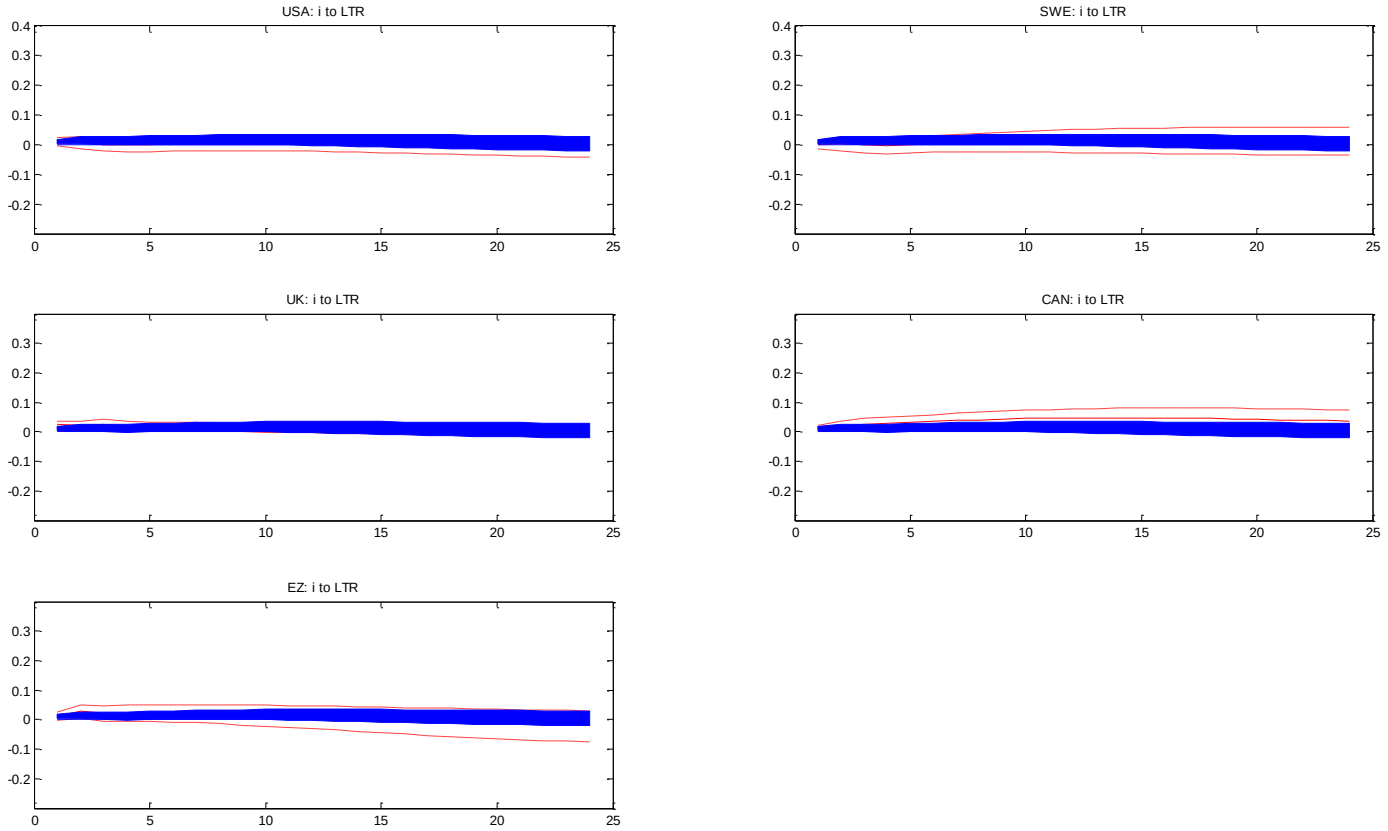

Figure 9: IRFs to a shock to long term real interest rate: individual countries and mean group panel VAR estimations.

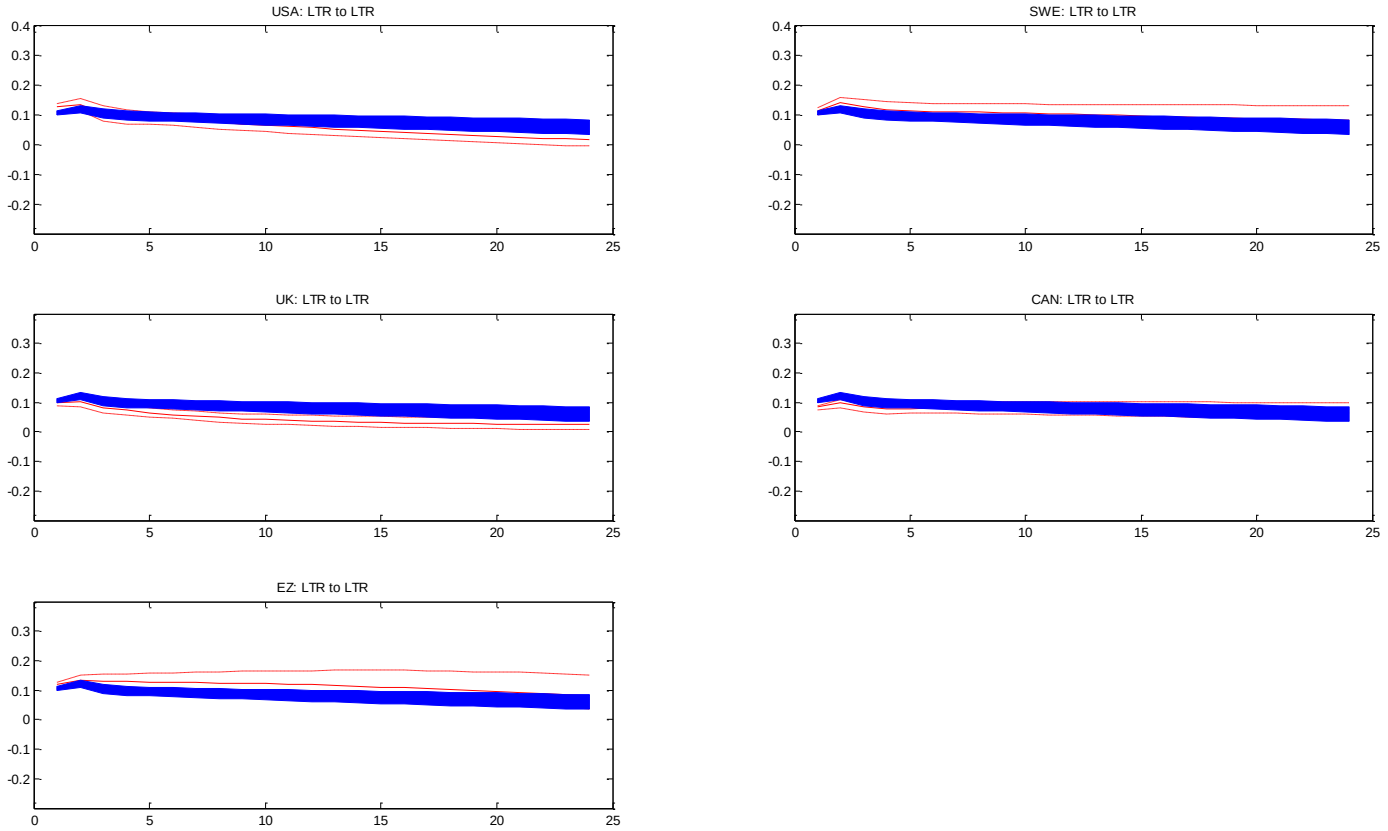

Figure 10: IRFs to a shock to policy interest rate: individual countries and mean group panel VAR estimations.

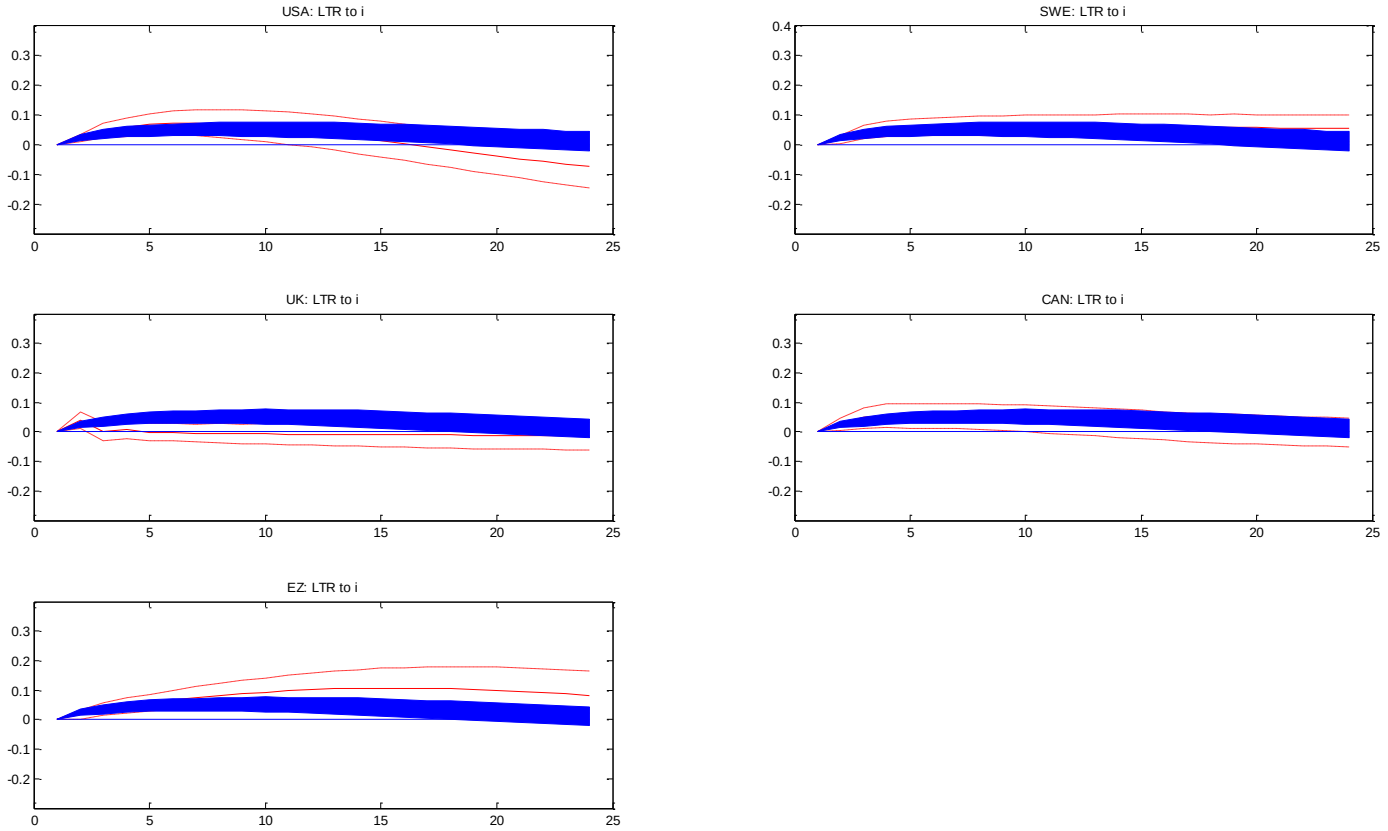

Figure 11: IRFs to a shock to long term real interest rate: individual countries and mean group panel VAR estimations.

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