Global Yield Curves

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Abstract

This paper flexibly introduces global factors in an empirical affine term structure model, nesting previous models with only domestic factors and models with only global factors. We apply our method to a panel of international yield curves and obtain a very good fit of the cross-country term structure of interest rates. We show that the secular decline of the term premium during the last 20 years can be accounted by global factors. Our global term structure model reveals an increase in the term premium after the 2008 credit crisis close to one percentage point in most countries. We also show that as the level of global yield curves becomes higher, domestic term premiums increase.

JEL Classification: C32, E43, F41, G12

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1 Introduction

There are compelling reasons to assert that global shocks impact cross-country government yield curves. The recent credit crisis, for instance, shows that macro-finance shocks are often transmitted internationally. At the same time, a sizable amount of domestic government debt is held by foreigners in global capital markets. Thus, positions on foreign bonds are naturally affected by home macro-finance conditions, and vice-versa. Yet, despite these important stylized facts, studies on the term structure of interest rates pay very little attention to international spillovers in the yield curves In this paper, we investigate the role of global factors in the yield curve of several industrialized countries.

This paper applies the -Factor Augmented Vector Auto Regression (FAVAR)- methodology as a state process for the yield factors, taking into account the influence of global factors on the yield curves of a panel of countries. In this way, we analyze the impact of global factors on domestic yield curves. Moreover, we embed this dynamic global model into a standard affine term structure model, so that we can gauge the influence of global factors on the entire term structure and the term premium on long government bonds. Our model nests previous term structure models, such as closed-economy models, so that we are able to test the restrictions and assumptions of both empirical and structural macro-finance models in the term structure literature.

We apply our methodology to a set of five countries -United States, Canada, United Kingdom, Japan and Germany- using quarterly data since 1990. We first prove, through block exogeneity tests, that global factors are important factors in the state process for the yield factors. We then show that our FAVAR term structure model provides a very good fit of the complete term structure of interest rates. The estimated term premiums in all countries have been decreasing in most of the years, but have experienced an increase of about one percentage point in the U.S., the U.K. and Germany during the current crisis. Global shocks are found to have a strong and significant effect on domestic factors, and thus on yields dynamics. In particular, global monetary policy tightening are found to increase the slope, level and curvature factors of the domestic economy, and to lead to a pronounced increase of the domestic term premium. We are also able to assess the relative contribution of global and domestic shocks to term premiums dynamics. Our results suggest that (1) global shocks explain an important share of term premium fluctuations, and that (2) the estimated secular decline of the term premium on long term bonds can be explained by global factors, in particular by a global level interest rate factor.

Our paper is inserted into a rapidly growing literature on yield curve models which aims at determining the macro-finance factors behind term structure dynamics. Ang and Piazzesi (2003) ignited this literature by investigating the monetary policy implications of empirical term structure models which do not allow for arbitrage among yields of different maturities -the so-called affine term structure models-. A related strand of the literature then elaborated structural macro-finance models consistent with an arbitrage-free term structure (see Rudebusch and Swanson (2008) and Bekaert, Cho and Moreno (2010) among others). All these models are built as closed-economy models and the vast majority of them exclusively deal with the U.S. Treasury yield curve.

Only very recently have several studies examined international yield curves in no-arbitrage frameworks. Wright (2010) follows a very similar -closed-economy- approach to Ang and Piazzesi (2003) to back out the corresponding term premiums across countries. In contrast, Spencer and Liu (2010) and Traczyk (2011) exploit international information to explain term structure dynamics in a limited number of countries (U.K., U.S. and Switzerland, respectively) but do not examine the implied term premiums. These last two works treat interest rates as I(1) processes. In this paper, we enhance the traditional affine term structure framework to flexibly accommodate global latent factors. We generalize by specifying the state space vector as a stationary FAVAR, allowing for the interaction between global and domestic factors while retaining the tractability and interpretation of standard no-arbitrage affine models. We are then able to measure the relative influence of global factors in the term structure as well as the term premium.

This paper proceeds as follows. In Section 2 we develop our global term structure model based on the FAVAR for the state process of the yield curve factors. Section 3 describes our estimation approach as well as the data employed. Section 4 shows our preliminary results. Section 5 provides some concluding comments, indicating the next extensions to be undertaken.

2 A Global Term Structure Model

In this section we first derive the global term structure model subject to analysis and then explain how to extract the implied dynamics of the entire term structure to both domestic and global shocks.

2.1 The Model

To understand the influence of global events on the term structure of industrialized countries, we consider a discrete-time affine term structure model of the sort employed by Ang and Piazzesi (2003), Cochrane and Piazzesi (2008) and Wright (2010).

Let p_t^n represent the price at time t of an $n-$period zero coupon bond, and let $y_t^n = -\log\left(p_t^n\right)/n$ denote its yields. If m_{t+1} denotes the nominal pricing kernel, bond prices can be computed recursively as

$$p_t^n = E_t \left(m_{t+1} p_{t+1}^n \right)$$

We assume the pricing kernel m_{t+1} is conditionally lognormal

$$m_{t+1} = \exp \left(-r_t - \frac{1}{2} \lambda_t' \lambda_t - \lambda_t' \varepsilon_{it+1} \right)$$

where $\lambda_t = \lambda_0 + \lambda_1 Y_t$ is an affine function of an $mx1$ vector of state variables, Y_t and ε_{it+1} is i.i.d. $N(0, I)$. We assume the vector of state variables is composed by two sets of variables:

$$Y_t = \begin{pmatrix} X_{it} \\ F_t \end{pmatrix}$$

where X_{it} is a vector of domestic variables specific to country i. Following Joslin, Priebsch and Singleton (2009), the vector X_{it} consists of the first three principal components of the zero-coupon yields from three months to ten years in that country, plus quarterly inflation and GDP growth. The state vector is completed with F_t, a set of "latent global factors" described below. In turn, the short-term process (r_t) is linear in the state vector:

$$r_t = \delta_0 + \delta_1' Y_t$$

Alternatively to the existant literature, we assume the true state of the system is described by a Factor Augmented VAR (FAVAR) model, where country i state variables

X_{it} and F_t global factors obey the following dynamic factor model:

$$X_{it} = \mu + \Lambda_i F_t + \Phi_i X_{it-1} + v_{it} \quad (1)$$
$$F_t = \Omega F_{t-1} + \eta_t$$

In our setting, we thus allow the evolution of country-specific variables, X_{it}, to be affected by global factors F_t. Notice that our FAVAR nests the case in which global factors do not affect domestic factors ($\Lambda_i = 0$), as in Wright (2010), and the case in which the evolution of X_{it} strictly follows the evolution of the global factors ($\Phi_i = 0$).

FAVARs have in general been used to estimate models with a large number of macroeconomic variables (Stock and Watson 2005, Bernanke Boivin Eliasz 2005, Forni, Giannone and Riechlin 2006) and track their dynamic response to a smaller set of structural shocks. These are typically VAR methods that are based on dynamic factor analysis, which was first introduced by Geweke (1977). Dynamic Factor Models rely on the assumption that the cross correlation among macroeconomic variables is due to the presence of unobserved (latent) components, which are in turn driven by common structural economic shocks. For instance, all the variables that relate to economic activity will be driven by a "common output shock" and the observed heterogeneity in these time series will be explained by the different response to the common structural shock. Identification of these small set of structural shocks is therefore what is really relevant for policy analysis. The FAVAR is thus well-suited for our exercise, where we allow the vector of state variables of the term structure to be influenced by a small set of "latent global factors" which drive the co-movement of inflation, real activity and interest rates across countries.

The empirical specification is similar to that adopted by Stock and Watson (2005) and Bagliano and Morana (2009). Differently from them, however, the vector of latent factors

F_t is extracted from a broader set of variables M_t which includes the term structures, inflation rates and growth rates of all the countries included in the analysis:

$$
\begin{aligned}
M_t &= \{M_{1t}, ..., M_{nt}\} \\
M_{jt} &= \left[i^1_{jt}, ..i^{10}_{jt}; gdp_{jt|t}, gdp_{jt+1|t}; \pi_{jt|t}, \pi_{jt+1|t}\right]
\end{aligned}
$$

Extracting latent factors from a set of variables taken from the different countries allows us to interpret the common factors F_t as global factors so that the behavior of the variables in M_t can be described by a combination of the elements in F_t with weights the factor loadings:

$$M_{it} = \Gamma F_t + \zeta_{it}$$

where ζ_{it} is an idiosyncratic component. As is common in the literature on dynamic factor models, F_t can be consistently estimated by applying principal components to the matrix of data M_t.This approach, however, can give raise to issues of interpretability of the extracted factors. Hence we adopt the strategy of Bagliano and Morana (2009) and extract the factors from sub components of the matrix Y. In our study, global factors F_t for a given country are computed as the three principal components of the macro variables and interest rates of the remaining countries. In particular, the first factor is extracted from the data on the term structures; the second from the data on real GDP growth and the third from data on the rate of inflation. In this way we can interpret the three elements of F_t as "Global shock to interest rates", "Global business cycle shock" and "Global inflation shock". Moreover, the first principal component extracted from the term structure is very similar to the average interest rate on the shortest maturity (1 year) and can be therefore interpreted as "Global Monetary Policy Shock". The three standardized global factors are plotted in Figure 1.[1]

The FAVAR model (1) can be easily rewritten in VAR(1) form as:

$$Y_t = \tilde{\mu} + \Gamma Y_{t-1} + \Psi u_t \tag{2}$$

where $u_t = \binom{v_{it}}{\eta_t}$ and the matrices $\tilde{\mu}$, Γ and Ψ are:

$$\begin{aligned}
\tilde{\mu} &= \begin{pmatrix} \mu \\ 0 \end{pmatrix} \\
\Gamma &= \begin{pmatrix} \Phi_i & \Lambda\Omega \\ 0 & \Omega \end{pmatrix} \\
\Psi &= \begin{pmatrix} I & \Lambda \\ 0 & I \end{pmatrix}
\end{aligned}$$

Bond prices are then found as in Wright (2010) and Ang and Piazzesi (2003)

$$p_t^n = \exp\left(A_n + B_n' Y_t\right)$$

where A_n is a scalar and B_n is an $mx1$ vector that satisfy the recursion:

$$\begin{aligned}
A_{n+1} &= -\delta_0 + A_n + B_n'\left(\tilde{\mu} - \Psi\lambda_0\right) + \frac{1}{2} B_n' \Psi \Psi' B_n \\
B_{n+1}' &= \left(\Gamma - \Psi\lambda_1'\right) B_n - \delta_1
\end{aligned}$$

with $A_1 = -\delta_0$ and $B_1 = -\delta_1$.

[1] Note however that the principal components extracted from the entire matrix Y bear the same interpretation.

2.2 Effects of Global Shocks

From (1) we can see that the FAVAR system can be recast in VAR form:

$$\begin{pmatrix} X_{it} \\ F_t \end{pmatrix} = \underbrace{\begin{pmatrix} \Phi_i & \Omega\Lambda \\ 0 & \Omega \end{pmatrix}}_{\Gamma} \begin{pmatrix} X_{it-1} \\ F_{t-1} \end{pmatrix} + \underbrace{\begin{pmatrix} v_{it} + \Lambda\eta_t \\ \eta_t \end{pmatrix}}_{\Psi u_t} \tag{3}$$

where the zero in the lower left corner of the matrix Γ indicates that global factors are considered exogenous to the country specific variables contained in X_t. Given that structural and idiosyncratic shock are uncorrelated - $E\left(v_{it}\eta_t\right) = 0$ - the estimated variance covariance matrix of the error term would assume the following form:

$$\Sigma_{\varkappa} = \begin{pmatrix} \Lambda\Sigma_\eta\Lambda' + \Sigma_v & \Lambda\Sigma_\eta \\ \Sigma_\eta\Lambda' & \Sigma_\eta \end{pmatrix}$$

Hence, by imposing some identification restrictions on the matrix Σ_η we are able to identify and track the effect of the global shocks. In fact, the FAVAR model in (3) can be inverted to obtain the moving average representation for the state variables X_t :

$$X_t = B\left(L\right)\eta_t + C\left(L\right)v_{it}$$

where $B\left(L\right)$ and $C\left(L\right)$ are polynomial in the lag operator that represent the impulse response functions for the structural global shocks. Their analytical expression is given by:

$$B\left(L\right) = \left(I - \Phi_i L\right)^{-1}\Lambda\left(I - \Omega L\right)^{-1}$$

Hence, interpretable impulse responses can be derived if we find a matrix Υ such that, defining $\psi_t = \Upsilon \eta_t$ we have that:

$$E\left(\psi_t \psi_t'\right) = \Upsilon \Sigma_\eta \Upsilon' = I$$

Because the variables we use to extract the global factors are interest rates, growth rates and inflation rates, we refer to Stock and Watson (2001) and identify structural shocks to the "Global interest rates", "Global growth" and "Global Inflation" by means of a simple lower triangular factorization where we order the factor extracted from the interest rates as the last one and the factor extracted from growth rates in the second position. Analogously, we use a lower triangular factorization also to identify the idiosyncratic shocks v_{it} and assume the same type of ordering, with inflation first, real growth second and the three components extracted from the yield curve in the last three positions.

Hence, the impulse responses to these identified shocks take the following expression:

$$\begin{aligned} \frac{\partial X_{it+h}}{\partial \eta_t} &= \Phi_i^h \Lambda \Omega^h B_0 \\ \frac{\partial X_{it+h}}{\partial v_{it}} &= \Phi_i^h C_0 \end{aligned}$$

where B_0 and C_0 are the Cholesky factors of Σ_η and Σ_v respectively.

3 Empirical Strategy and Data

Our approach to estimation follows Joslin, Priebsch and Singleton (2009) and Wright (2010). The parameters in the short-rate process, δ_0 and δ_1, are estimated by regressing the short-term interest rate onto a constant and the elements of Y_t via OLS. Γ, Ψ and

$\tilde{\mu}$ are estimated by estimating the FAVAR model (1) via OLS. We leave as a future extension the MLE estimation of the FAVAR, following Stock and Watson (2005).

The remaining parameters -prices of risk- are estimated by minimizing the sum of squared differences between actual and fitted yields, that is as:

$$\left\{\hat{\lambda}_0, \hat{\lambda}_1\right\} = \arg\min_{\lambda_0,\lambda_1} \sum_t \sum_n \left(y_t^n - \tilde{y}_t^n\right)^2$$

where $\tilde{y}_t^n = -\left(A_n + B_n' Y_t\right)/n$ are the model implied yields. Having estimated the model parameters, term premiums at various horizons can be computed in the usual ways.

In order to compute the model implied term premium -an important object of our analysis-, we first compute the model-implied 5-year forward rate 5 years from now. The term premium is the difference between this model implied forward rate and the average expected one-year rate from 5 to 10 years since now.

Several recent papers have considered the possibility that some factors in a term structure model could be important for forecasting future interest rates, but may not be needed to fit the cross-section of current bond yields (unspanned factors). This implies zero restrictions in the short-rate responses to factors (δ_1) as well as on the vector of prices of risk (λ_1). In this paper version we treat the first three country-specific principal components of the yields as spanned factors, while the macroeconomic factors and the global factors are treated as unspanned. In our setting, this seems a sensible choice, given that the global factors have a contemporaneous impact on the domestic principal components of the yield curve and so these should be sufficient statistics to pin down the cross-section of the yields. In a future extension of the paper, we will assess the role of global factors and domestic macro variables in shaping the cross-section of the term structure of interest rates.

The series on zero coupon yield curves for the U.K., the U.S., Canada, Germany and Japan are obtained from the websites of the Bank of England, the Federal Reserve, the Bank of Canada, the Bundesbank and the Ministry of Finance of Japan respectively[2]. The series for the three month short term interest rate are from Datastream.

The series are available at daily and monhtly frequencies and are updated regularly. To keep consistency with the available frequencies of the macroeconomic variables, we construct a quarterly macro-finance dataset with yields of maturities from 1 year to 10 years. The starting date is the first quarter 1990 in all cases. Besides data on zero coupon yield curves, the paper uses survey data on real-time estimates for CPI inflation and GDP growth this year and predictions for CPI inflation and GDP growth next year. These data are obtained from Consensus Forecast.

4 Results

In this section we report the empirical results obtained for our FAVAR term structure model. We first carry out formal statistical tests showing that global factors matter for the dynamics of domestic factors. Then we show the model fit across countries and plot the implied term premiums. We also assess the relative importance of global and domestic factors on term premium dynamics across countries. Finally, we perform impulse response function analysis of domestic factors and implied term premiums to the global shocks.

[2]The methodologies used in constructing the series are described in Bolder, Johnson, and Metzler (2004) for Canada; Anderson and Sleath (1999) for the U.K.; Gürkaynak, Sack and Wright (2007) for the U.S.; the October 1997 edition of the Monthly Report for Germany.

4.1 Block Exogeneity Tests

While there are many reasonable economic reasons why global factors should influence domestic term structure factors, it should be shown this economic intuition has a formal statistical counterpart. This is what we do in this subsection, where we formally test whether the matrix Λ in our FAVAR term structure model (1) enters significantly in the system. To this end, we perform likelihood ratio tests, where the null of no-statistical significance is tested against the natural alternative of significance.

Table 1 shows the results of the likelihood ratio tests, with degrees of freedom corrected as in Sims (1980) for the number of parameters in each equation. Results show that we reject the null of no-significance of global factors at the 1% statistical level for all countries. Thus, our inclusion of global factors in the term structure state of space is completely justified. Moreover, we clearly reject models with only domestic factors. To conclude this subsection, we emphasize that global factors for each country were constructed only with foreign variables.

4.2 Model Fit

Table 2 shows the square-root mean errors implied by our non-linear least square estimation. It is quite low and similar across countries, with Germany and Japan exhibiting the best fit. In turn, figures 2 to 4 plot the implied in-sample model fit of the FAVAR term structure model. It does so along three dimensions: the one year rate, the 10-year rate and the 5-year forward rate between 5 and 10 years from a given period. The model fit is very good at short, medium and long frequencies, at the short and long end of the term structure and across countries. While this is not too surprising, given the large set of factors considered, it gives us confidence regarding the term premium identification, which we discuss next.

4.3 Term Premium Analysis

As mentioned in Section 3, we identify the term premium as the difference between the model-implied 5-to-5 year forward rate and the average expected one-year rates 5-to10 year hence. Figure 5 shows the implied term premium of our FAVAR term structure across countries. For all countries, we see a decline of the term premium across modeling specifications, consistent with the findings in Wright (2010).

Our FAVAR term structure model implies, for all countries, a higher term premium in the first years of the sample across countries, and low term premium in the last years. Comparing the term premium across countries, we see that Canada had the highest term premium starting in 1990 and has a term premium close to zero since 2005. The UK has had negative term premiums since essentially 2000 whereas the US term premium has hovered between 1 and 2 percentage points since 2000. In Germany we observe a very pronounce fall in the term premium between 1995 and 2000 (from above 3 to below 1%). Interestingly, and in contrast to the closed-economy of Wright, results point to a large increase of the term premium in the years following the credit crisis for the UK and Canada, and to a lower extent in the US and Germany. In particular, our FAVAR model shows that the term premium in the UK has switched to positive in 2010.

In order to draw some intuition regarding the source of term premium dynamics, we perform the following exercise. Conditional on the estimated parameters, we shut down all domestic (global) shocks to derive counterfactual term premiums due completely to global (local) shocks. Figure 6 shows that global factors are key to understand term premium dynamics at all frequencies in Germany, the UK, Japan and the US, whereas they are very influential at medium frequencies in Canada. This is a very relevant result as it points to the key influence of international linkages when understanding term premium dynamics. In contrast, domestic factors seem to have a smaller influence, especially in the second part of the sample, where its contribution is relatively flat across countries.

In order to draw more intuition regarding the specific factors triggering term premium dynamics, Figures 7 to 11 further show the impact of each of the global factors. They plot the implied term premiums conditional on all global shocks and on each global shock. The counterfactual term premium under the global interest rate factor tracks the actual estimated term premium at all frequencies, whereas the counterfactual term premium under the inflation and GDP factors track the term premium at medium and long frequencies. Thus, the global interest rate or global monetary policy factor seems to be the key driving force behind term premium dynamics

4.4 Impulse Response Function Analysis

Figures 12 to 17 report the impulse response functions of domestic factors after the three global shocks. We first show the responses for the UK with 95% statistical confidence bands and then we plot the responses of the domestic factors across countries -for sake of clarity, in this case we omit the confidence bands-. Asymptotic confidence bands were obtained through a Montecarlo exercise with 500 replications. Figures 12 and 13 show the responses to the global interest rate -or monetary policy- shock. Interestingly the global monetary policy shock has a large, positive and statistically significant effect on the domestic level of the yield curve during four quarters. This implies a clear relation among the interest rate levels across countries. The slope of the yield curve initially goes down but then shows a protracted increase and positive values for most countries.

The rationale is that after a global monetary policy tightening event there is a positive relation among long-term yields, while domestic monetary may have remained constant. A similar result obtains with the curvature factor. Finally, inflation tends to increase whereas GDP growth increases in some countries after the shock. This can be related to the fact that a global monetary policy shock would depreciate the home currency thus increasing inflation and boosting exports.

Figures 14 and 15 show the responses to the global inflation shock. A global inflation shock increases inflation and output during a short time, while it has a negative effect on the domestic level of the yield curve -more pronounced on the US and Canada-. In the US, the slope and curvature experience a large hump-shaped decline after the global inflation shock, pointing at a large reaction of the short-end of the yield curve to this global inflation shock.

Figures 16 and 17 show the responses to the global GDP shock. We can see that domestic GDP growth benefits from a positive global business cycle shock. As a result domestic inflation and the level of the yield curve increase during a few quarters. The slope reacts mildly positively across countries, while the curvature oscillates around zero but is never significant. Again, the US experiences the largest responses, with increases in spread and curvature, which are related to an also relatively large increase in the domestic interest rate level, surely related to an increase in the long-term of the yield curve.

Finally, we are able to compute the responses of the term premium to the three global shocks across countries, using the term premium definition. Figure 18 shows that the domestic term premium strongly and persistently rises after a global monetary policy shock, whereas it experiences mild declines after global inflation and GDP shocks. Thus, as the level of global yield curves become higher, domestic long term bonds become riskier. These results thus show that global interconnectedness should be taken into account in any government bond pricing model.

5 Conclusions and Extensions

Recent term structure models have emphasized restrictions implied by no-arbitrage conditions in the market for government yields of different maturities. In contrast, they have greatly overlooked the implications of international financial linkages embedded in global financial markets free of restrictions to capital mobility. In this paper, we postulate a general framework to account for systematic international linkages among term structures while retaining the more traditional no-arbitrage structure.

Our model provides a very good fit of the yield curve and results point to a decline of the term premium of long term bonds in our panel of countries, including the US, UK, Germany, Canada and Japan. Interestingly, we detect an increase in the term premium of about 1 percentage point following the credit crisis. We also show that the estimated decline of the term premium can be attributed to global factors, in particular to the global monetary policy factor. Importantly, as the level of global yield curves increase, so does the domestic term premium on long term bonds.

As extensions to improve this version of the paper, we intend to estimate our FAVAR model via MLE, along the lines suggested by Stock and Watson (2005). In preliminary work, we have observed that OLS and MLE estimates are very similar, but MLE estimates in this type of models have been shown to be more efficient. We will also expand our dataset with more countries and will try to determine the optimal size of our vector of factors, as well as the inclusion of additional variables. In this version, we have estimated a very general model with 8 factors, but it is likely that some of these factors explain little of the yield curve dynamics. We will also include a discussion on the choice of spanned and unspanned factors. In the context of the optimal-size global yield curve model, we will also assess the out-of-sample forecasting power of the open-economy term structure model relative to its closed-economy counterpart. With these results we hope to bring about implications for theoretical term structure models in order to exploit key information stemming from relevant international linkages.

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Table 1: **Block Exogeneity Tests**

Likelihood Ratio Values	
Canada	0.000
Germany	0.000
Japan	0.000
UK	0.000
US	0.000

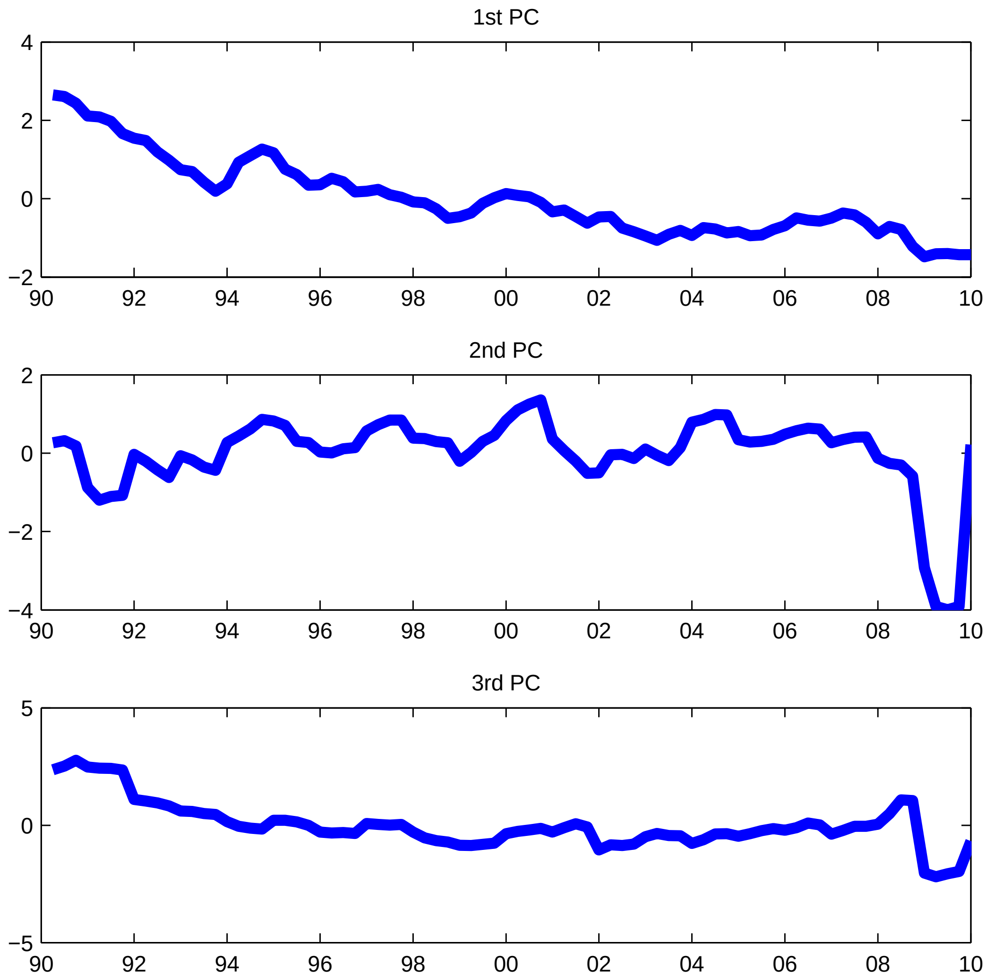
This table shows the p-values associated with the likelihood ratio statistics testing no-significance of global factors on domestic factors, as specified in our FAVAR term structure model. We apply the Sims (1980) correction on the likelihood ratio test, correcting degrees of freedom for the number of regressors per equation.

Table 2: **Model Fit**

Fit of Affine Term structure Model	
Canada	0.118
Germany	0.100
Japan	0.100
UK	0.109
US	0.111

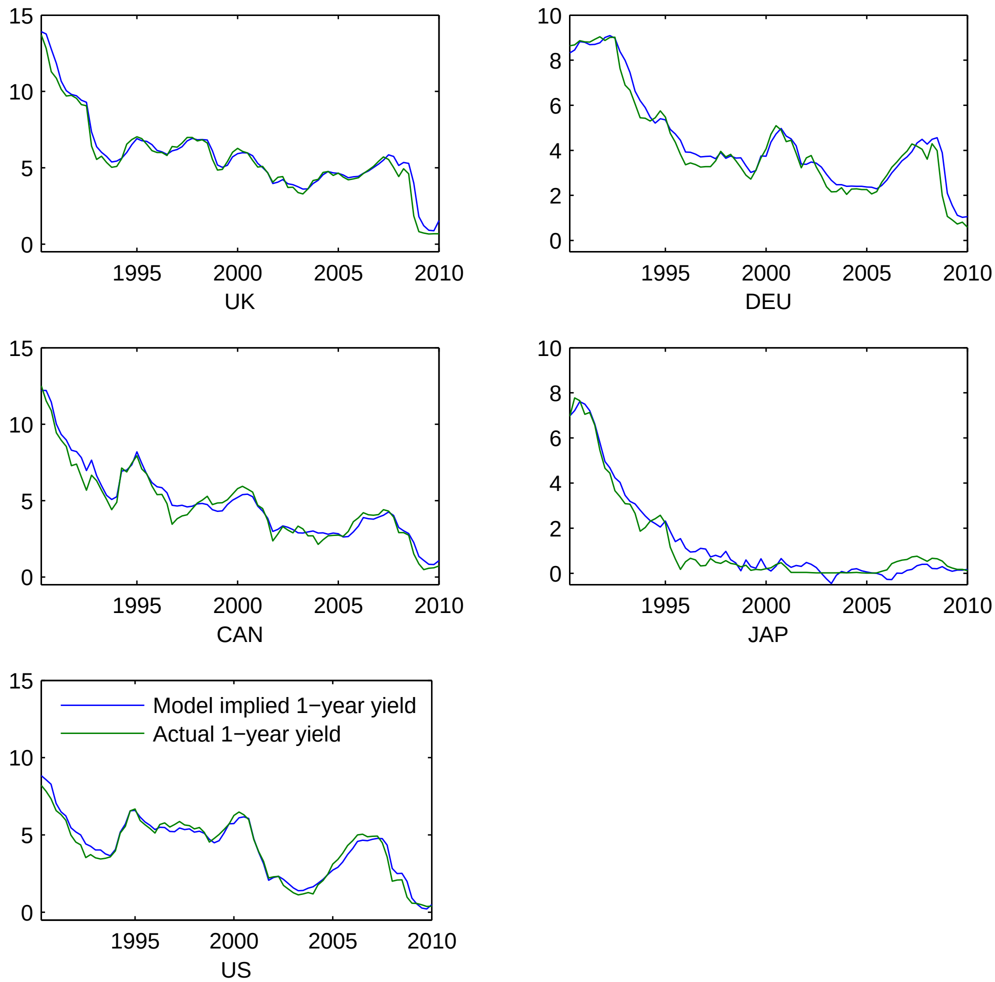
This table shows the root mean square fitting error (square root of the minimized value of the objective function of the affine term structure model) for each country, in percentage points.

Figure 1: **Global Factors**



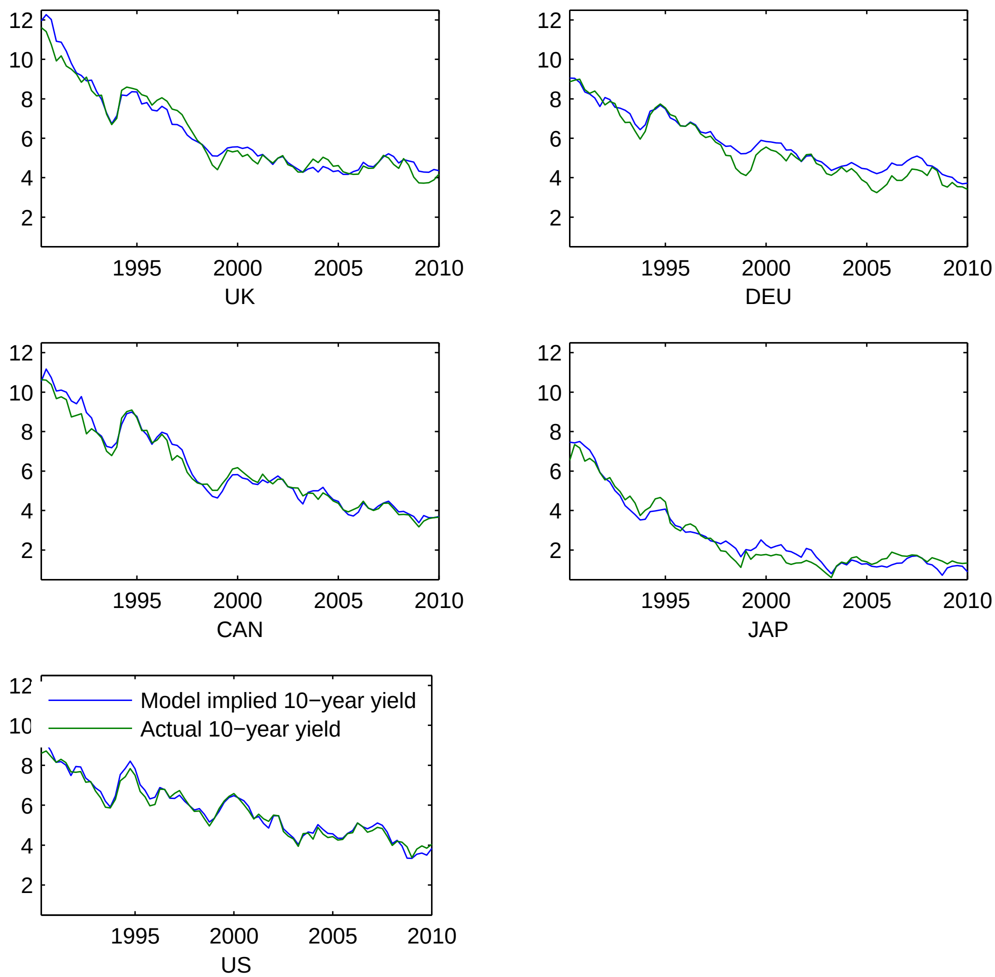
Note: This figure shows the average of the global factors across countries. Global factors are computed as the first three principal components of the vector of variables including all yields and macro series across countries.

Figure 2: **Yield Curve Fit (1-year interest rate)**



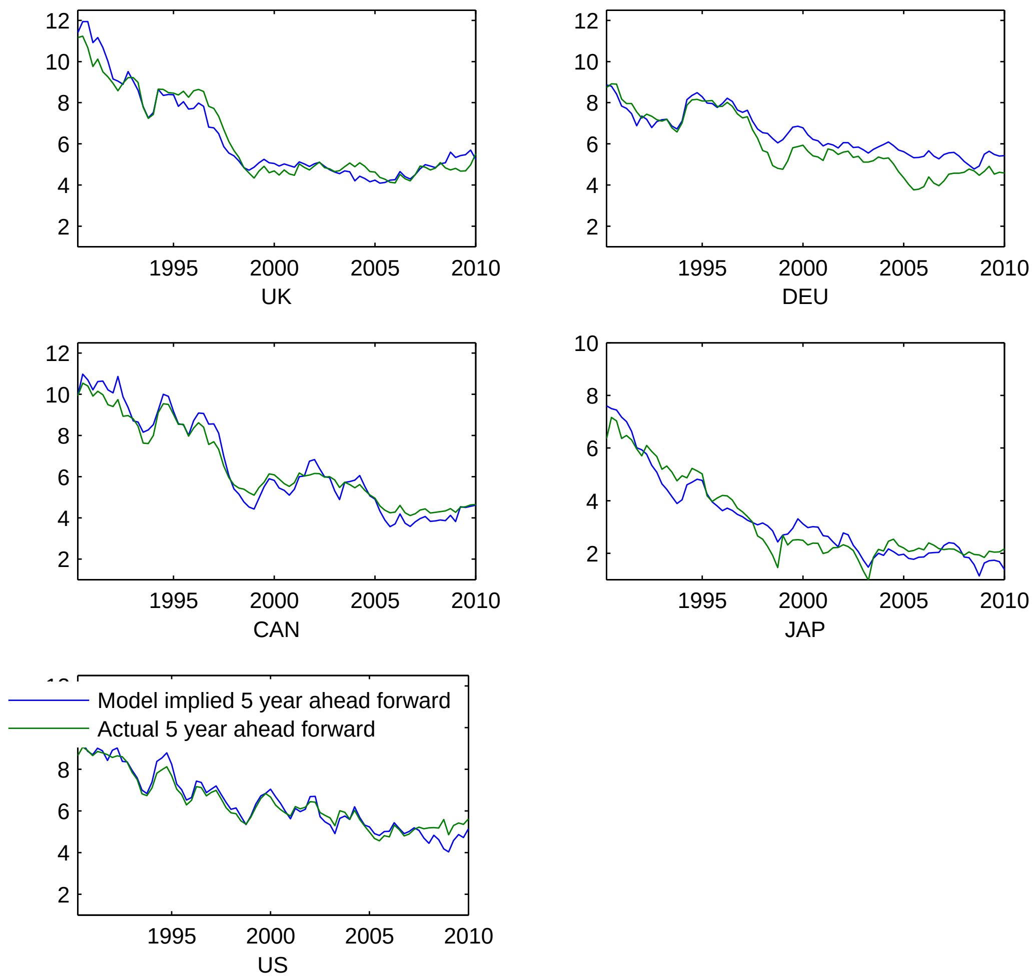
Note: This figure plots the one-year yield together with the implied analog of our FAVAR term structure model.

Figure 3: **Yield Curve Fit (10-year interest rate)**



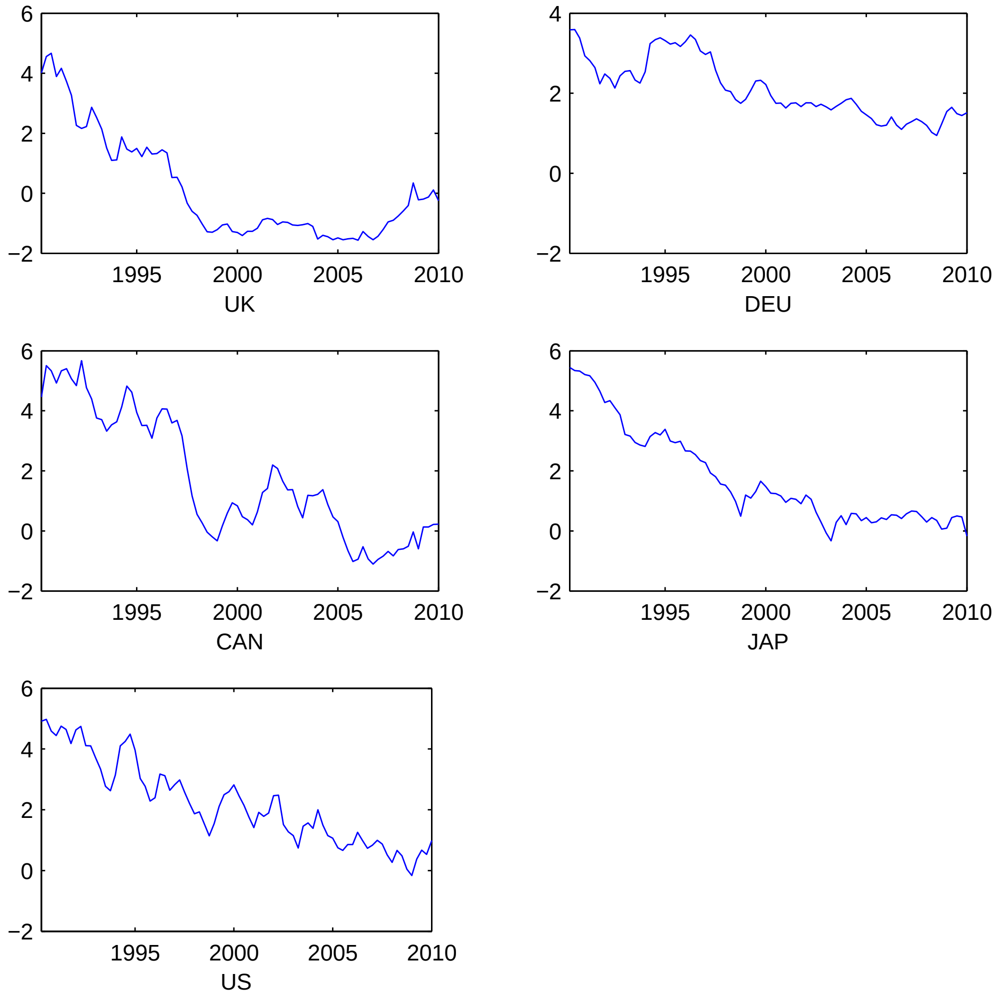
Note: This figure plots the 10-year yield together with the implied analog of our FAVAR term structure model.

Figure 4: **Yield Curve Fit (5-to-5 year forward rate)**



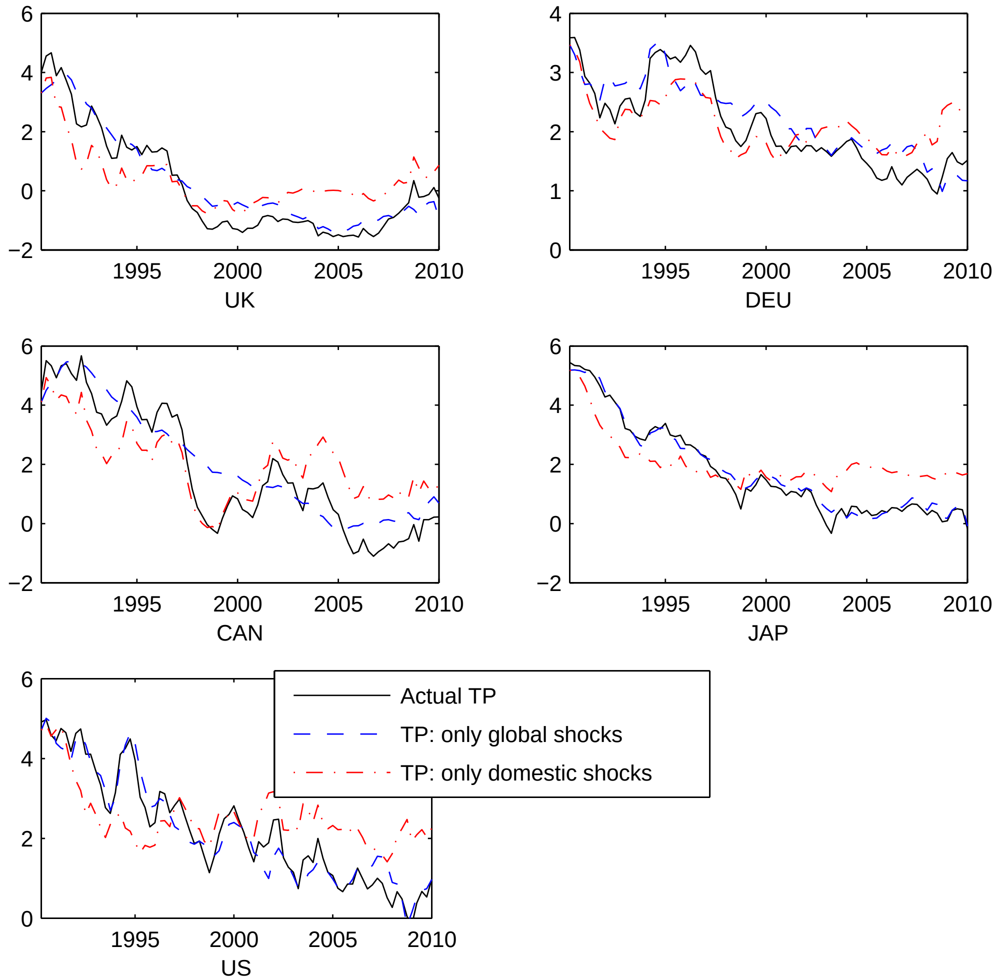
Note: This figure plots the 5-to-5-year forward rates together with the implied analog of our FAVAR model.

Figure 5: **Implied Term Premiums**



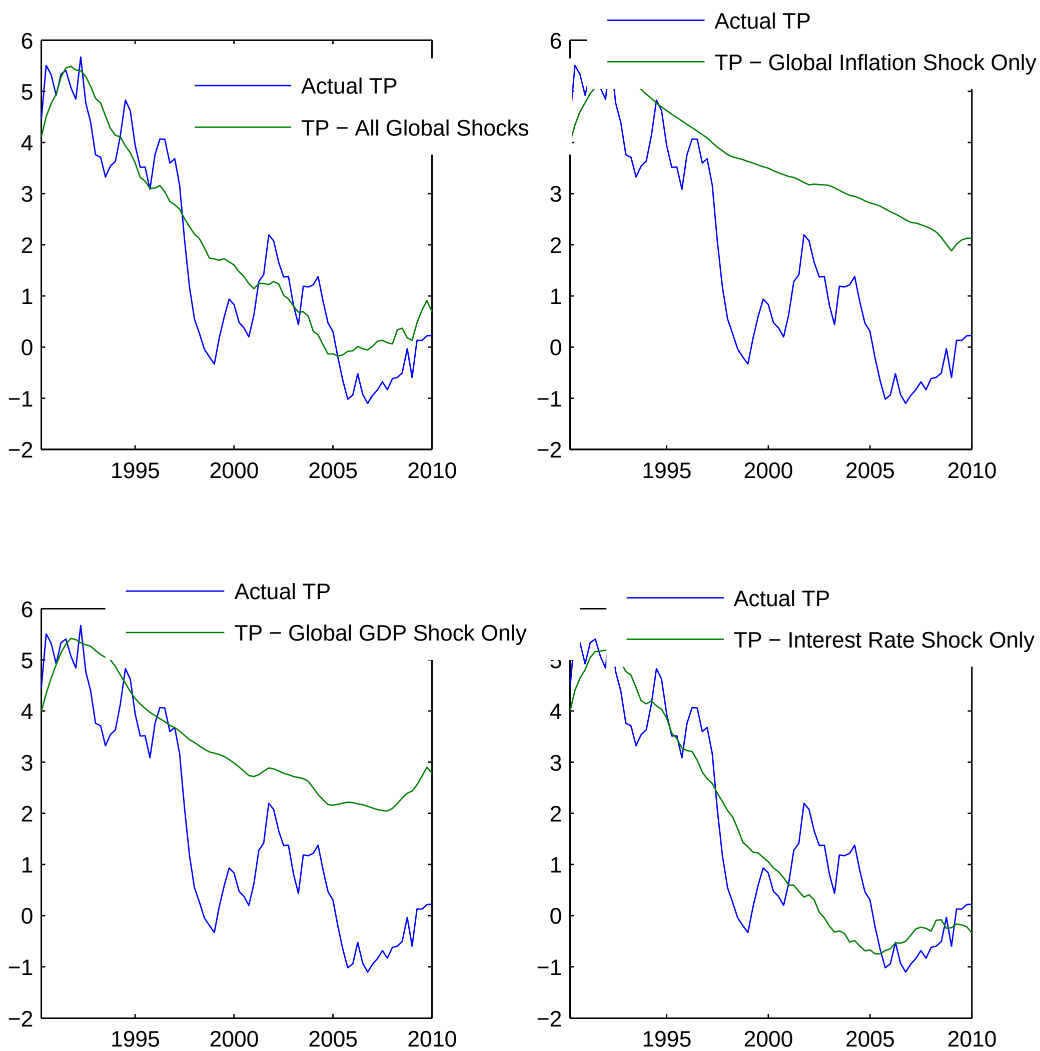
Note: This figure shows the implied forward 5-to-5-year term premiums across countries by our FAVAR term structure model.

Figure 6: **Term Premium: Global versus Domestic Factors**



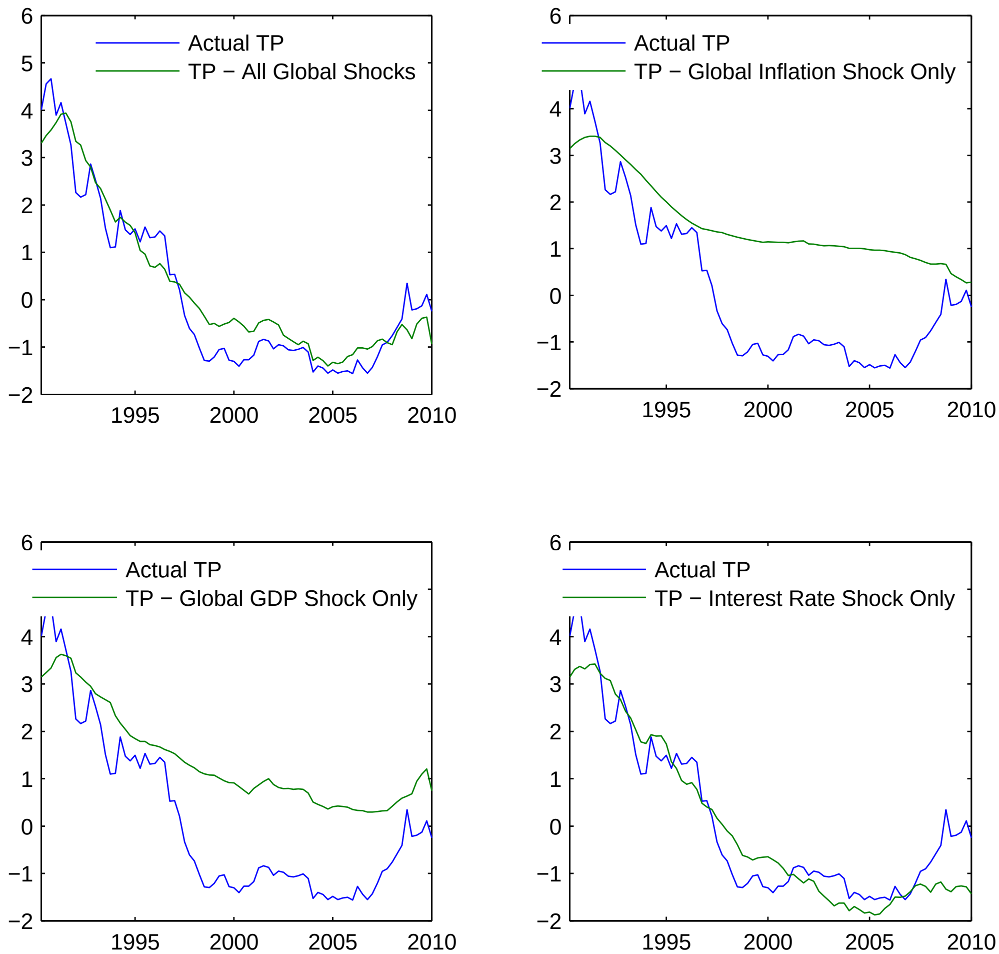
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with only with domestic factors across countries.

Figure 7: **Term Premium and Global Factors: Canada**



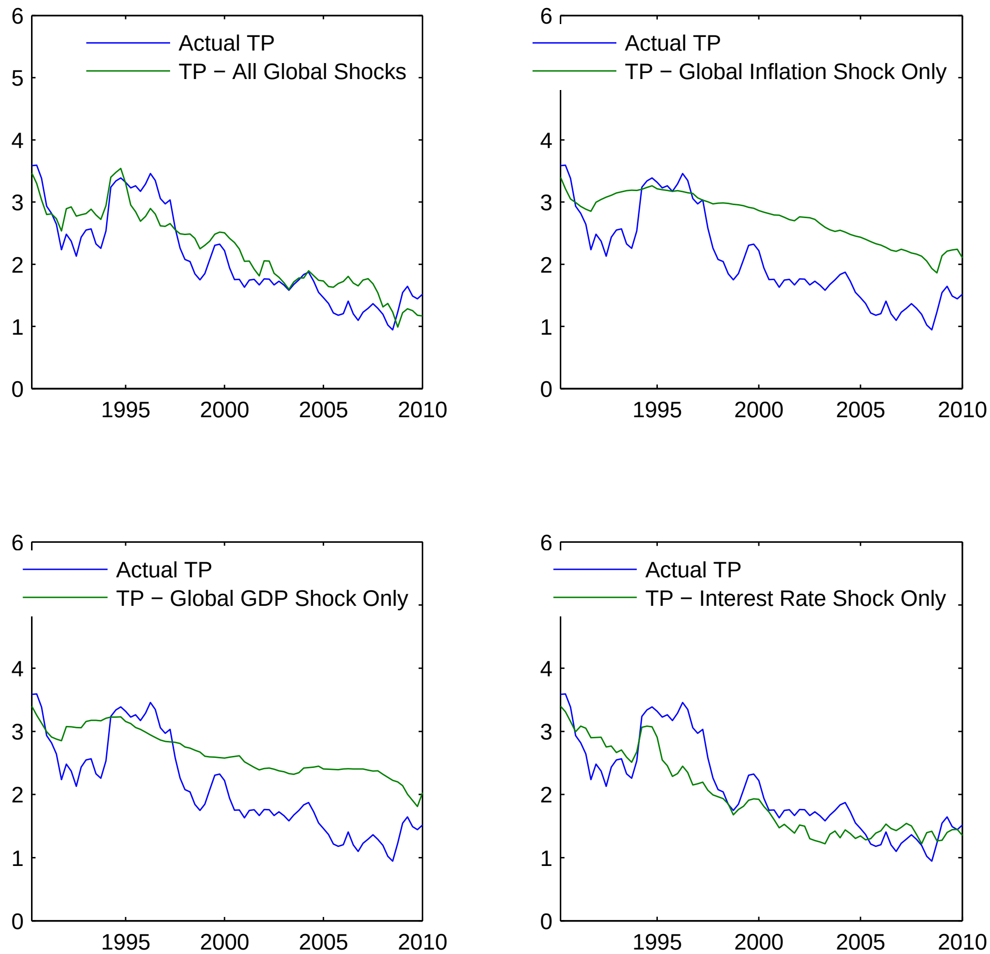
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with each one of the global factors for Canada.

Figure 8: **Term Premium and Global Factors: the UK**



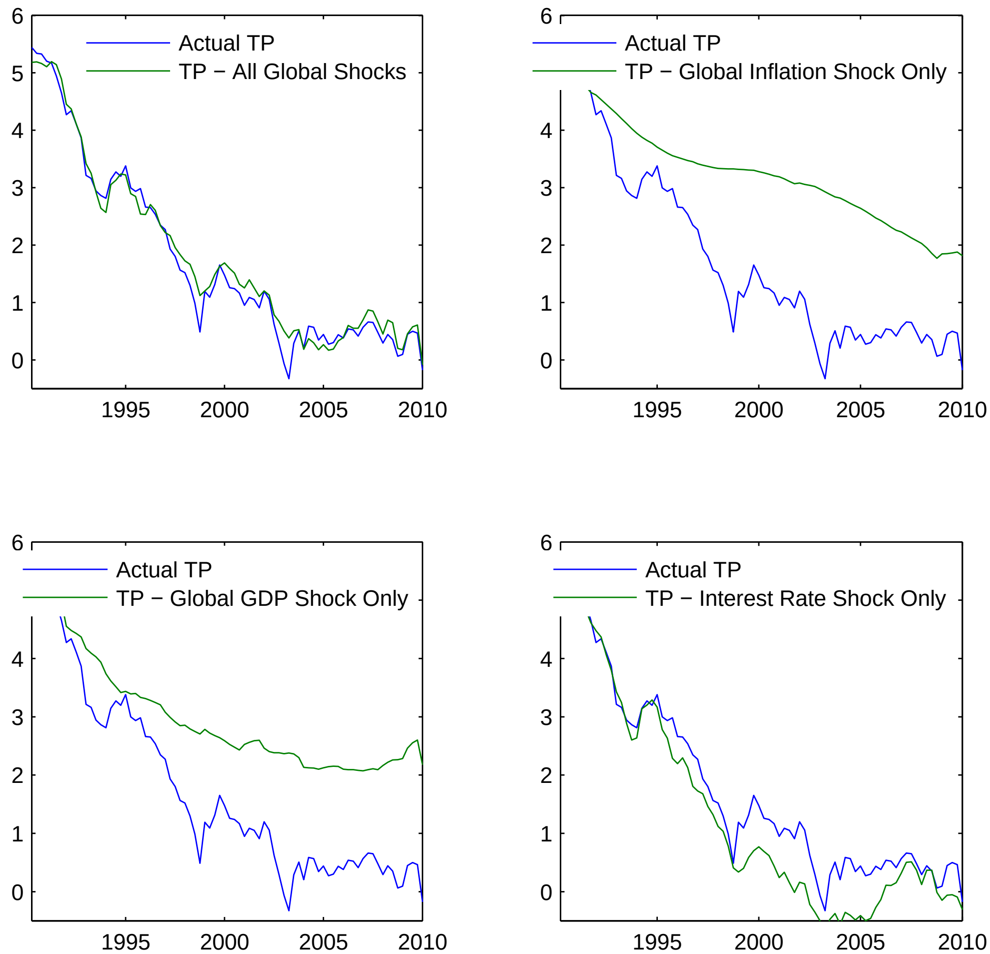
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with each one of the global factors for the UK.

Figure 9: **Term Premium and Global Factors: Germany**



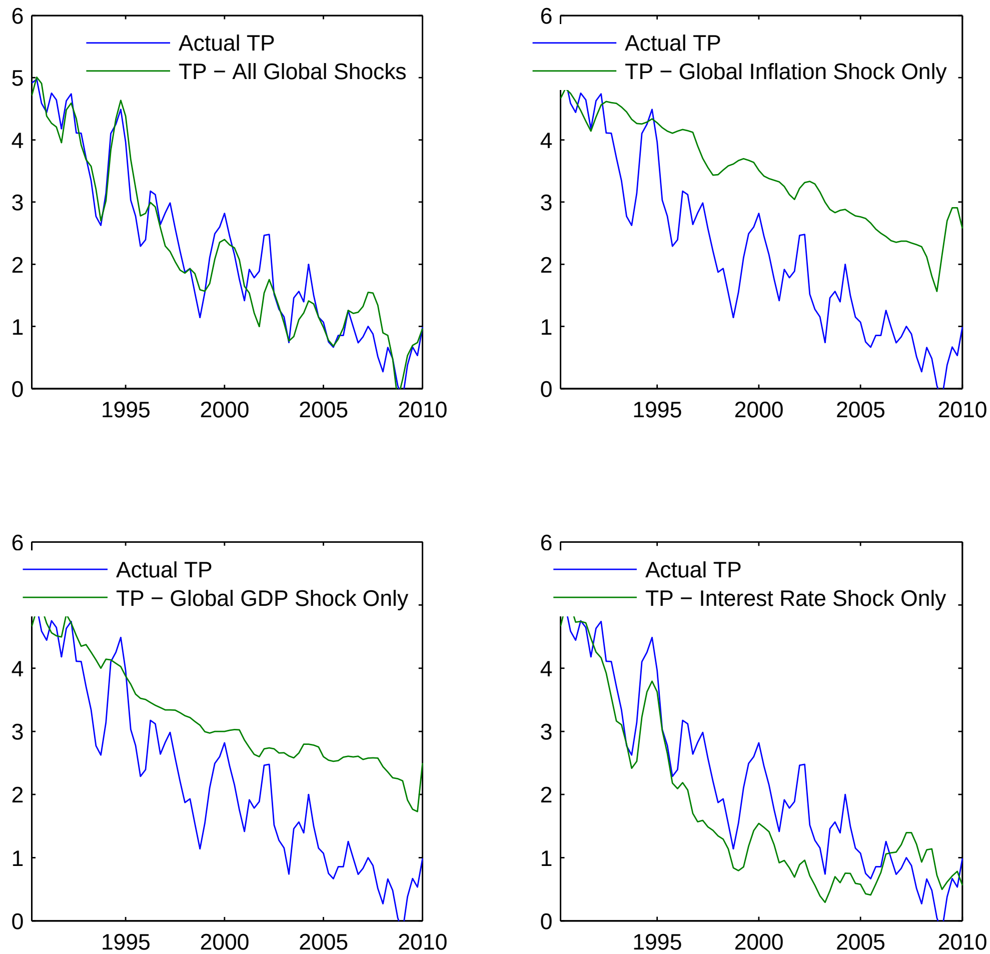
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with each one of the global factors for Germany.

Figure 10: **Term Premium and Global Factors: Japan**



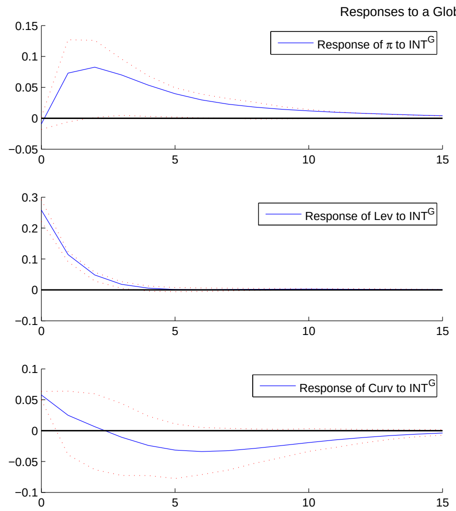
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with each one of the global factors for Japan.

Figure 11: **Term Premium and Global Factors: the US**



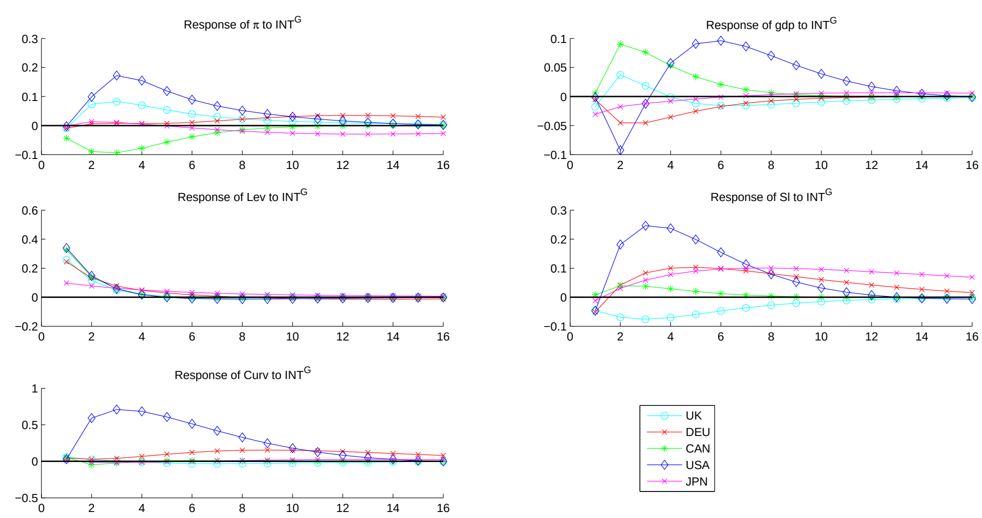
Note: This figure shows the term premium implied by FAVAR term structure model together with the implied term premium which would have been obtained only with all global factors and with each one of the global factors for the US.

Figure 12: **Impulse Responses to Global Monetary Policy Shock: the UK**



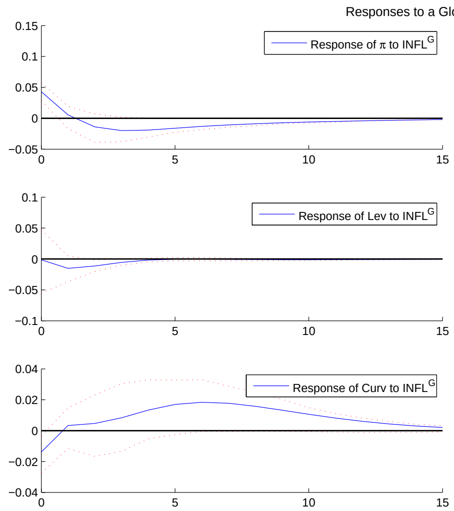
Note: This figure shows the responses of all UK domestic factors - inflation, GDP growth, level, slope and curvature- to the global monetary policy shock, together with the 95% confidence bands.

Figure 13: **Impulse Responses to Global Monetary Policy Shock: all countries**



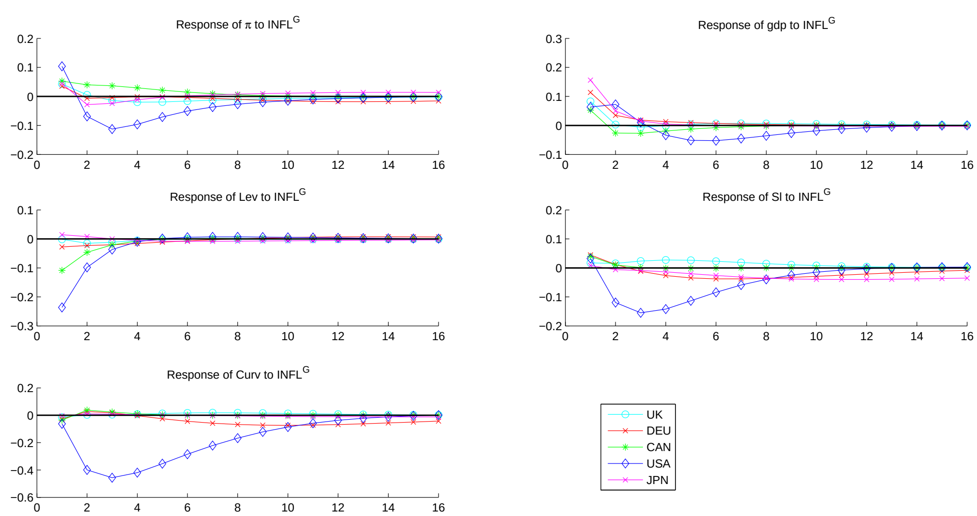
Note: This figure shows the responses of all domestic factors -inflation, GDP growth, level, slope and curvature- to the global monetary policy across countries shock, together with the 95% confidence bands.

Figure 14: **Impulse Responses to Global Inflation Shock: the UK**



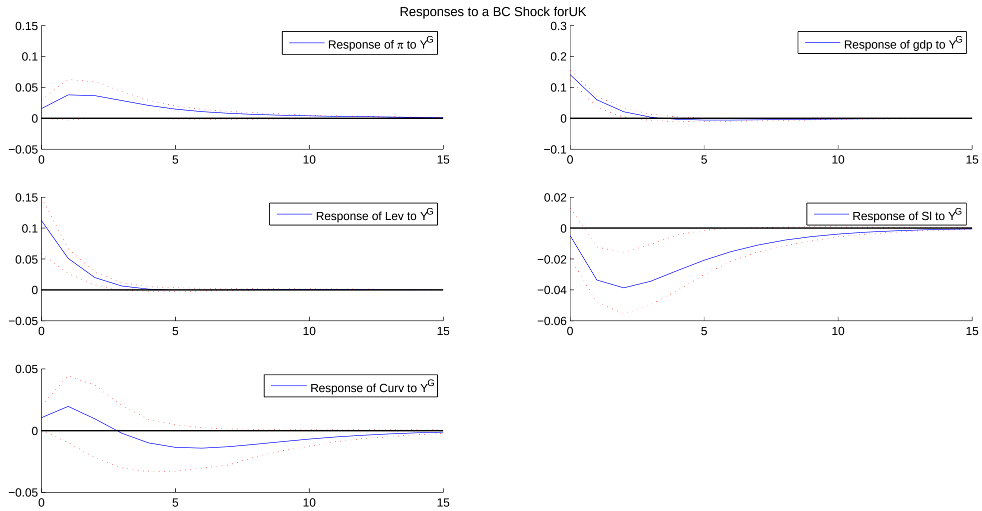
Note: This figure shows the responses of all UK domestic factors -inflation, GDP growth, level, slope and curvature- to the global inflation shock, together with the 95% confidence bands.

Figure 15: **Impulse Responses to Global Inflation Policy Shock: All countries**



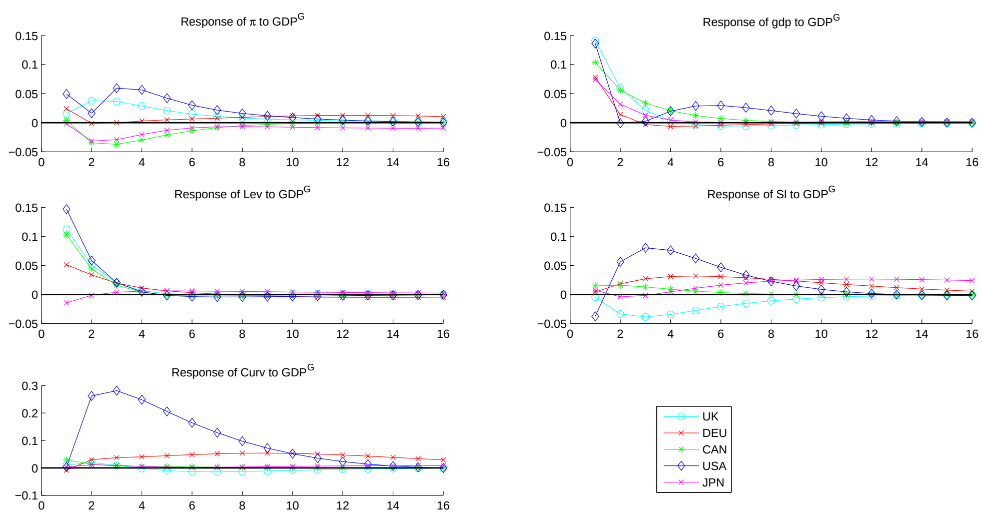
Note: This figure shows the responses of all domestic factors - inflation, GDP growth, level, slope and curvature- to the global inflation shock across countries, together with the 95% confidence bands.

Figure 16: **Impulse Responses to Global GDP Shock: the UK**



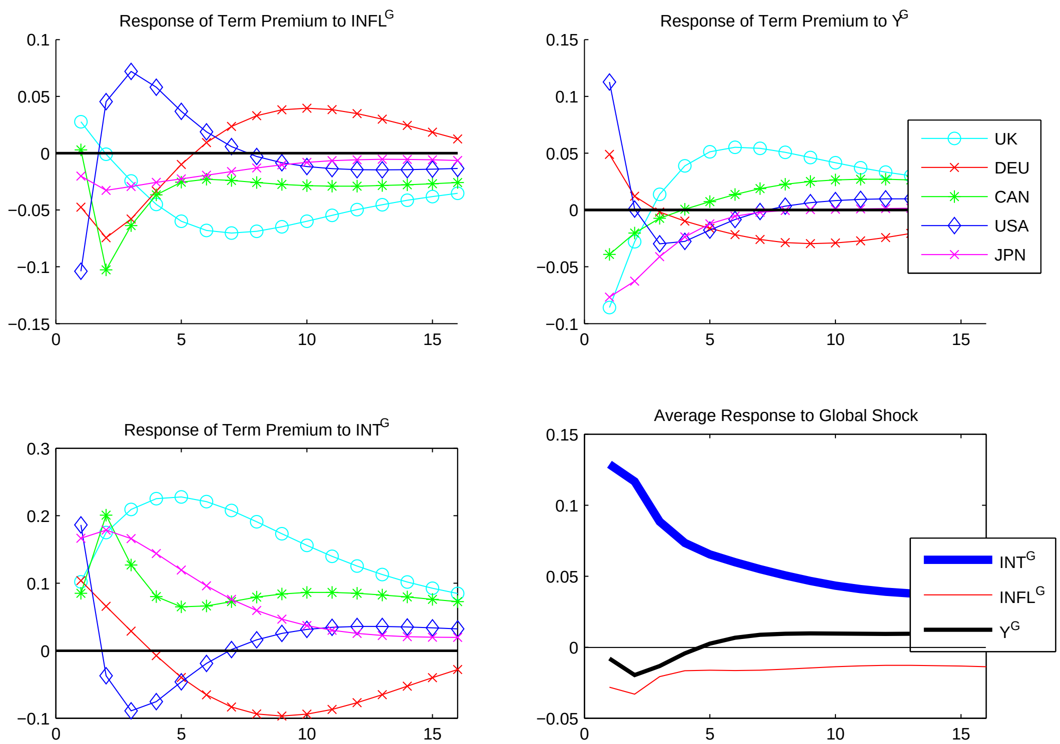
Note: This figure shows the responses of all domestic factors inflation, GDP growth, level, slope and curvature to the global GDP shock, together with the 95% confidence bands.

Figure 17: **Impulse Responses to Global GDP Shock: All countries**



Note: This figure shows the responses of all domestic factors - inflation, GDP growth, level, slope and curvature- to the global GDP shock across countries, together with the 95% confidence bands.

Figure 18: **Impulse Responses of Term Premium to Global Shocks: All countries**



Note: This figure shows the responses of the term premium to the three global shocks across countries. The south-east figure graphs the cross-country average impulse response to each of the shocks.