Essays in Macroeconomics

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Declaration of Authorship

I, Ali Orazgani hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Abstract

This thesis consists of three chapters. Chapter 1 investigates the impact of quantitative easing (QE) on the UK housing market and macroeconomic variables employing FAVAR, using monthly data from 2009M03 to 2016M12. The policy instrument in this study is the size of government assets purchased relative to 2009Q1 GDP. The results suggest that QE supports economic recovery, contributes to GDP increase, and reduces unemployment, but significantly impacts house prices in the UK, particularly in England, and increases the house price to income ratio.

Chapter 2 investigates whether a "feedback effect" exists in UK bond and equity markets whereby increasing investment flows leads to an increase in price, leading to further increases in investment. We found no evidence of this in the UK bond market. However, when including monetary policy shock, we find some evidence of a reinforcing price-flow dynamic in the bond market. We extend the analysis to include the open economy and look at the impact of monetary policy shock. We find in particular that tightening monetary policy causes outflow from domestic bonds (corporate) while the impact on foreign bond flows is uncertain. Furthermore, we examine whether investors choose bonds or equity due to monetary policy tightening. The result suggests a switch from equity to bonds.

Chapter 3 analyses the impact of external demand, supply and oil price shocks on the UK economy using a rich dataset employing factor-augmented vector auto regression (FAVAR). Unlike previous studies, we distinguish shocks originating from emerging markets and advanced economies. The identification that has been used is based on sign restriction. The main result suggests that a positive demand

shock in advanced economies increases inflation, GDP deflator and wages. The profile for emerging markets is the same, but with lower magnitude. A positive supply shock to both regions reduces the prices in the UK. Finally, the oil price shock pushes up inflation both in the UK and internationally. The result from this FAVAR is comparable to multi country large scale models such as NiGEM.

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Introduction to thesis

This thesis applies recent advances in multiple time series analysis to model the dynamics of the UK economy using large panel data sets. This thesis has three chapters. The first chapter uses a Factor Augmented VAR (FAVAR), based on Bernanke et al. (2005), to assess the impact of unconventional monetary policy on a large array of UK macroeconomic variables including house price data. The second chapter applies the more conventional VAR approach to a wide range of asset classes to explore whether there is a feedback effect and herding in response to UK monetary policy shocks. The third chapter also uses a FAVAR to analyse the effect of various international shocks from advanced and emerging markets on a large panel of UK macroeconomic variables. By using large datasets in the statistical analysis, the thesis broadens the picture of the dynamics of the UK economy more than the existing literature.

This thesis makes several contributions to the literature. Significant contributions are discussed here, and there is more detail in each chapter.

In the first chapter, I look at the impact of UK monetary policy on house prices post-crisis. When interest rates approached their effective lower bound during the financial crisis, central banks including the Bank of England (BoE) used a new set of monetary policy tools. Under quantitative easing (QE) central banks purchased assets on a large scale to reduce long-term yields. A key question is whether this had an impact on house prices and the economy, and if so, can we quantify it? House prices have been widely considered, by both academics and policy makers, to have contributed to the financial crisis in 2008-2009. The rebound in the housing market coincided with the introduction of QE in the first quarter of 2009 and with subsequent programmes such as QE2 in late 2011 and QE3 in mid-2012 in the UK. This rebound and rapid increase in house prices sparked a debate about the role of QE and whether it had created a new bubble in the housing market, threatening future financial stability. Most of the existing literature (e.g Weale and Wieladek (2016)) typically uses a simple VAR approach to study QE: this study will incorporate a large panel data set and employs Factor Augmented VAR (FAVAR). Following Bernanke et al (2005) the framework divides information in two sets — observable and non-observable. The observable set contains output, inflation and the QE measure as a share of asset purchases in the first quarter of 2009 GDP as our policy instrument. We include the nominal effective exchange rate (NEER) to capture the international dimension of our open economy. The unobservable set contains information that may not be captured by the observable set. This additional information is summarised in another three variables, the factors, which can describe and represent the characteristics of a large data set. The combination of both observable and non-observable information can describe the dynamics of the economy and answer our questions.

The results suggest that QE supports economic recovery, contributes to GDP growth and reduces the unemployment rate. However it significantly impacts real house prices in the UK, particularly in England, and increases the house price to income ratio while reducing the user cost of housing by lowering mortgage rates. It does reduce uncertainty in financial markets, which creates a favourable environment for raising capital for Non-Financial Corporations, increases equity prices and reduces government and corporate bond yields.

As we can see, despite the positive contribution of QE in terms of supporting economic recovery and boosting output and jobs, it may also contribute to debate on housing affordability and the difficulties faced by people trying to get into the housing market. In addition, the house price index is a leading indicator of the status of the economy and inflation increasing beyond the economic fundamentals and so may also pose a risk to financial stability and the economy. Martin Wolf, associate editor and chief economics commentator at the **Financial Times**, London on the UK's housing crisis, 5 February 2015[1] commented as 'This is a really big issue. That is, of course, why no politician dares touch it.'

In the second chapter we analyse the asset management sector. Worldwide, fund managers managed $76tn in 2015.[2] The UK is the second largest market for asset management after the US and it is relatively unregulated compared to the banking sector. The biggest company manages about the same volume of assets as the biggest banks, and asset management is an important player in financial sector. Recently, there has been a structural shift in the financial system, moving risk from banks to asset management. Since the crisis, policy makers have been concerned that the asset management sector may contribute to financial instability by redeeming from funds when markets decline, with implications for the real economy. An IMF report in 2013 examined the idea that the rising long term treasury yield could trigger herding (redemption, portfolio sales, and further rate increases which leads to falling bond prices). Feroli et al. (2014) provided a theoretical framework and suggested that they found evidence of feedback from bond flows to bond returns in the US. This paper follows Feroli et al. (2014) and applies the methodology to the UK data, using similar data with a broader set of asset classes. We contribute to the literature by expanding the analysis to the open economy and looking at whether investors will invest in the domestic economy or overseas as a result of domestic monetary policy shock. We also looked at how investors switch between bonds and equities.

We find that in contrast to their analysis of the US economy, there is no evidence of a feedback effect in the UK bond market. However, when a monetary policy shock was included, we found some evidence of a reinforcing price-flow dynamic in the bond market. We find in particular that when monetary policy is tightened, investors redeem funds due to a rise in interest rates because of the fall in prices so

[1] https://www.ft.com/content/f5b26d8a-ac59-11e4-9d32-00144feab7de
[2] The size of the nominal GDP for the world is around $74 trillion according the World Bank estimate for 2015.

there is an outflow from domestic corporate bonds. The impact on foreign bond flows is uncertain. We look at whether investors choose bonds or equity when monetary policy is tightened: the results suggest that investors switch from equity to bonds. This chapter contributes to policy debates on the risk that financial instability in the asset management sector could spread to the real sector. For example, on 6 Feb 2018 market participants anticipated an interest rate rise and shifted their assets from equities to bonds and other assets. This wiped about US$4 trillion from global markets within a week (Reuters 6 Feb 2018).[3] This is in line with one of the predictions of the extension of the model, which is that investors may switch from equities to bonds when interest rates increase.

In the third chapter we use another rich dataset to study the impact of external supply and demand shocks in the UK economy, distinguishing between shocks originating from emerging markets and advanced economies. This is important because the UK is leaving the EU, which may more imply trade with less advanced economies. We employ a factor augmented VAR (FAVAR) similar to that in chapter one, which was expanded by Mumtaz and Surico (2009) to include international factors. The identification is based on sign restriction. The main result suggests that a positive demand shock in advanced economies increases inflation, GDP deflator and wages. This is in line with the literature. The profile for emerging markets is the same as for advanced economies but with lower magnitude. This can be explained by degree of interaction and economic ties with these countries. The response of prices to the demand shocks after 1997 is short lived, around 2-4 quarters. This could be due to low inflation as a result of inflation targeting. However, the initial responses are comparable to the full sample. The oil price shock pushes inflation both in the UK and internationally. This will lead to decreases in consumption, GDP and house prices. The result from this VAR is comparable to the multi country large scale models NiGEM. This chapter contributes to policy debates on Brexit.

[3] https://uk.reuters.com/article/global-markets/global-markets-rolling-world-stock-sell-off-runs-to-4-trillion-idUKL8N1PW3MR

Chapter 1

The Impact of Unconventional Monetary Policy on the UK Housing Market

1.1 Introduction

When interest rates approached their effective lower bound during the financial crisis, central banks including the Bank of England (BoE) used a new set of monetary policy tools. Under quantitative easing (QE)[4] central banks purchased assets on a large scale to reduce long-term yields by purchasing bonds.

The impact of this policy on real GDP and inflation has been widely debated in academic and policy circles, for example by Kapetanios et al. (2012), Joyce et al. (2011), Bridges and Thomas (2012), Churm et al. (2015), Weale and Wieladek (2016) and Cloyne et al. (2015) and Pesaran and Smith (2016).

Previous studies relied on only a few variables to study the impact of QE: this paper uses 139 variables related to real activity, prices, the financial market and the housing market to study the impact of QE on the UK economy, and in particular on the housing market.

Following Bernanke et al. (2005) and Mumtaz and Surico (2009), we used factor-augmented vector autogression (FAVAR) to summarise information from 139 variables from 2009M3 to 2016M12 into a small number of estimated factors and used them as regressors with GDP, CPI and QE measures to assess the impact of BoE-implemented QE in the UK. Employing a wider array of variables overcomes the problem of omitted information in a small-scale vector autoregression (VAR) model. It also allows us to look at the impact of the shock on individual variables in the panel.

[4] "Creation of new money by central banks such as the Bank of England in order to buy assets in large quantities. In this the Bank will buy assets from the private sector, for example pension funds, high street banks and non-financial firms. The majority of these assets are government bonds (also known as gilts). As the market for government bonds is large the Bank can buy these assets in large quantities fairly quickly. The purchases of assets on such a scale will lead to pushing up the price and lowering yields (the returns) on them. This will encourage the seller of the assets to use the money they received from the sale to buy assets with higher yield instead, such as company shares and bonds. As demand for this type of assets increases the yields in general will be lower. The company that issues these bonds will benefit from paying lower yields, thus having extra cash to invest and spend. This will boost the economy. (adapted from Bank of England website)"

Figure 1-1 shows that the rebound in the housing market coincided with the introduction of QE in the first quarter of 2009 and with subsequent programmes such as QE2 in late 2011 and QE3 in mid-2012. This rebound and rapidly rising house prices sparked a debate about the role of QE in increasing house prices in the UK and in effectively creating a new bubble in the housing market. The house price index also serves as a leading indicator of the status of the economy and inflation, as pointed out by Stock and Watson (2003). It is one of the biggest domestic risks to financial stability, as BoE Governor Mark Carney suggested in his 2014 speech. House prices in London were even cited as a typical credit bubble by the International Monetary Fund (IMF) in 2014.

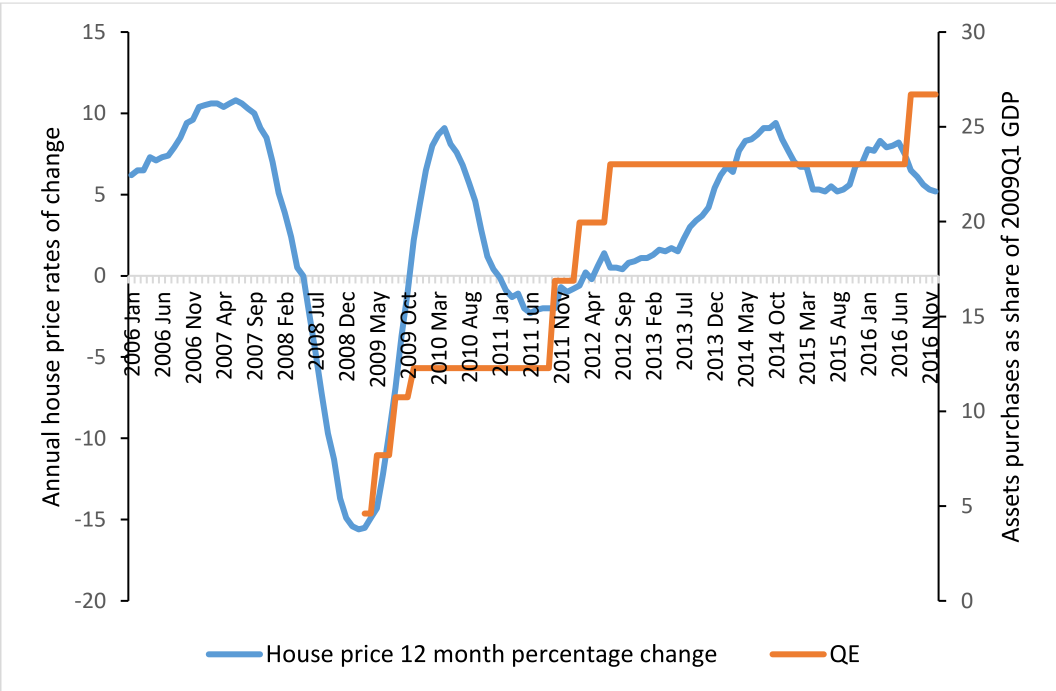


***Figure 1-1*: Annual house price rates of change, UK all dwellings from January 2006 to June 2017 along the QE as share of 2009q1 GDP**

Sources: ONS, BOE and author calculation

House prices have been widely debated in both academic and policy circles as a contributor to the financial crisis in 2008-2009, which started in the US. Tylor (2009a, 2009b), Jarocinski and Smets (2008), and Ahrend (2010) pointed to the role of monetary policy, particularly very low interest rates over an unnecessarily long period, as creating housing market bubbles. In contrast, Bernanke (2010), Negro and Ottrok (2007), Greenspan (2009), and Dokko et al. (2009) argued that the global savings surplus and unrestricted international capital flows were responsible for the housing bubbles in the US.

We can get insight into house price increases, particularly in the UK, by examining the role of QE. To the best of our knowledge, this is the first study that uses FAVAR to look into the impact of QE on the wider economy and in particular on UK house prices.

Monetary policy can influence house prices directly and indirectly. The direct effect of monetary policy on house prices includes the transmission of the burden of cost to home owners, the expectation of future house price movement, and greater investment in housing supply, while the indirect effects appear in wealth and credit channels (Maclennan et al. 2000; Mishkin, 2007; Elbourne, 2007; Wadud et al., 2012).

The direct effect of monetary policy on user cost influences house prices because mortgage payments go down when interest rates go down. This reduces the user cost of housing, increases the demand for housing and pushes house prices up. The rate decrease also reduces construction costs, firms invest more and supply increases, which reduces prices.

The indirect effect of monetary policy transmission is through wealth and credit channels. The fall in interest rates increases housing demand, house prices increase and home owners feel wealthier. This could encourage greater demand for housing and further price increases. It reduces the mortgage repayment for credit-constrained households putting upward pressure on house prices.

Unconventional monetary policy can affect the economy and, in particular, house prices by reducing bond yields. The mortgage rate goes down, reducing housing costs and increasing demand for houses, pushing house prices up and increasing expenditure through the wealth effect.

In this paper, we analyse the impact of QE on the UK housing market and macroeconomic variables using factor-augmented vector autoregression (FAVAR). We quantify the impact of QE on the housing market nationally and across regions in the UK, and on macroeconomic variables using a data-rich methodology.

1.2 Methodology

This paper uses the framework from Bernanke et al. (2005). Let Yt be M by 1 vector of observable economic variables that drive the economy. In our case, this is QE and real activity and prices. We know some important information may not be captured by Yt and we summarise this additional information by K by 1 vectors of unobserved factors. $F_t = [F_1\ F_2\ \ F_3]$', where K is small. The joint dynamic of Ft and Yt will be determined by the following equation:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = B(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + u_t \qquad (1\text{-}1)$$

In this equation B (L) there is a conformable lag polynomial of finite order p, and u_t, the error term with mean zero and covariance **Ω**.

Equation (1-1) is a standard VAR model in which Ft is an unobservable factor that is extracted from a large panel of N indicators (136 in our example), which contains information about the economy. We can map the vector of information variables to the unobservable factors and observable variables in the following forms:

$$X_t = \lambda^f F_t + \lambda^y Y_t + v_t \qquad (1\text{-}2)$$

In this equation (1-2), λ^f is N by K and λ^y is N by M are the matrices of factor loading for unobservable and observable factors. In addition, v_t is the metrics of N by 1 vector, zero mean disturbances.

Equations 1-1 and 1-2 form the FAVAR model presented by Bernanke et al. (2005). As we can see from this model, X_t will be driven by the joint dynamic of F_t and Y_t.

As Bernanke et al. (2005) suggested, there are two methods that can be used to estimate the factor model. The first method is two-step estimation using principal components. The second method is one-step estimation, which uses Bayesian likelihood methods.

The estimation is based on a two-step procedure. The factors are estimated by the principal components (Stock and Watson 2002, 2005), and then their dynamics are estimated. Principal component analysis is a mathematical tool that reduces a complex data set, possibly correlated, to a lower dimension that is uncorrelated, called principal components. Simply put, we try to construct a small data set that can describe and represent the characteristics of a large data set. We have used the two step approach because of simplicity of computation, after Bernanke et al. (2005), Boivin and Giannoni (2007), Soares (2011), Bagzibagli (2012), Uhlig and Amir-Ahmadi (2012) and many others.

There are some differences. The two step principal component estimation allows for some cross-correlation in error terms in equation (1-2), which must vanish as the number of variables (N) goes to infinity. Secondly the two step provides a nonparametric way of uncovering the common space spanned by the factors of X_t, which we denote by $\hat{C}(F_t, Y_t)$. The likelihood-based method, on the other hand, is fully parametric. Therefore the methods have different biases and variances, depending on how well specified the model is. Finally, in the literature the two step approach is considered easier to compute than the one step.

Extracting factors using principal components is subject to the rotational indeterminacy problem. We should use a normalisation process while extracting factors using principal components. Following Bernanke et al. (2005), we use C'*C/=I. Where $C' = \left[\left(\mathrm{C}(F_1, Y_1), \ldots . \mathrm{C}(F_T, Y_T)\right)\right]$. This implies that $\hat{C} = \sqrt{T}\hat{Z}$, where $\hat{Z}$ are the K largest eigenvector of $X'X$, sorted in descending order.

We divide the data into slow moving variables, available on a monthly frequency, and fast moving variables, available daily. We placed the policy variables last to ensure that unobserved variables do not respond within a month to the policy variables. In the two step procedure, the factors need to be rotated to reflect the fact that policy can affect fast moving variables immediately. We follow Bernanke et al. (2005) for the two step explanation:

The first step uncovers the common space spanned by the factor X_t. We denote this common space $\hat{C}(F_t, Y_t)$. In the first step process Y_t is not assumed to be observed, then the first K principal components of the dataset X_t are assumed to uncover the space spanned by the estimate factors $\hat{C}(F_t, Y_t)$. In other words, QE, which is a policy variable in our example, would be part of a linear combination of underlying $\hat{C}(F_t, Y_t)$ because QE (policy variable) is part of Y_t in all specifications. It would thus not be valid to simply estimate a VAR in $\hat{C}(F_t, Y_t)$ and Y_t and identify the policy shock recursively. Therefore, we should remove the contemporaneous relationship between common space $\hat{C}(F_t, Y_t)$ and QE. The strategy would be to estimate the following regression.

$$\hat{C}(F_t, Y_t) = b_{c^*}\hat{C} * F_t + b_{QE}QE_t + e_t$$

In this $\hat{C} * F_t$ will be the estimate of all common components except QE. In practice we can obtain the estimate for$\hat{C} * F_t$, using principal components from a subset of slow moving variables, which by assumption are not affected contemporaneously by QE. Then we estimate $\widehat{F}_t$, as follow:

$$\widehat{F}_t = \hat{C}(F_t, Y_t) - b_{QE}QE_t$$

We can then estimate a VAR that includes $\widehat{F}_t$ and Y_t identified recursively and the QE comes last in our benchmark main model

Finally, we follow standard procedure in VAR analysis from Koop and Korobilis' (2009) implementation of the code from Bernanke et al. (2005). The diffuse priors were chosen to obtain impulse responses, then the error band was derived from the posterior density of the impulse responses.

We also use Gibbs sampling to approximate the posterior distribution in the models with the 25 000 Gibbs replications and 15000 burn in draw in the main model. For the other models we will report if we change the number of the Gibbs sampling due to their computational intensive time.

1.3 Data

We use the monthly data from 2009M1 to 2016M12. The data sets contain information about real activity, price movements, money supply, the financial market and the housing market. For real activity, we collected data on production, output and retail sales as a measure of consumption and employment data. Inflation is based on wages, consumer price indices and import prices. The money market includes lending to household and non-financial firms from M4 and high street banks' lending to industry. The financial market, on the other hand, includes the exchange rate, interest rate and equity market. The housing market includes housing supply, house prices and residential rent on both national and regional levels and mortgage lending. Appendix A shows the full list of the variables. We should note that we applied a seasonal adjustment X12 to all non-seasonally adjusted data. We deflated the nominal house price and equity by the consumer price index to create real house price and real equity prices. We also transformed the data to log difference and level difference to make it stationary before using it in the model. The sources for this data are ONS, DataStream, Bloomberg, OECD, and the Bank of England.

1.4 Estimation

We measure QE following Weale and Wieladek (2016) and Haldane et al. (2016). They measured QE as the volume of assets purchased relative to 2009Q1 GDP. They then directly introduced the Bank of England's assets purchase programme as a monetary policy measure into the structural vector autoregression (SVAR).

Unlike Weale and Wieladek (2016) we are using the FAVAR model, in which GDP, CPI and QE are the only observable variables. We summarise the state of the economy by three factors that are extracted from a large panel of variables. These three factors, along the observable variables, create equation 1. We order the QE, which is the size of assets purchased relative to 2009Q1 GDP, last. This ensures that the latent factors, GDP and CPI, do not respond to QE shock within the month. We also split data into slow-moving and fast-moving variables. Most financial data is available on a daily basis and is fast-moving in our model. We treat monthly data as slow-moving variables and standardise our data to zero-mean and variance one, then apply principal component analysis to capture the common factor in the data set.

1.4.1 Selection of number of factors

The number of factors could be determined by prior knowledge, visual inspection of scree plot, information criteria and many other statistical measures. For example, Bai and Ng (2002) and Onatski (2010) used information criteria to select the right number of factors. Bernanke et al. (2005) used a range of models to determine the number of factors. To decide the number of factors to model the impact of monetary policy on the economy, they compared the impact of the shock on the economy using a different number of factors each time. Unfortunately there is not a widely accepted method for determining the number of factors.

We compute the number of common factors using Bai and Ng's (2002) information criteria presented in table 1-1. According to various criteria the most popular common factors could be three or five factors. Our sample is just 94 observations and it would be difficult to include many factors due to the lack of degrees of freedom. We decided on three factors, and they are equally as important as five factors. We also visually inspect the number of factors using a scree plot, which is a graphical representation of eigenvalues ordered from largest to smallest. We can show this by the per cent of variance explained by each principal component in Figure 1-2. The horizontal axis shows the principal components and the vertical axis shows the amount of variance that can be explained by each principal component. Based on this information we select three factors that can explain more than 70 per cent of the variation in our data.

	IC criteria			PC criteria			BIC3 criteria	AIC3 criteria
nb factor	IC1	IC2	IC3	PC1	PC2	PC3	BIC3	AIC3
0	-0.011	-0.011	-0.011	0.989	0.989	0.989	0.989	0.989*
1	-0.107	-0.098	-0.131	0.879	0.885	0.865	0.857	0.938
2	-0.130	-0.111	-0.178	0.847	0.859	0.818	0.803	0.963
3	-0.150*	-0.122*	-0.222	0.823	0.841*	0.780	0.757	0.996
4	-0.148	-0.110	-0.244	0.820*	0.843	0.762	0.731	1.049
5	-0.145	-0.098	-0.265*	0.820	0.849	0.748*	0.709*	1.104

***Table 1-1*: Selection of the number of factors based on information criteria**

The * indicates the common factors for these variables.

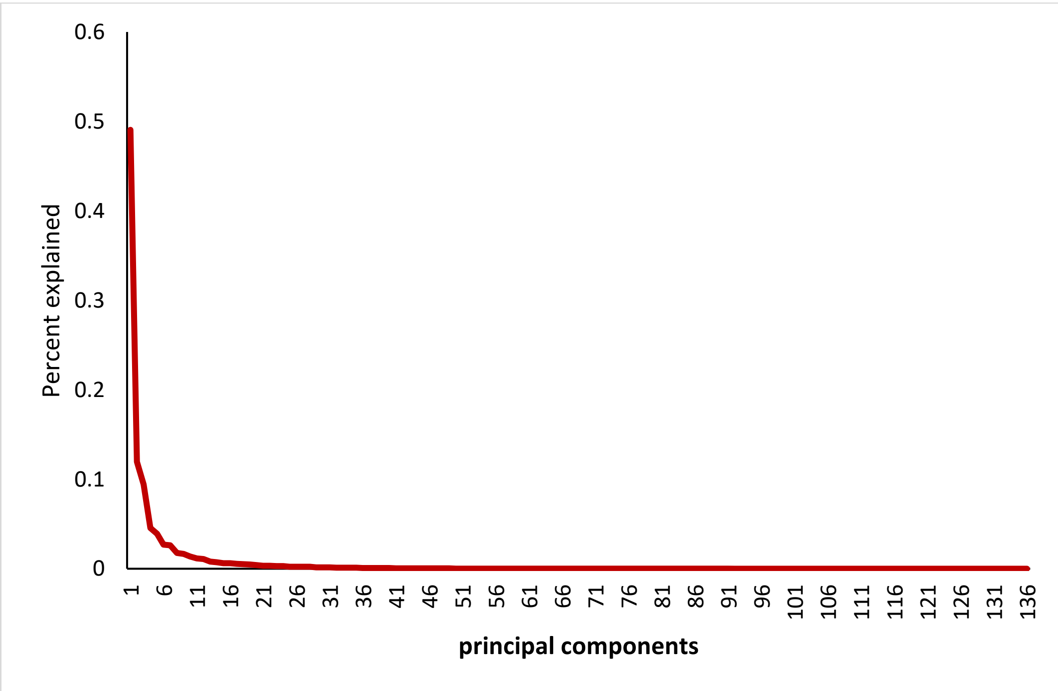


Figure 1-2: The per cent of variance explained by each principal component

1.4.2 Contribution of each variable to each principal component (factor)

The contribution of each variable for a given principal component is important because we can see how our house price data is represented in the factors that we have chosen. In PCA the correlation between factor and variable shows the information they share. This correlation coefficient is called factor loading, which we denote as λ. We follow Abdi and Williams (2010) in that the sum squared λ^2 of the correlation between variable and factors should equal 1. Therefore, the squared λ^2 coefficient is easier to interpret, as it represents the proportion of variance of a variable that is explained by a factor. Figure 1-3 shows the contribution of each variable to the first three factors. As we can see, house prices are well represented in these three factors. For example, the contribution of UK house prices to the first three factors ranked first. Most house price variables such as those for England, London, and the Southeast and East ranked top when we order the variables according to their contribution to the three factors.

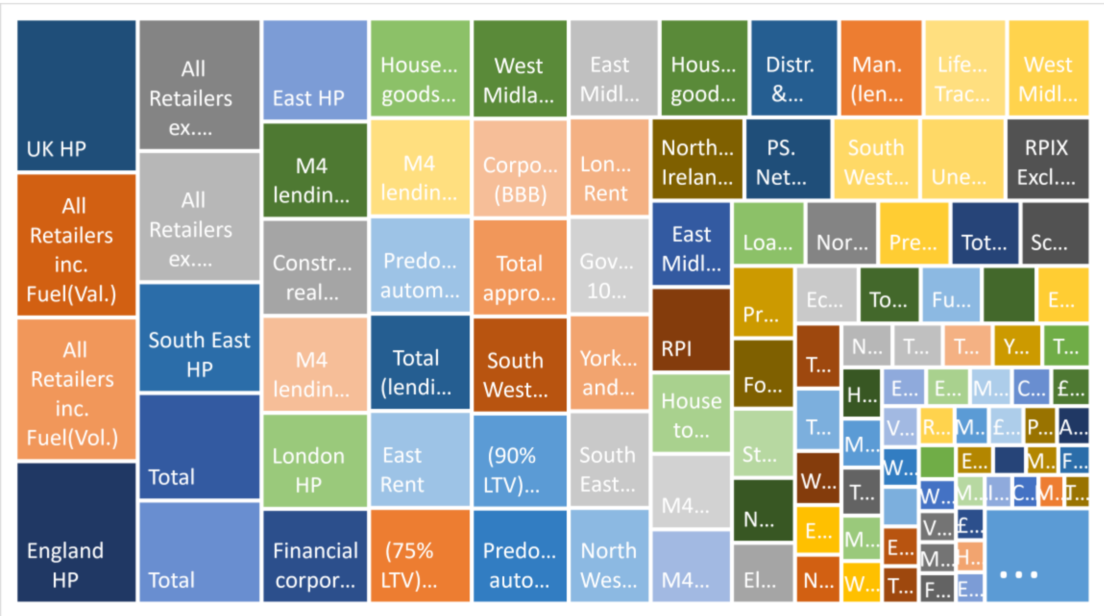


Figure 1-3: The proportion of variance of a variable that is explained by three factors

* Size of square reflects their contribution to the first three factors

1.5 Empirical Results

This section describes the main results. First, we present the aggregate macroeconomic response to the shock and compare it with existing studies to establish a benchmark. Second, we discuss the housing market and associated sectors, such as house prices and financial and credit markets. Third we check for robustness: we estimate the model using sign restriction; we replace the QE measure by Weale and Wieladek (2016) with the Wu-Xia (2016) shadow rate and recompute our main model, and we update the main model to include the international dimension of our small open economy. Finally, we present the forecast error of our main estimation.

1.5.1 Aggregate macroeconomic response

Figure 1-4 presents the impulse response on selected variables when asset purchases are increased by 1 per cent of GDP. The significant impact of QE on the overall macroeconomic variables is clear and the direction of the impact is in line with economic theory, as expected. GDP and industrial production has increased while unemployment has fallen. Increasing money supply may lead to pressure on Sterling, devaluing the exchange rate and boosting exports. It reduced volatility as a measure of uncertainty in the market, given that at the time the economy was in flux due to the financial crisis. The real asset price appreciated and consumer prices increased. Figure 1-4 shows that purchasing assets worth 1 per cent of GDP will increase real GDP up to 0.25 per cent over 3 years; the consumer price index will increase up to 0.032 per cent within 5 months and unemployment will fall by 40 basis points over 3 years.

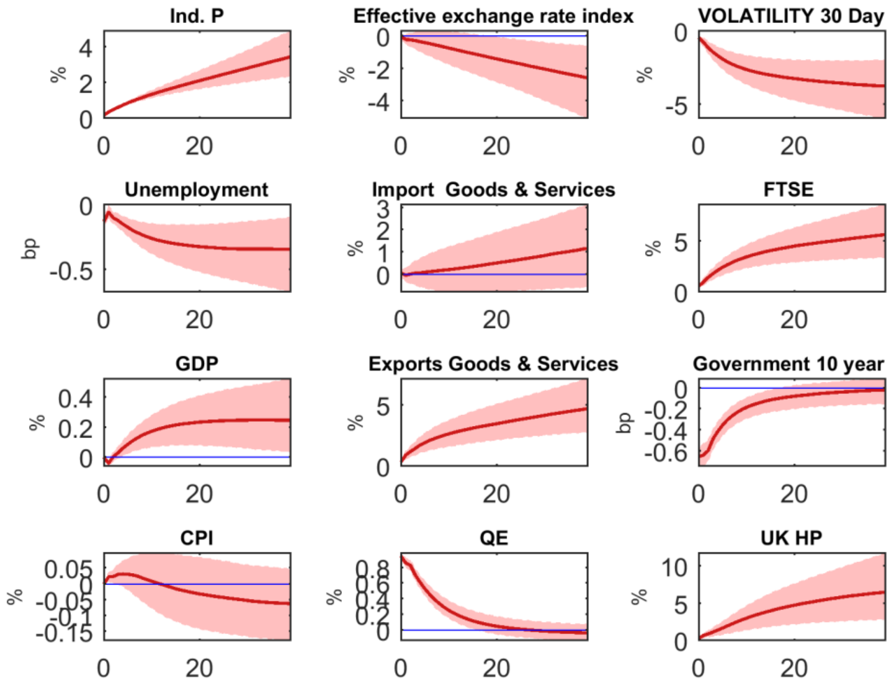


Figure 1-4: Aggregate macroeconomic response to assets purchases main model

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

We compare our estimation of the impact of QE to existing literature in table 2. Most of this literature looks at the broader impact of QE on the economy. In addition, there is a consensus in empirical literature that QE can stimulate economic activity. However, it is more difficult to estimate the impact of QE on economic activity than on financial markets.

Kapetanios et al. (2012), use three different VAR models to construct counterfactual forecasts considering that QE reduced the yield spreads. Taking the average estimate from these models, they concluded that QE had a peak impact of 1.5 per cent on real output and 1.25 percentage points on CPI. Bridges and Thomas (2012) use the money demand and supply framework to assess the impact of QE on money supply and spending and incorporate it into an SVAR model. Their estimates across the average model are very similar to Kapetanios et al. (2012), which is that real GDP increased by 2 per cent and CPI by 1 percentage point.

Churm et al. (2015) use ARDL and BVAR models to assess the impact of QE and found that QE1 has a peak impact of 0.8 per cent on GDP and 0.6 percentage points on CPI. They found that QE2 has a similar impact, 0.6 per cent, on GDP and a significant positive impact on inflation.

Weale and Wieladek (2016) used SVAR with four-difference identification to assess the impact of QE in the US and the UK. They concluded that asset purchases of 1 per cent of GDP, can increase real GDP by up to 0.25 per cent and CPI by up to 0.32 per cent in the UK. Haldane et al. (2016) expanded their work to measure the impact of an increased central bank (CB) balance sheet on the economy. The results are broadly the same for the UK and the US, as they used the same methodology and data as Weale and Wieladek (2016).

Most of these studies use a variety of models to assess the impact of the QE with very high uncertainty. They report their findings by taking the average of the estimated models.

As table 2 shows, overall results are broadly in line with the current literature considering the high uncertainty around the estimations, difference models, different identification and inclusion of pre-crisis data.

	GDP (%)	*CPI (PP)*	*Time Frame peak impact*
Joyce, Tong and Wood (2011)	1.5	0.75	NA
Kapetanios, et al. (2012)	1.5	1.25	Using different model, hence different time *
Bridges and Thomas (2012)	2	1	Output 2 year and inflation a year
Pesaran and Smith (2016)	1		On impact and disappear within 2 years
Ghoodhart and Ashworth (2012)	3	0.4	NA
Weale and Wieladek (2016)	3.1	4.3	NA (from graph within a year)
Churm et al. (2015)	0.8	0.6	after a year
Cloyne et al. (2015)	5.5	1.5	After around 6 years
This paper	3.3	0.4	output within 20 month, CPI within 5

* BVAR, (within a year), MS-VAR (Within a month) and TVP-VAR (after 3 quarter). This is the average of the model response.

Table 1-2: Our results in comparison to other studies

1.5.2 Housing market

In this section we look at the national and regional housing market and house prices in the UK. We also look at bank lending, in particular mortgage lending. The housing market, especially house prices, are affected by economic conditions, the availability and affordability of mortgages, population changes and housing supply. In addition, because houses are assets they are subject to speculation. The exceptionally low yield for government bonds sends investors looking for alternative assets. Jorda et al. (2014) suggest that loose monetary policy may lead to a boom in real estate and this in turn may affect financial stability.

1.5.2.1 Housing market overview

Figure 1-5 presents the impulse response to increases of asset purchases by 1 per cent of GDP on selected variables in the housing market. The horizontal axis shows the month and the vertical axis shows the impact of the shock. We can see that due to the QE shock real house prices increased 7 per cent over three years. This generated capital gains and boosted household wealth. An ONS survey suggested that aggregate household gross property wealth increased by £625 billion from July 2008 to June 2014.

The figure also shows house prices by country. The biggest house price increases occurred in England with a similar rate to the overall UK house price increase. There were no significant and immediate house price increases in Scotland, Wales or Northern Ireland, where prices rose by 1 to 3 per cent. The difference in response across countries suggests heterogeneity in the housing market in the UK.

Furthermore, as home ownership increases short run rental prices decline in England and Wales. In the medium term the rental price in England will revert to base and there is a long-term impact on the rental price in Wales.

The total sales volume of properties decreased, which may have put extra pressure on house prices due to lack of supply. The higher house prices combined with a supply shortage and lower wage growth increases the house price to income ratio.

This will reduce housing affordability, even though mortgage costs are lower.

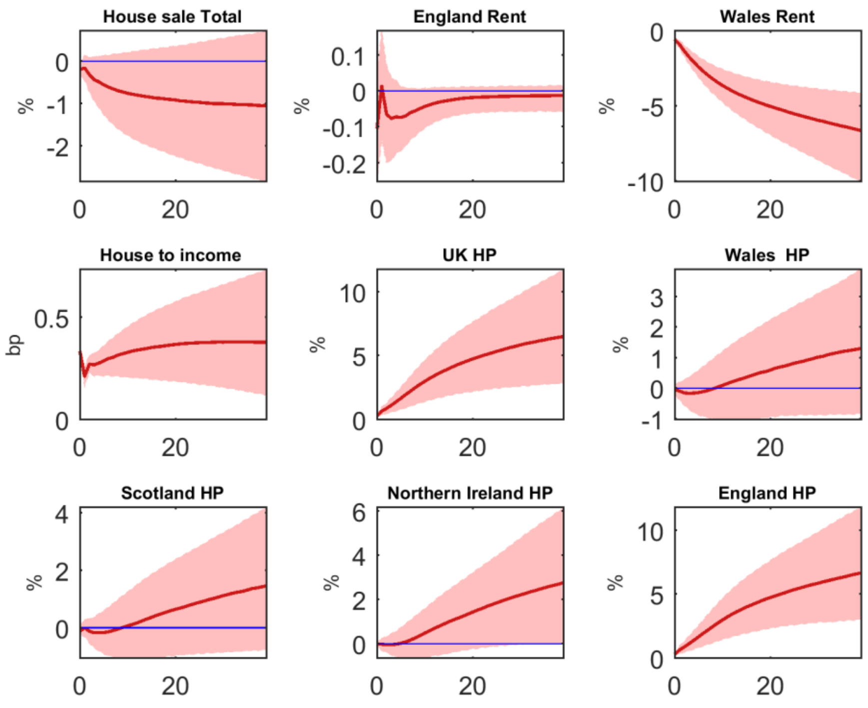


Figure 1-5: Overall housing market response to assets purchases main model

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

1.5.2.2 House prices in England

Figure 1-6 presents the response of house prices to QE shock in England. Nearly all house prices in England are rising between 3 to 7 per cent cumulatively, with Yorkshire and the Humber showing the smallest gains. Surprisingly we do not see huge increases in London: the real house price in London increases by about 3 per cent. This does not support the view that house price increases in London are due to cheap credit. The IMF in 2014 report cited soaring house prices in London as a sign of a credit bubble, but house prices in London may be fuelled by other factors as well. In Figure 1-7 we illustrate the England housing stock as a share of the population between 2001 and 2015. We can see that housing stock as a share of the population in London is falling much faster than in any other area in the UK. This is a trend that commenced in 2004, when the UK opened its doors to new European members. It shows that supply is a major issue in London, and the population is rising. The ratio of house prices are 10 times higher than average income in London, which is twice the UK average. Furthermore, the increase in house prices in London has a spillover effect to other parts of the UK (Holly et al., 2009).

House prices in the South West, South East and East are rising much faster than elsewhere in England due to the shock. Real house prices in these regions increased between 5-7 per cent over the horizon.

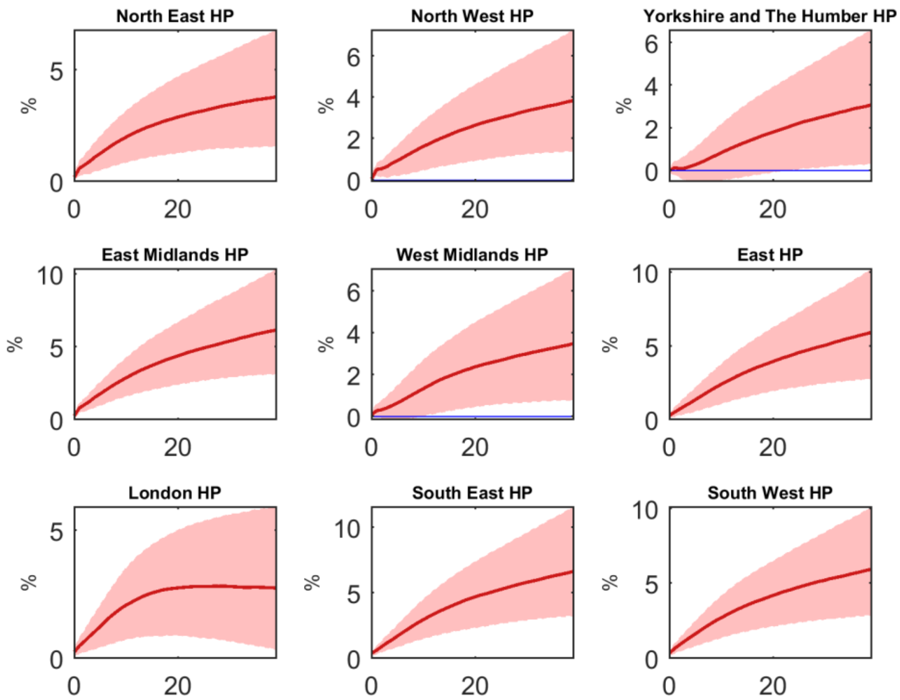


Figure 1-6: England Real House price response to assets purchases

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

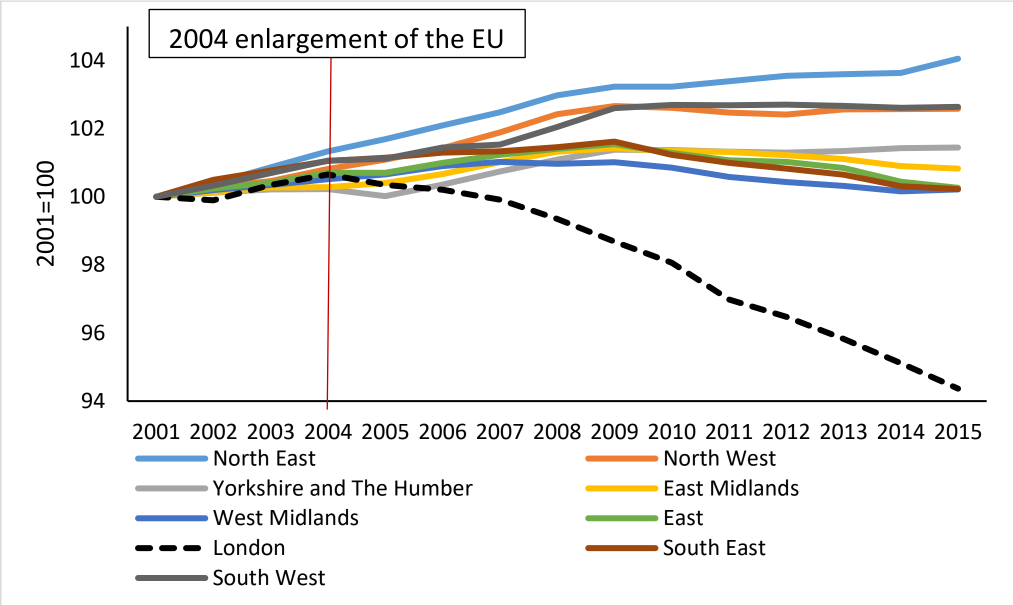


Figure 1-7: England region housing stock as a share of population between 2001 and 2015

Source: ONS, author calculation

1.5.2.3 Financial and credit market.

The first three rows in Figure 1-8 show the financial market response to the QE shock. The response is unsurprising. Volatility as a measure of uncertainty decreased due to QE, the FTSE improved, the exchange rate fell, the corporate bond rate fell about 60 basis points while the 10-year government bond rate fell to about 70 basis points, and the mortgage interest rate also fell.

Central bankers and others have suggested that QE has reduced the long-term yield by reducing term premiums. Yellen (2012), for example, said that research by Federal Reserve staff and others showed that their balance sheet operation had a substantial effect on the long-term Treasury bond. A lot of research suggested that QE had decreased the bond yield: this includes Wright (2012), D'Amico et al. (2013), Bauer and Rudebusch (2014), Christensen and Rudebusch (2012), Chung et al. (2012), Gagnon et al. (2011), Hamilton and Wu (2012), Krishnamurthy and Vissing-Jorgensen (2011), Meyer and Bomfim (2010) and Neely (2015).

In the UK, Breedon et al. (2012), Caglar et al. (2011), Bridges and Thomas (2012), Christensen and Rudebusch (2012), Joyce et al. (2011a), Joyce and Tong (2012), Kapetanios et al. (2012), McLaren et al. (2014), and Meier (2009) reported that the first round of QE had reduced the bond yield between 48-150 basis points. Meier (2009) estimates that the first round of QE reduced the bond yields by 48-60 basis points, while Joyce et al. (2011) estimated that the first year of QE reduced government bond yields by about 100 basis points. Weale and Wieladek (2016) report that the 20 year government bond yields will reduce by 50 basis points as a result of QE.

The fall in bond yields could induce a fall in other interest rate instruments such as the mortgage rate. In turn, the fall in the mortgage rate could reduce the cost of having a mortgage. This could be the one of the channels that influence house prices in the UK.

Furthermore, equity prices have increased by about the same amount as house prices. Òscar Jordà et al.(2017) studied 16 advanced economies from 1870 to 2015, covering total return for equity, housing, bonds, and bills. They concluded that housing returns are the same as equity with lower risk. Furthermore the returns on housing is higher than assets such as bond and treasury bills. This makes property an attractive investment during periods of high uncertainty since the financial crisis.

The assets purchased through QE from the non-bank private sector were deposited in the banking sector. This increased the banking sector reserve with the Bank of England (BoE), increasing liquidity in the banking system and encouraging more lending. However, as the banking system was under pressure to reduce their balance sheets, there was little expectation by the Bank of England and MPC that the banks would increase lending (Joyce et al., 2011).

The last two rows in Figure 1-8 show the state of the lending market in the UK when asset purchases were increased by 1 per cent of GDP. Overall credit conditions improved for both the household and non-financial sectors. For example, we can see increases in lending to households and in firms' ability to raise capital through selling securities. M4 lending to non-financial corporations initially increased but the degree of uncertainty is increased over the horizon. However, M4 lending to households that is secured by dwellings has improved. A speech by Alex Brazier (2017) from the Bank of England suggests that over the past 10 years, the number of consumer credit write offs is 10 times higher than mortgages and in addition, people in Britain do everything they can to pay off their mortgage debt. This is why banks did not take huge losses on mortgages during the crisis and shows why banks prefer secured lending. This in turn gives people who already own one property a better chance of buying another. This is in line with the IMF report (2016) that buy-to-let lending has grown faster than overall residential property lending. This may also increase the price of the property.

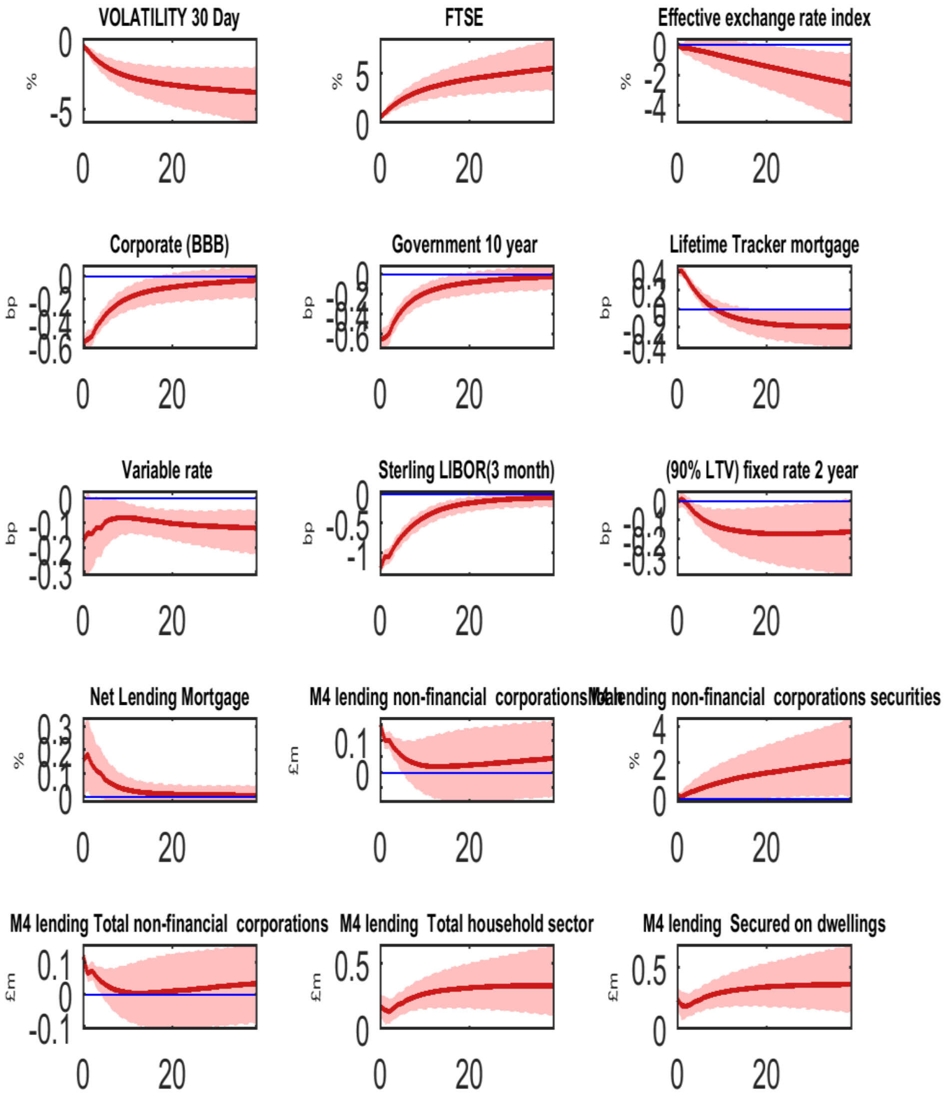


Figure 1-8: Financial and credit market response to assets purchases

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

1.6 Robustness

We look at the robustness of our result from several perspectives. We first use sign restriction to evaluate the robustness of our result. Then we examine our result by replacing the QE measure with the shadow rate (Wu and Xia 2016). Finally we include additional variables to cover the international dimension of our model.

1.6.2 Sign restriction

Sign restriction is a popular tool for looking at the impact of a shock. The method was pioneered by Blanchard and Diamond (1990), Fatus (1998), Canova and del Nicole (2002) and Uhlig (2005). They suggested that structural inference using VAR might be based on prior beliefs about the sign of the impact of certain shocks (Baumeister and Hamilton, 2015).

In this, we have the following prior assumptions on the observable variables while unobservable data will be unrestricted. To identify shocks in our model we extend the observable set and include long term interest rates and real equity price following Weale and Wieladek (2016). We identify the AP, or QE, shock as being the only shock which moves equity prices and long run interest rates in opposite directions and which also has a positive association between QE and equity prices to distinguish it from an (not modelled in this revision) uncertainty shock.

Furthermore, as result of a shock to output the CPI will increase while a shock to CPI will reduce output. However, the impact for both shocks on assets purchases (AP) will be determined in the model. In addition, as we are going to look at impact of the AP shock on CPI and GDP, we do not restrict the output and CPI. However, the impact on long term bond and real equity prices is positive in both cases. Table 1-3 present this identification scheme.

Column1	Log GDP	Log CPI	QE	10 year Gov. B yield	log Real equity price
Demand shock	+	+		+	+
Supply shock	-	+		+	+
AP shock			+	-	+

Table 1-3: The matrix for restriction

This table shows the sign restriction on the impulse response for each identified shock. + Sign shows positive, while - shows negative. Blank entry indicates no restriction.

This scheme is implemented as follows. We can decompose the covariance matrix of Ω in the following form

$$\Omega = A_0 A_0'$$

In this A_0 shows the contemporaneous impact of the structural shockε_t. A_0 can be restricted using prior information to define the shock of the interest. In practice we can get the structural matrix A_0 through the procedures introduced by Rubio-Ramírez et al. (2008). We can decompose the structural covariance matrix Σ of VAR into eigenvalue –eigenvector as flow $\Omega = PDP'$ and we define $\tilde{A}_0 = PD^{\frac{1}{2}}$. Then we draw N×N from the Normal distribution, N (0, 1) and take the QR decomposition of K. We compute Q and R such that K=QR, then we compute a structural impact matrix as $A_0 = \tilde{A}_0 Q'$. We will keep the shock if it satisfies the sign condition; otherwise we discard it.

Figure 1-9 shows the responses of UK macroeconomic variables when asset purchases were increased by 1 per cent of GDP in 2009 using sign restriction. The output is scaled to the standard deviation of the shock. Comparing this figure to those obtained under recursive identification in Figure 1-4 shows that our results are robust. The general direction of the movement of the variables is identical to what we obtained earlier. However, the magnitude of response for some variables differs. For example, we can see that the response of long term government bonds is stronger under the sign restriction. As output increases, unemployment falls by nearly the same amount as in our main estimation while CPI is barely responsive, and ambiguous. The exchange rate will fall, leading to fewer imports and encouraging more exports. Although the confidence band under sign restriction is much wider for the majority of our results, the median response is nearly the same.

Because of the decline in government bond yields, investors may exchange UK assets for foreign ones in the search for higher returns. Therefore, QE will put downward pressure on the nominal effective exchange rate (NEER). We can see from Figure 1-9 that the exchange rate is falling due to asset purchases. This will increase the competitiveness of the UK economy and exports will grow faster than imports, boosting output growth.

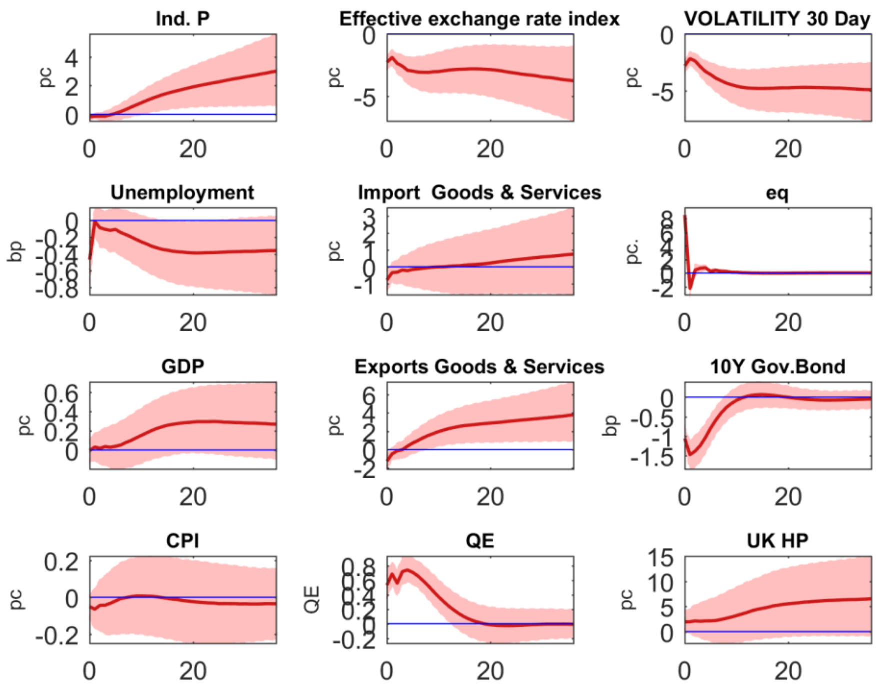


Figure 1-9: Aggregate macroeconomic response to assets purchases sign restriction

This figure shows the median response and the 68 per cent confidence band. We show results for sign restriction. The shock scale to standard deviation of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

The impact on the housing market and house prices in England is shown in Figures 1-10 and 1-11. The results are very similar result to those in Figure 1-5 and 1-6, however, the median magnitude is slightly lower than the result obtained under recursive identification, while its confidence band is slightly wider. Overall house prices increased over the horizon by about 6 per cent. The real house price response in England is between 2 to 5 per cent. House sales initially increase but fall over time, consistent with the earlier result.

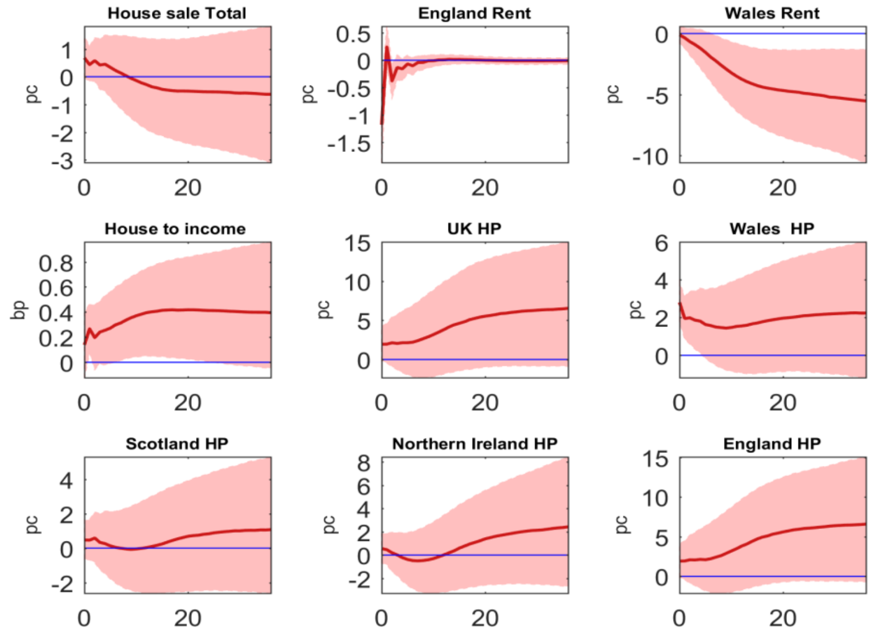


Figure 1-10: Overall housing market response to assets purchases sign restriction

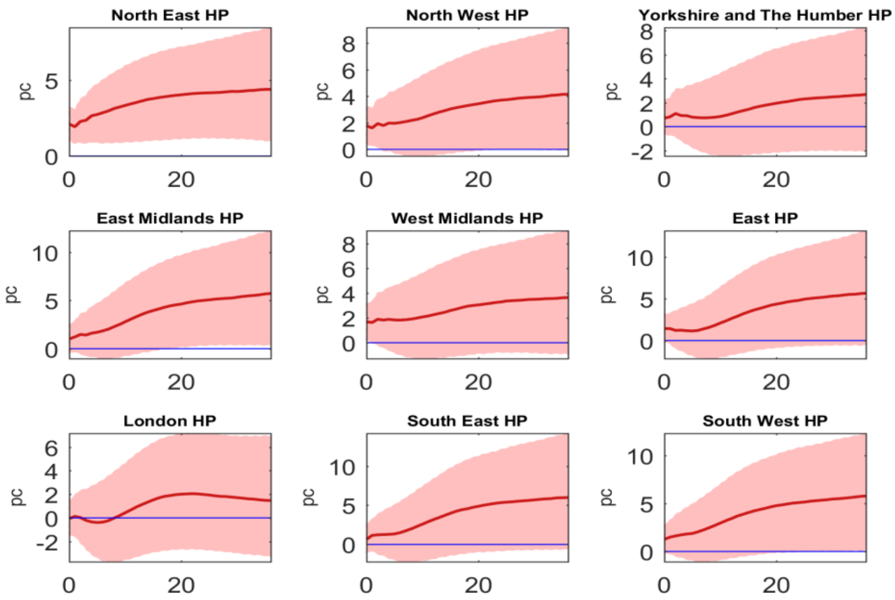


Figure 1-11: England Real House price response to assets purchases sign rustication

The figures 1-10 and 1-11 show the median response together with 68% confidence band. We show results for sign restriction. The shock scale to standard deviation of QE shock and 25000 Gibbs replication and 10000 for inference were used to grenade impulse response.

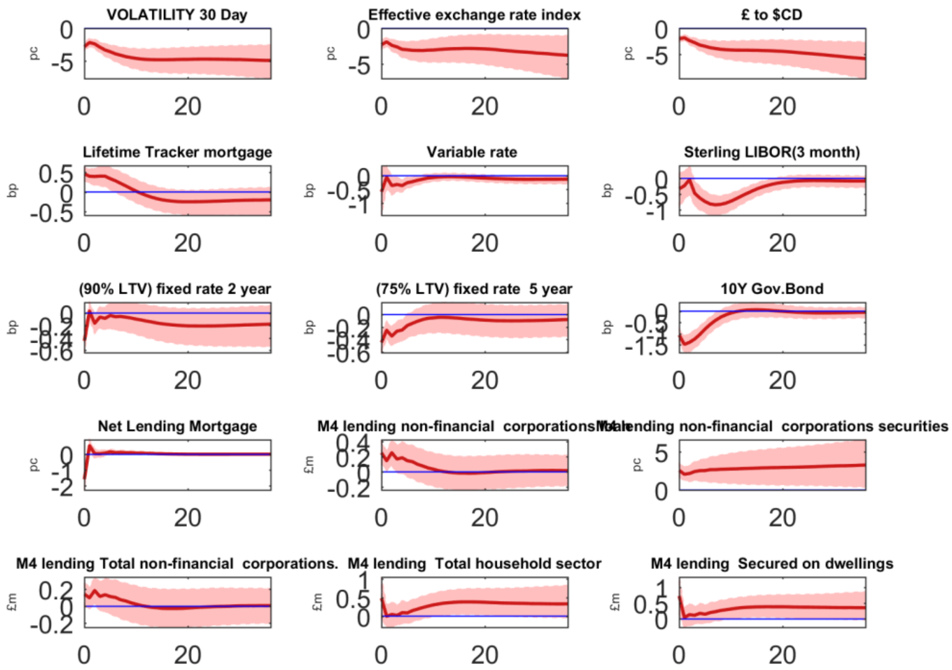


Figure 1-12: Financial and credit market response to assets purchases under sign restriction

This figure shows the median response and the 68 per cent confidence band. We show results for sign restriction. The shock scale to standard deviation of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

Figure 1-12 shows the impact on financial and credit markets under sign restriction. Comparing this result to those obtained under recursive identification, we can see nearly an identical response except net lending mortgages. Volatility as a measure of uncertainty in financial markets is reduced by 3 per cent. Most interest rates are falling as expected.

In summary, under sign restriction the median impact is nearly the same with the highlighted exceptions. We can have a wider confidence band than our base model, under sign restriction. Overall, our result is robust.

1.6.2 Shadow rate

The shadow rate was introduced by Fischer Black (1995) and extended by Wu and Xia (2016), to measure the impact of QE on the base rate in the US. It shows the impact of QE on the traditional bank base rate, which can be negative. In other words, the shadow rate computes the base rate equivalent of QE using Treasury forward rates. As described by the Federal Reserve Bank of Atlanta, "These forward rates are constructed with end-of-month Nelson-Siegel-Svensson yield curve parameters from the Gurkaynak, Sack, and Wright (2006) dataset. […]. In short, the shadow rate is assumed to be a linear function of three latent variables called factors, which follow a VAR (1) process. The latent factors and the shadow rate are estimated with the extended Kalman filter." (Federal Reserve Bank of Atlanta, 2017). The full description of the model can be found in Wu and Xia (2016).

The shadow rate can be a substitute for the base rate in economic models such as VAR, the New Keynesian model and the general equilibrium model (Dee Gil, 2017). Figure 1-13 compares the shadow rate to the official Bank of England rate. We can see the shadow rate tracking the base rate closely. We estimate our main FAVAR model by replacing the QE measure (Weale and Wieladek (2016)) with the shadow rate (Wu and Xia 2016). As the shadow rate is a substitute for the base rate, we reduce the base rate by 100 basis points.

Figure 1-14 presents the impact of a reduction of 100 basis points over the same set of variables in Figure 1-4. Comparing these figures to our main model estimation in Figure 1-4 shows that they are virtually identical except that we see a fall in real output and an increase in unemployment before the model settles. Overall, most of the variables produce nearly the same result. However, we can see a stronger response from the CPI, which stays positive to the end of the horizon and increases by 0.12 per cent.

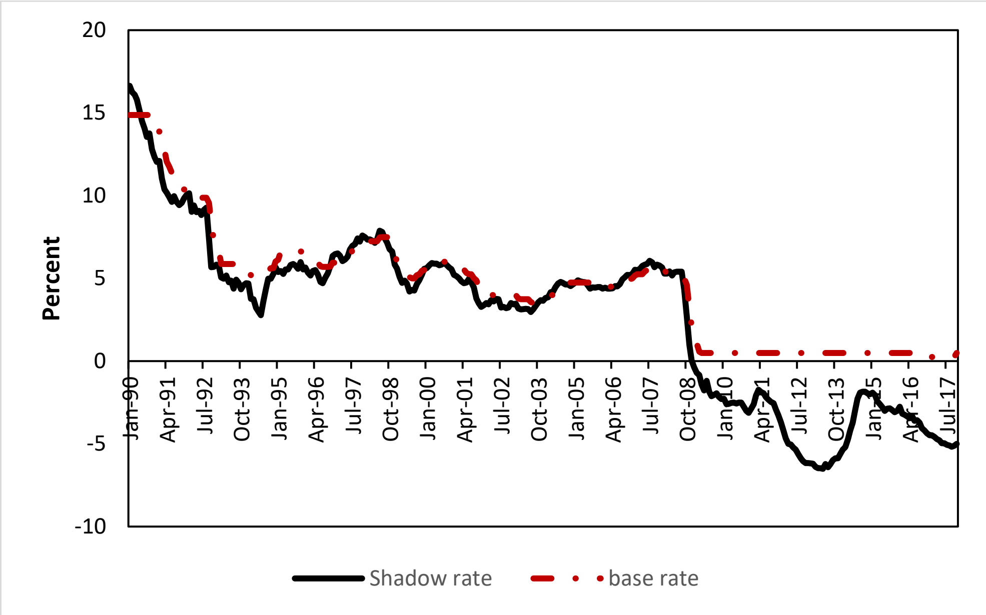


Figure 1-13: Shadow rate and Bank of England base rate

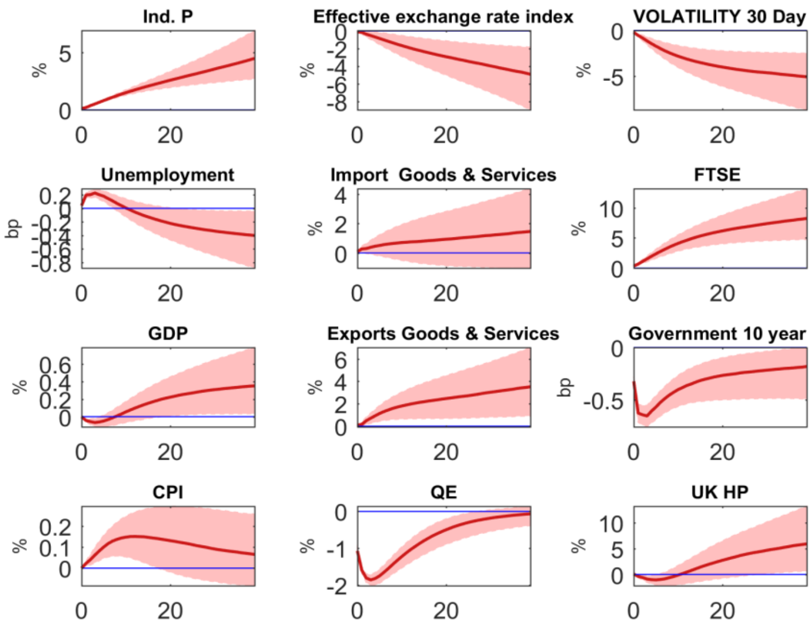


Figure 1-14: Aggregate macroeconomic response to assets purchases shadow rate

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

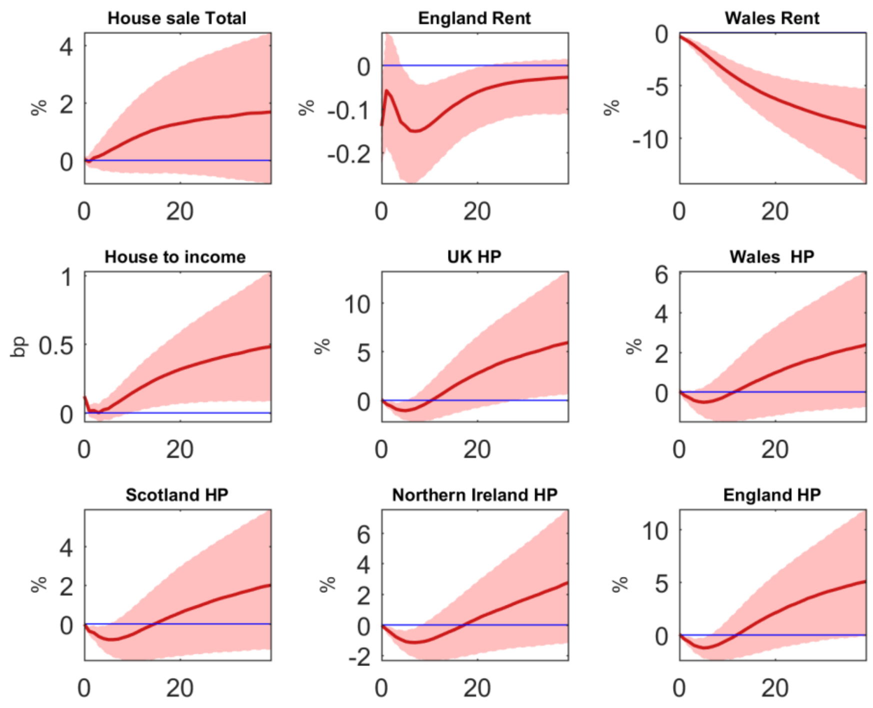


Figure 1-15: Overall housing market response to assets purchases shadow rate.

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

Figure 1-15 shows the overall house price equivalent to Figure 1-5 in our main result. All the responses are similar with minor changes to their magnitude, except house sales. House sales under the shadow rate are increasing rather than decreasing. Furthermore the regional house price in Figure 1-16 is comparable to Figure 1-6 in our main result. Overall, we can see a positive influence on real house prices, just as we obtained in our main result. However, the magnitude for the median response is falling compared to our benchmark result. We can see that the median response for the South West and South East declines to around 2 and 4 per cent over the horizon. However, the response of house prices in London increases to around 4 per cent. In addition, under the shadow rate we have a brief very small negative for most house prices at the beginning. This could be due to the strong CPI response at the beginning of the model. As the CPI increases real house prices fall. The financial market response is also similar to the one we obtained in our main model.

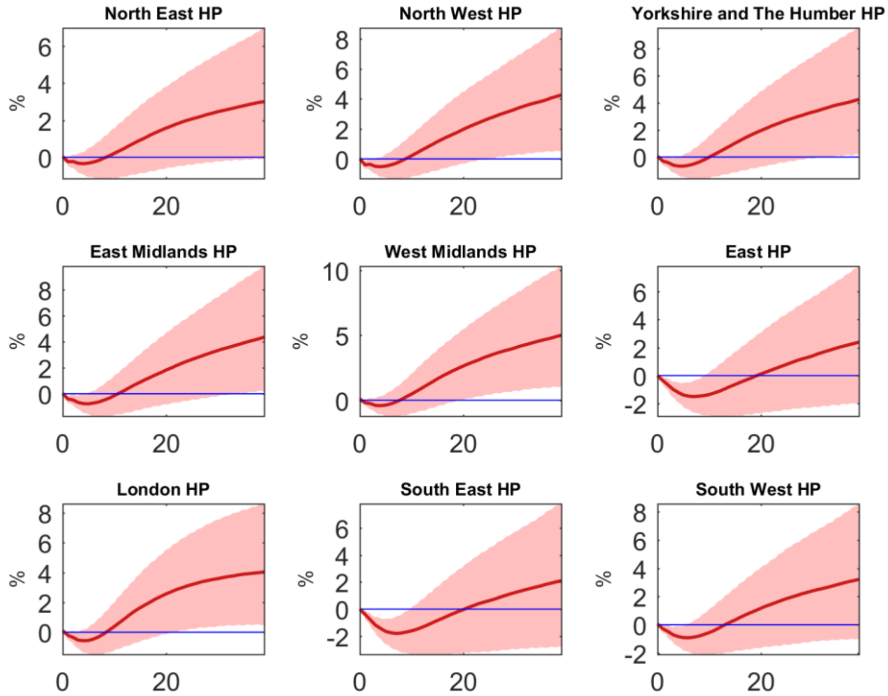


Figure 1-16: England Real House price response to assets purchases shadow rate.

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

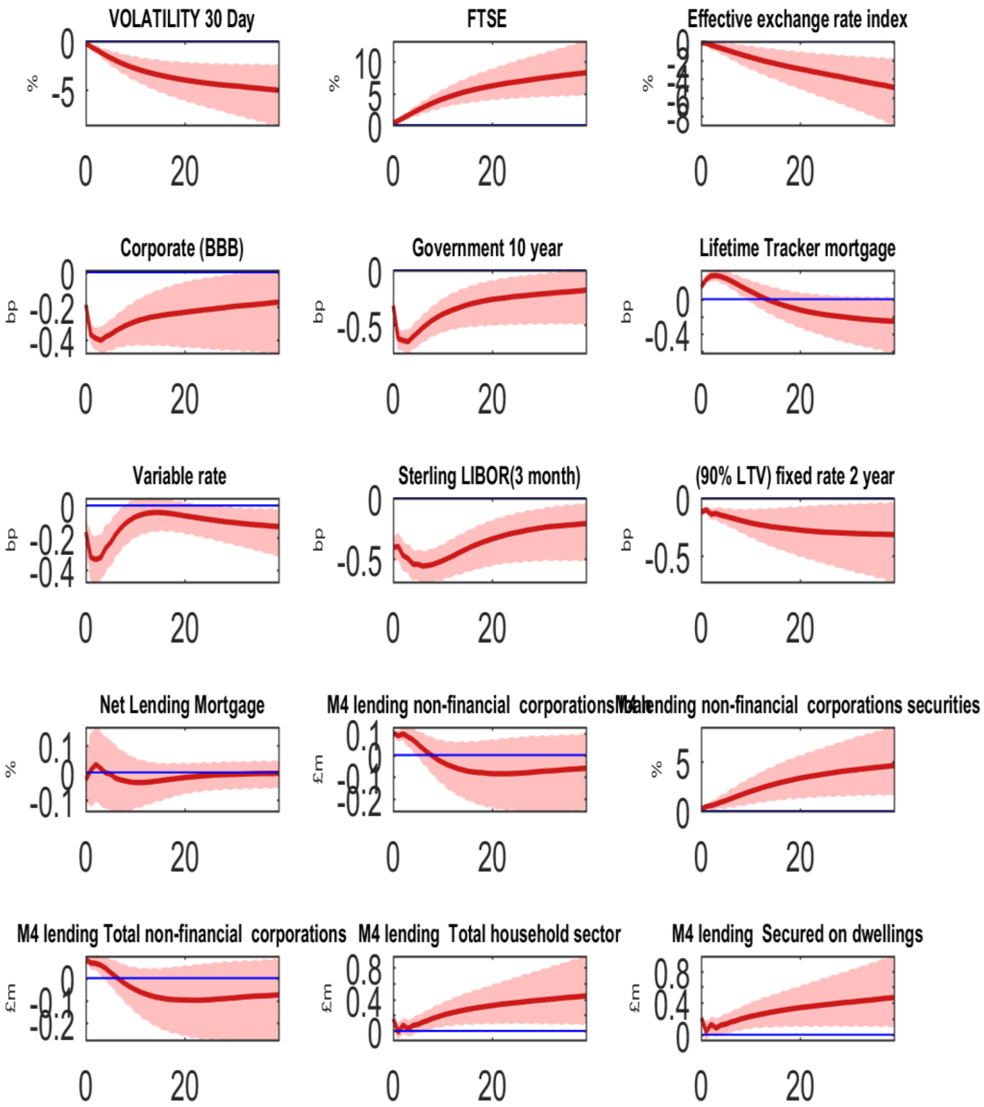


Figure 1-17: Financial market response to assets purchases under shadow rate

This figure shows the median response and the 68 per cent confidence band. We show results for recursive identification. The shock scale to unit of QE shock, 25000 Gibbs replication draw and 15000 burn in draw were used to generate impulse response.

1.6.3 Open economy

The simplest approach without changing the structure of the model is to introduce an extra observable variable to the VAR to capture the international development in our model. The extra variables, one by one as part of the observable variable, place last in the VAR, this is the approach followed by Weale and Wieladek (2016). The approach of adding extra external variables to the VAR is also used by Bruno and Shin (2015) to cover the international dimension of their model. We added the spread between Italian and German 10-year government bond yields, the natural logarithm of real oil price in the UK sterling, the nominal effective exchange rate (NEER) and finally we take the common factor of asset purchase as a share of GDP in 2009Q1 by ECB, Federal Reserve (Fed) and Bank of Japan.

The result from the inclusion of these additional external variables on the broad macroeconomic variables, housing market, house prices in England and the financial and lending market are in Appendix B. The overall result is in Figure 1-18 below. The results appear robust and are broadly intuitive: asset purchases by the Bank of England increase GDP, reduce unemployment, increase house prices and increase house to income ratio. This occurred in every scenario we tested. Furthermore, the scenarios also increase equity prices, reducing the nominal effective exchange rate (NEER) and bond yields, although the impact on these variables under these scenarios differs in magnitude but within a reasonable band. Details are in Appendix B. Overall our result is robust to the inclusion of an international development variable.

Figure 1-18: Results with NEER as Control Variable (overview open economy)

This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The nominal effective exchange rate (NEER) is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

1.6.3 Variance decomposition (FEVD)

We look at determining the fraction of forecasting error that is attributable to a QE shock for common components. This is an important exercise that shows how much of the forecast error is due to the given shock at a particular horizon. To implement this, we follow the steps set out in Bernanke et al (2004). In this, the variance decomposition for χ_{it} can be expressed as the following equation:

$$\frac{\Lambda_i\, var\left(C_{t+k} - \check{C}_{t+k|t} \middle| \epsilon_t^{AP}\right)\Lambda_i'}{\Lambda_i\, var\left(C_{t+k} - \check{C}_{t+k|t}\right)\Lambda_i'} \tag{1-3}$$

In this equation Λ_i is the i^{th}line of $\Lambda = [\Lambda^f, \Lambda^q]$ and the following part

$$\frac{var\left(C_{t+k} - \check{C}_{t+k|t} \middle| \epsilon_t^{AP}\right)}{var\left(C_{t+k} - \check{C}_{t+k|t}\right)} \tag{1-4}$$

is the standard VAR variance decomposition for equation 1-1.

Table 1-4 reports the results for forecast error variance decompositions (FEVD), measuring what percentage of the variance of 5, 15, 20 and 36 months ahead the forecast error owes to the QE shocks. The last column shows the R^2 of the common components for each of these variables. The contribution of the QE shock ranges between 5.8 to 11.6 per cent at the horizon of 36 months, with the exception of the financial market variables. This may suggest a relatively small impact for the monetary policy shock. However, inspecting R^2 of the common components, the result suggests that most of the house prices are well represented in our factors. This is also evident from Figure 1-3 which we looked at before our analysis. For example, the house price has R^2 of 89 per cent. This confirms that the estimated FAVAR captures an important dimension of the UK business cycle. In addition, we should have less confidence in those variables with low R^2 (Bernanke et al. 2005).

Horizon (in Month)	5	15	20	36	R^2
QE	68.5	46.1	40.4	32.5	100*
FTSE	34	32.4	31.2	27.4	6.9
Corporate (BBB)	29.5	19.9	17.9	15.4	92.3
Government 10 year	28	22.6	20.6	17.9	77.4
Ind. P	27.1	26.4	24.4	19.2	1.9
VOLATILITY 30 Day	26.4	27.7	27.4	25.2	3
Net finance raised by PNFCS	10.3	11.1	11.3	11.3	22.7
Exports Goods & Services	8.8	10.5	10.7	11.6	14.2
Effective exchange rate index	7.5	9.6	10.2	11.2	5.6
Import Goods & Services	7.5	9.4	9.6	10.9	4.4
M4 lending non-financial corporations securities	5.1	7.1	7.5	8.5	9.3
M4 lending Secured on dwellings	4.3	5.6	5.9	6.6	12.5
M4 lending Total household sector	3.7	7.1	7.9	8.9	74.3
Unemployment	2.7	5.8	6.8	8.3	96.4
M4 lending Total NFCRP	2.7	3	3.7	5.6	98.9
House Price					
North East HP	4.1	6.3	6.7	7.5	19.2
Wales HP	3.5	5.7	6.2	7.4	14.9
East Midlands HP	3.2	5.4	5.8	6.6	46.4
South West HP	2.9	5.2	5.8	6.6	42
Scotland HP	2.7	4.2	4.6	5.5	22.9
East HP	2.4	4.3	4.7	5.7	54.8
South East HP	2.4	4.3	4.8	5.6	64.5
North West HP	2.4	3.9	4.3	5.1	39.4
London HP	2.1	3.9	4.2	4.7	50.9
Northern Ireland HP	2	3.7	4.3	5.2	50
England HP	2	3.9	4.2	5.1	82
West Midlands HP	2	3.7	4.2	4.8	39.7
Yorkshire and The Humber HP	2	3.7	4.1	5	37.3
UK HP	1.9	3.7	4	4.8	89.4

Table 1-4: Contribution of the QE shock to variance of the common components.

**Shows observable by construction, the table show the median for FEVD*

1.7 Conclusion

In this paper, we examined the dynamic effect of quantitative easing (QE) on the UK housing market and wider economy from 2009M3 to 2016M12 using monthly data fed into factor-augmented vector auto regression (FAVAR).

The results suggest that QE supports economic recovery, contributes to GDP growth and reduces unemployment. It has a significant impact on house prices in the UK, particularly in England. Surprisingly, the result does not support the claim that London house prices are due to cheap credit: supply may also be a constraint in London. The transmission mechanism could be attributed to both direct and indirect effects of unconventional monetary policy. The direct effects reduce mortgage rates, which lead to a reduction in housing costs in line with Gabriel et al. (2014), while indirect effects could be through the wealth effect experienced by homeowners. QE increases the house price to income ratio, but depresses rent prices in the short term. The impact of macroeconomic variables is in line with the current literature and the expected financial market reaction.

Our estimates of the impact of asset purchase on output and CPI are similar to earlier work on the impact of monetary policy in the UK, despite using different models and identification, and the inclusion of pre-crisis data in previous estimates. We do not have a benchmark to assess our house price impact but we have tested our results using sign restriction, the shadow rate of Wu and \ Xia (2016) and an open economy model.

QE is shown to support economic recovery and boost output and jobs, but it may adversely affect housing affordability, especially for first home buyers. The house price index is a leading indicator of the status of the economy and inflation increasing beyond the fundamental may pose a risk to financial stability and the economy.

APPENDIX A : list of variables in the model , transcode, 5 log difference, 2 level difference, 1 level, 3 second level difference ; Slow=0, fast =1.

Variable	Transcode	slow/fast	Name
1	5	0	Ind. P
2	5	0	Mining & Qur.
3	5	0	Manuf.
4	5	0	Elec., Gas steam and air con.
5	5	0	Water Supply, Swe. & w. Management
6	5	0	Construction
7	5	0	Services
8	5	0	Distr. & Accom. & Food Service
9	5	0	Transp. And Storage & Information and Comm.
10	5	0	Fin., Real est., Scient., Prof., Tech and Support act
11	5	0	PAD, Educ., Health, Soc. Work, Arts, Ent and Rec.
12	5	0	Consumer Durables
13	5	0	Consumer Non-Durables
14	5	0	Capital Goods
15	5	0	Intermediate Goods
16	5	0	Energy
17	5	0	All Retailers inc. Fuel(Vol.)
18	5	0	All Retailers ex. Fuel(Vol.)
19	5	0	Predominantly food stores
20	5	0	Total
21	5	0	Household goods stores
22	5	0	Predominantly automotive fuel1
23	5	0	All Retailers inc. Fuel(Val.)
24	5	0	All Retailers ex. Fuel(Val.)
25	5	0	Predominantly food stores
26	5	0	Total
27	5	0	Household goods stores
28	5	0	Predominantly automotive fuel1
29	3	0	Pop. Aged 16 and over
30	5	0	Total in employment
31	1	0	Economic activity
32	1	0	Unemployment
33	5	0	Import Goods & Services
34	5	0	Exports Goods & Services
35	5	0	PS. Net debt (PSND) £m CPNSA
36	1	0	PS. Net Debt (ex. PS. Banks) as a % of GDP
37	1	0	PS.net inv., ex. PS. Banks (£ million)
38	5	0	RPI

39	5	0	RPIX Excl. Mortgage Interest
40	5	0	Food and non-alcoholic beverages
41	5	0	Alcoholic beverages and tobacco
42	5	0	Clothing and footwear
43	5	0	Housing, water, electricity, gas and other fuels
44	5	0	Furniture, household equipment and maintenance
45	5	0	Health
46	5	0	Transport
47	5	0	Communication
48	5	0	Recreation & culture
49	5	0	Education
50	5	0	Restaurants and hotels
51	5	0	Miscellaneous goods and services
52	5	0	Whole Economy wage
53	5	0	Man., wage
54	5	0	Construction wage
55	5	0	Services, wage
56	5	0	Wholesaling, retailing, hotels & restaurants, wage
57	5	0	Private sector Wage
58	5	0	Public sector Wage
59	5	0	Fin. & and bus. Services, wage
60	5	0	PS ex. Fin. Services wage
61	5	0	Import index
62	5	0	Export index
63	5	0	M4
64	5	0	M0
65	1	0	Financial corporations
66	1	0	M4 lending non-financial corporations loan
67	5	0	M4 lending non-financial corporations securities
68	1	0	M4 lending Total NFCRP
69	1	0	M4 lending Total Consumer credit
70	1	0	M4 lending Unincorporated
71	1	0	M4 lending Total household sector
72	1	0	M4 lending Secured on dwellings
73	5	0	Mining & Qur. (lending)
74	1	0	Man.(lending)
75	1	0	Construction& real estate(lending)
76	5	0	Electricity & etc(lending)
77	5	0	Wholesale (lending)
78	5	0	Transport, storage (lending)
79	1	0	Total (lending)
80	3	0	Net Lending Mortgage
81	5	0	Total approvals for house purchase(Val.)

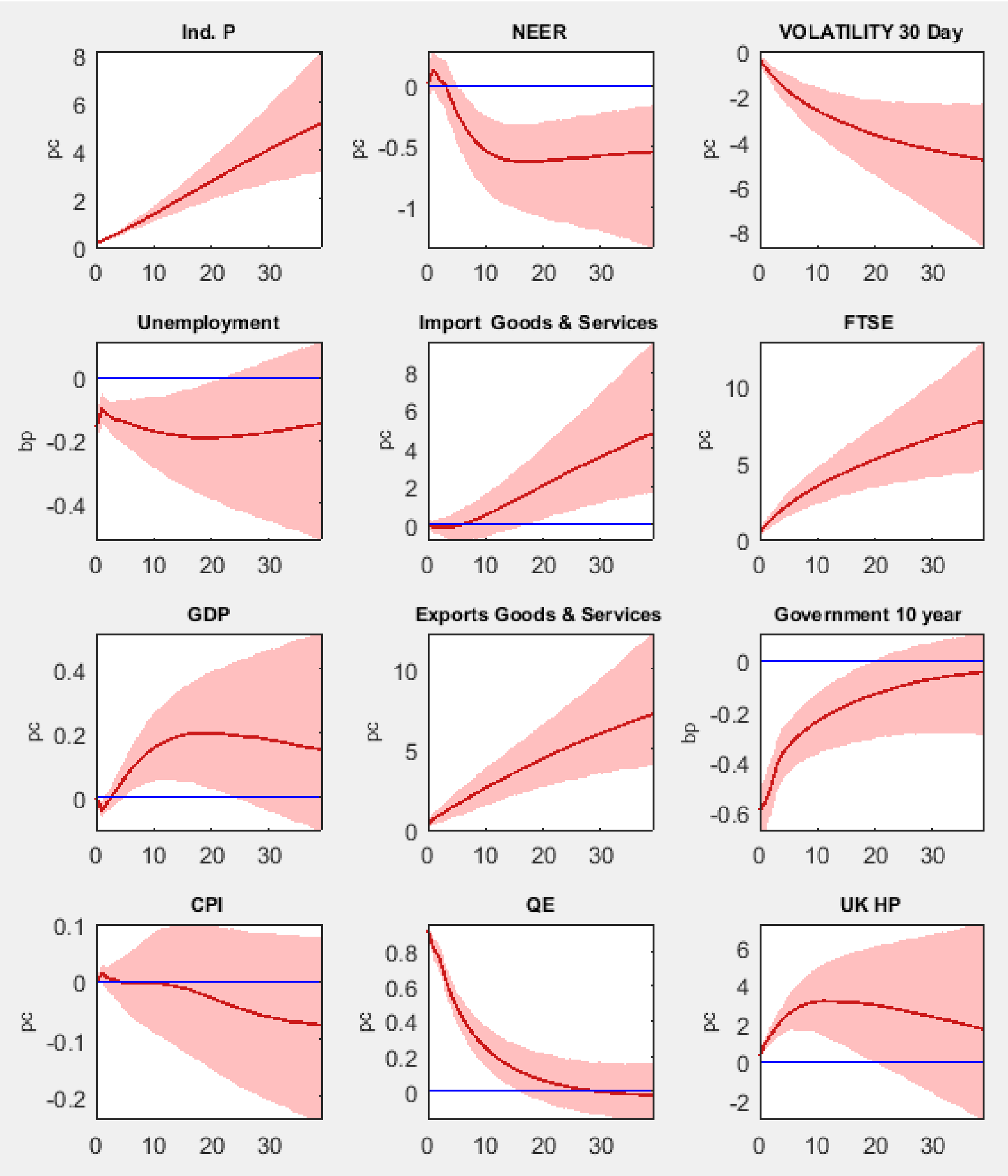
82	5	0	Total approvals for remortgaging (Val.)
83	5	0	Total approvals for other secured (Val.
84	5	0	Total approvals for secured lending(Num.)
85	5	0	Total approvals for house purchase(Num.)
86	5	0	Total approvals for remortgaging(Num.)
87	1	0	Total approvals for other secured(Num.)
88	1	0	Net finance raised by PNFCS
89	1	0	Equity issued PNFCS
90	1	0	Bonds issued PNFCS
91	1	0	Commercial paper issued PNFCS
92	1	0	Loans by MFIS
93	5	0	Average value (HP)
94	5	0	House sale Total
95	5	0	New build Sale
96	3	0	England Rent
97	5	0	Wales Rent
98	5	0	North East Rent
99	5	0	North West Rent
100	5	0	Yorkshire and The Humber Rent
101	5	0	East Midlands Rent
102	5	0	West Midlands Rent
103	5	0	East Rent
104	5	0	London Rent
105	5	0	South East Rent
106	5	0	South West Rent
107	3	0	England excluding London Rent
108	1	0	House to income
109	5	0	UK HP
110	5	0	Wales HP
111	5	0	Scotland HP
112	5	0	Northern Ireland HP
113	5	0	England HP
114	5	0	North East HP
115	5	0	North West HP
116	5	0	Yorkshire and The Humber HP
117	5	0	East Midlands HP
118	5	0	West Midlands HP
119	5	0	East HP
120	5	0	London HP
121	5	0	South East HP
122	5	0	South West HP
123	5	1	VOLATILITY 30 Day
124	5	1	FTSE

125	5	1	Effective exchange rate index
126	5	1	£ to $CD
127	5	1	£ to €
128	5	1	£ to $US
129	5	1	£ to ¥
130	1	1	Corporate (BBB)
131	1	1	Government 10 year
132	1	1	Lifetime Tracker mortgage
133	2	1	Variable rate
134	1	1	Sterling LIBOR(3 month)
135	1	1	(90 per cent LTV) fixed rate 2 year
136	1	1	(75 per cent LTV) fixed rate 5 year

Variable	Transcode		Name
1	4	Observable	GDP
2	4	Observable	CPI
3	1	Observable	QE

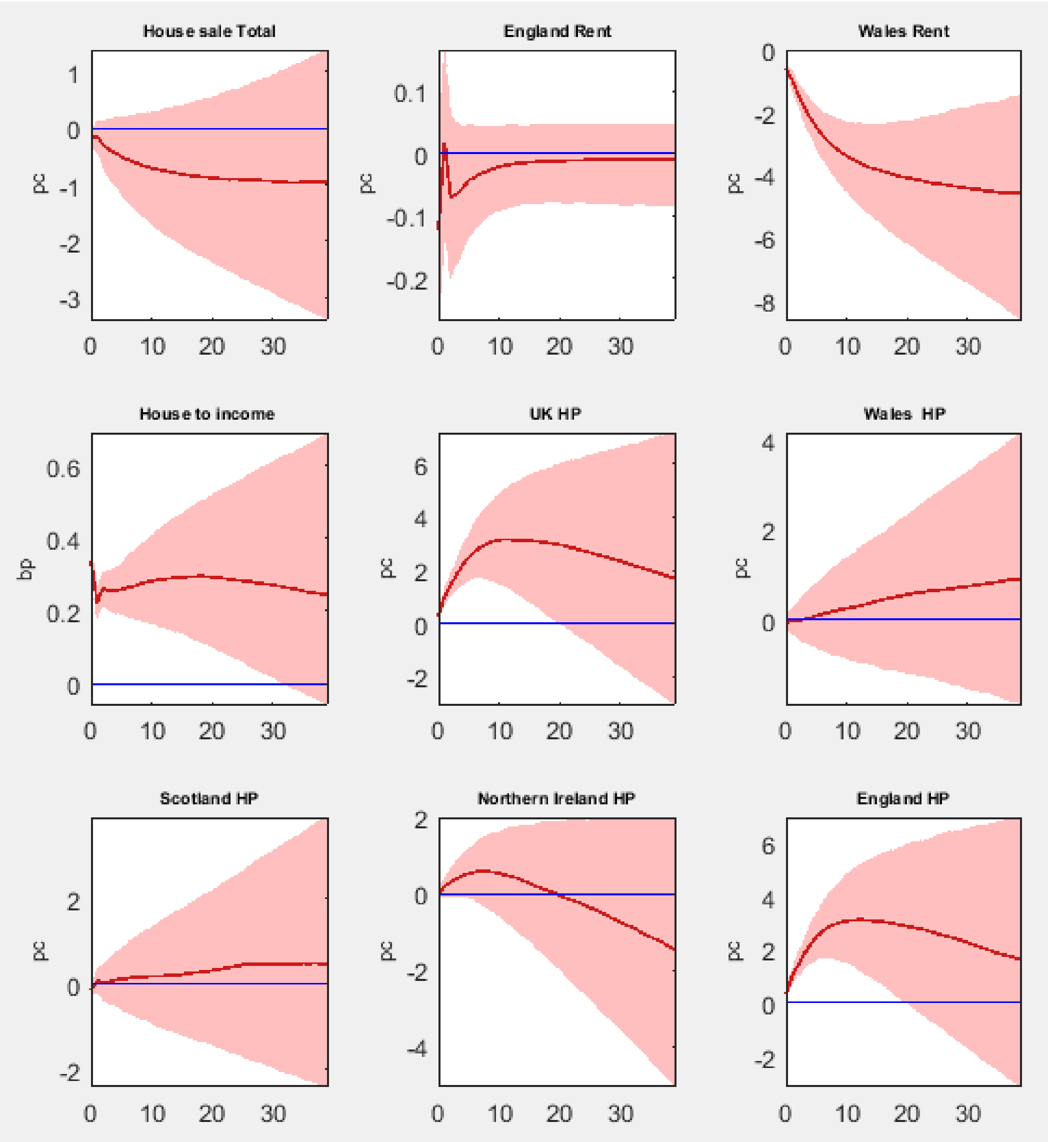
APPENDIX B: Open Economy

Figure 1-19: A-Results with NEER as Control Variable (Overview Open economy)



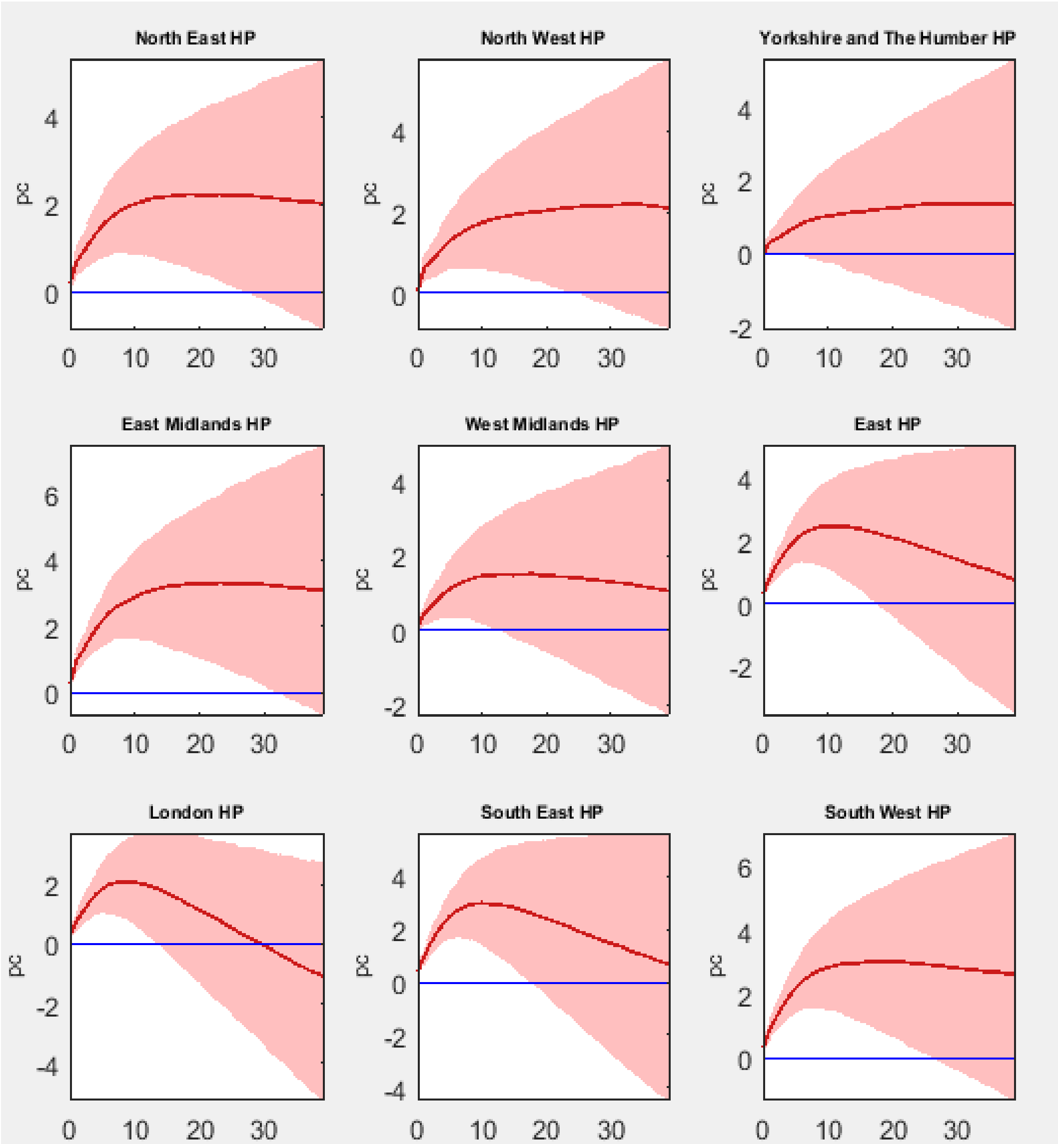
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The nominal effective exchange rate (NEER) is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-20: B- Results with NEER as Control Variable (Housing Market)



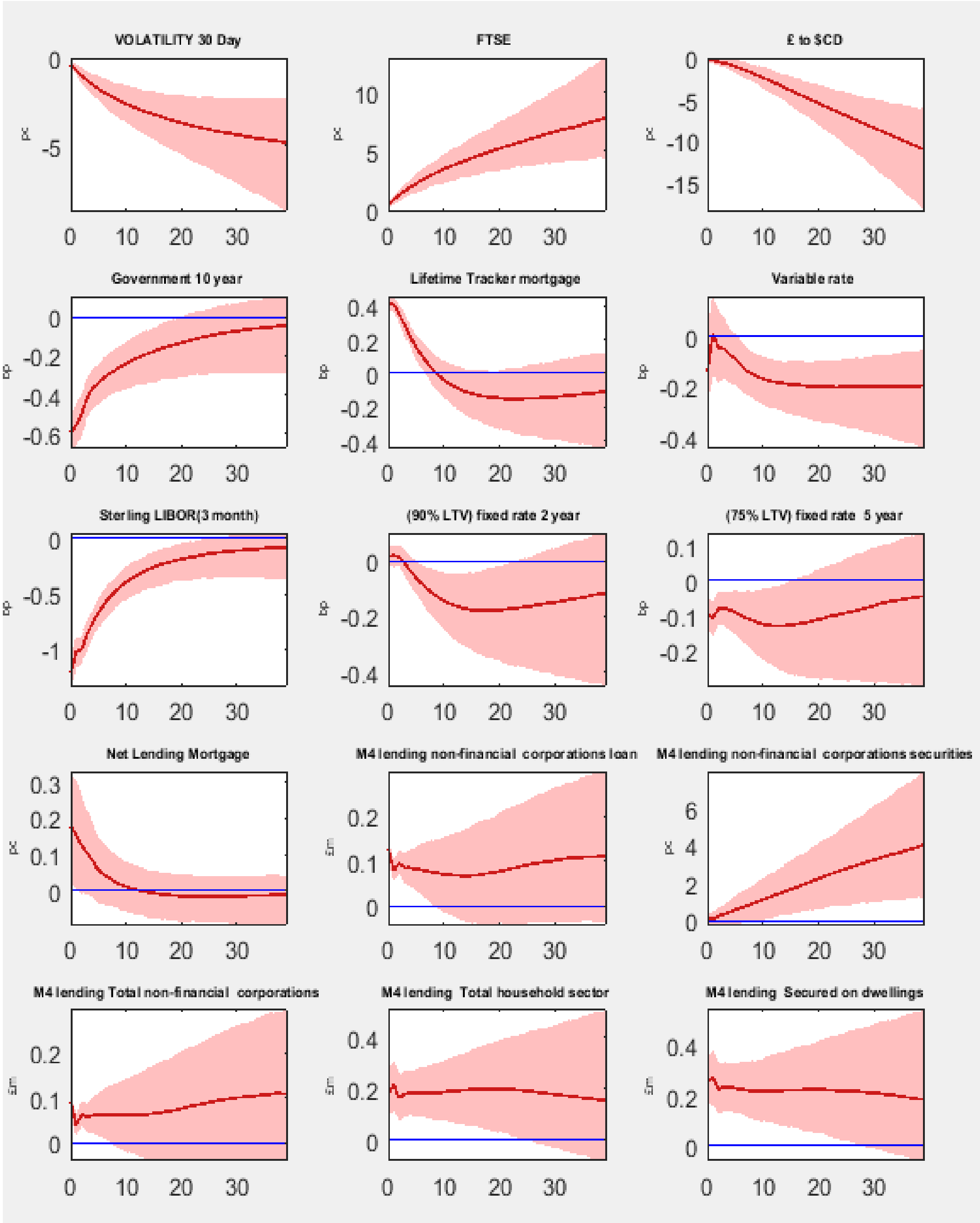
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The nominal effective exchange rate (NEER) is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-21: C- Results with NEER as a Control Variable (House price England)



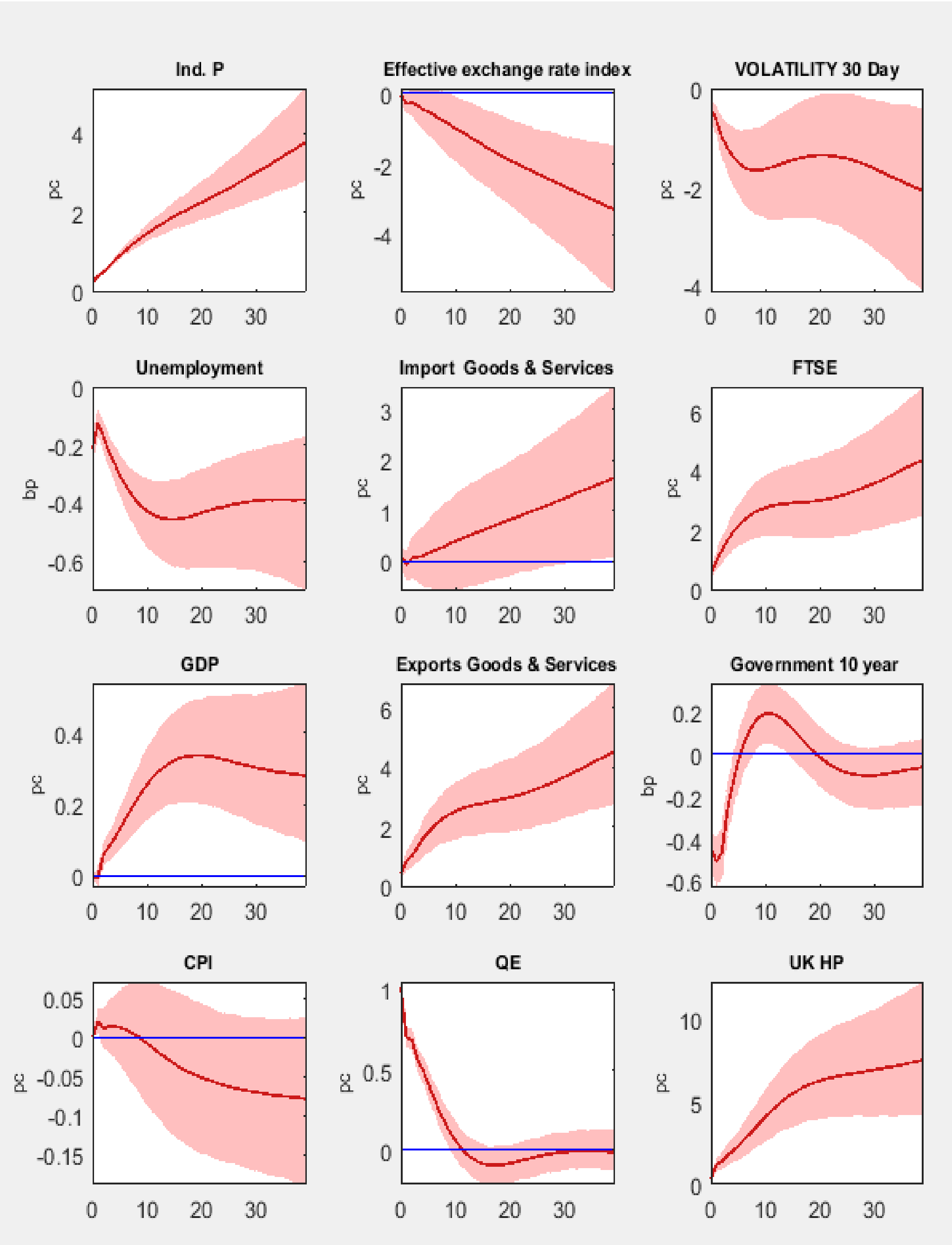
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The nominal effective exchange rate (NEER) is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-22: D- Results with NEER as Control Variable. (Financial market and Lending)



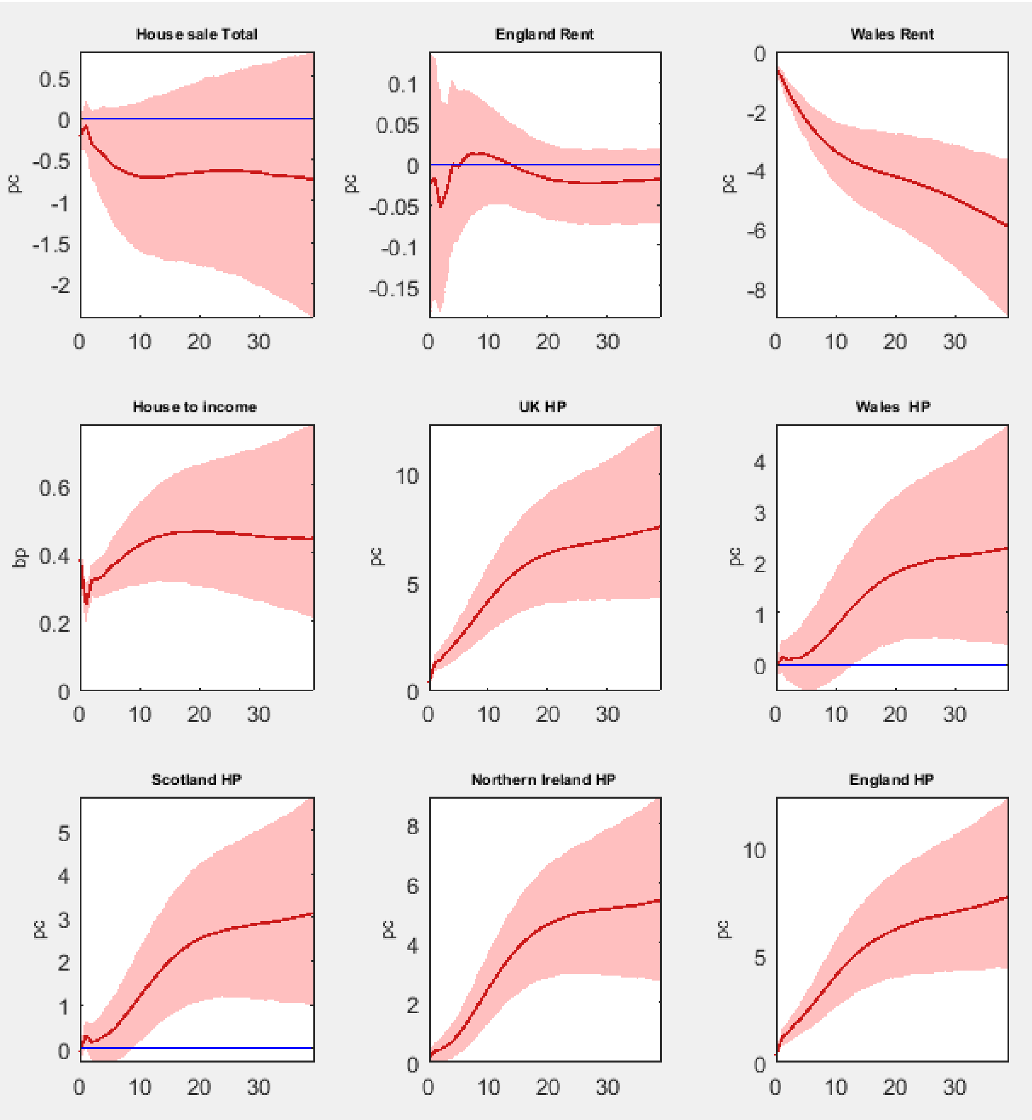
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The nominal effective exchange rate (NEER) is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-23: A- Results with spread between the Italian to German 10-year Gov. Bond Yield as Control Variable (Macroeconomic Overview)



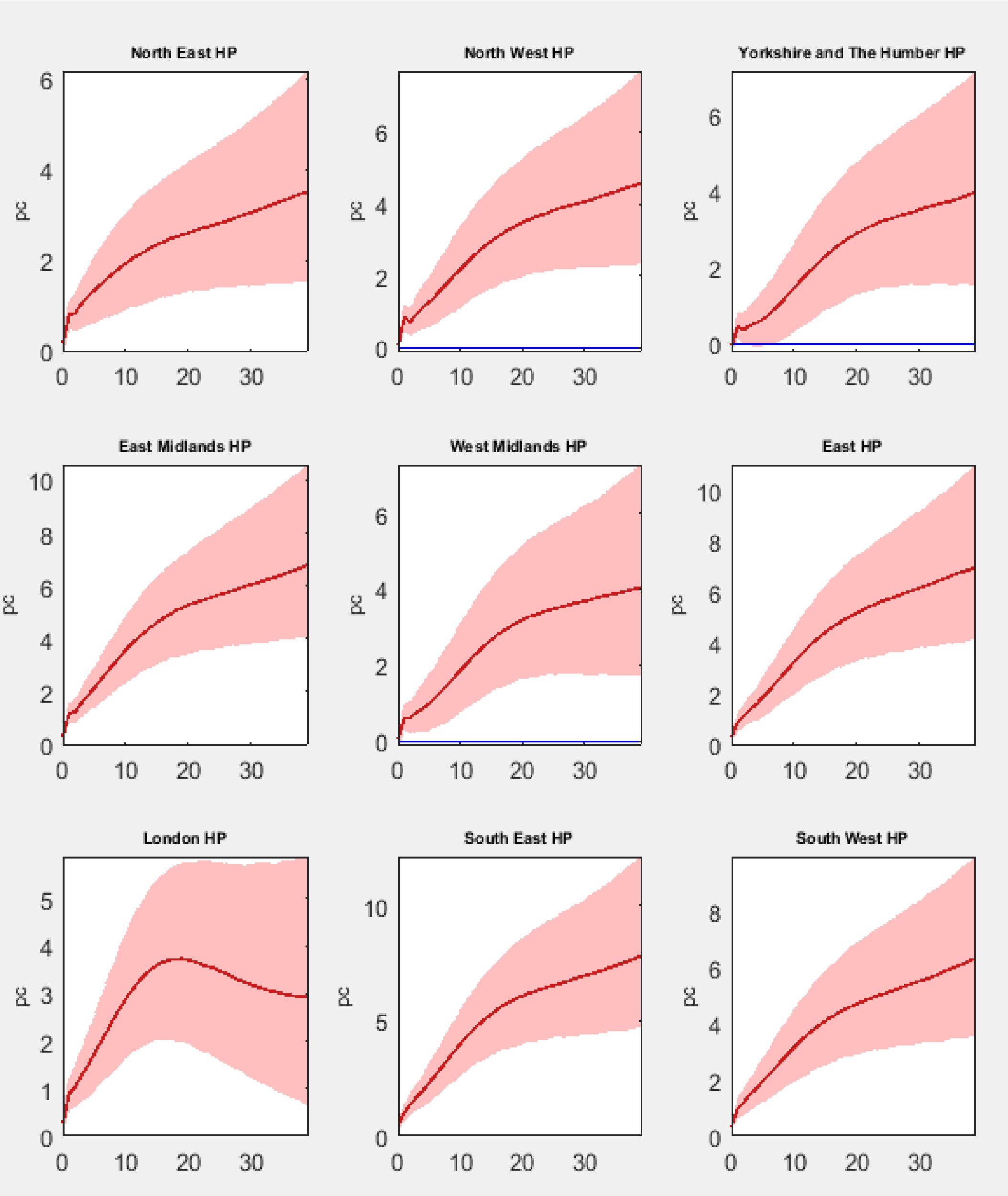
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The spread between the Italian to German 10-year Gov. Bond Yield is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses

Figure 1-24: B- Results with spread between the Italian to German 10-year Gov. Bond Yield as Control Variable (Housing Market)



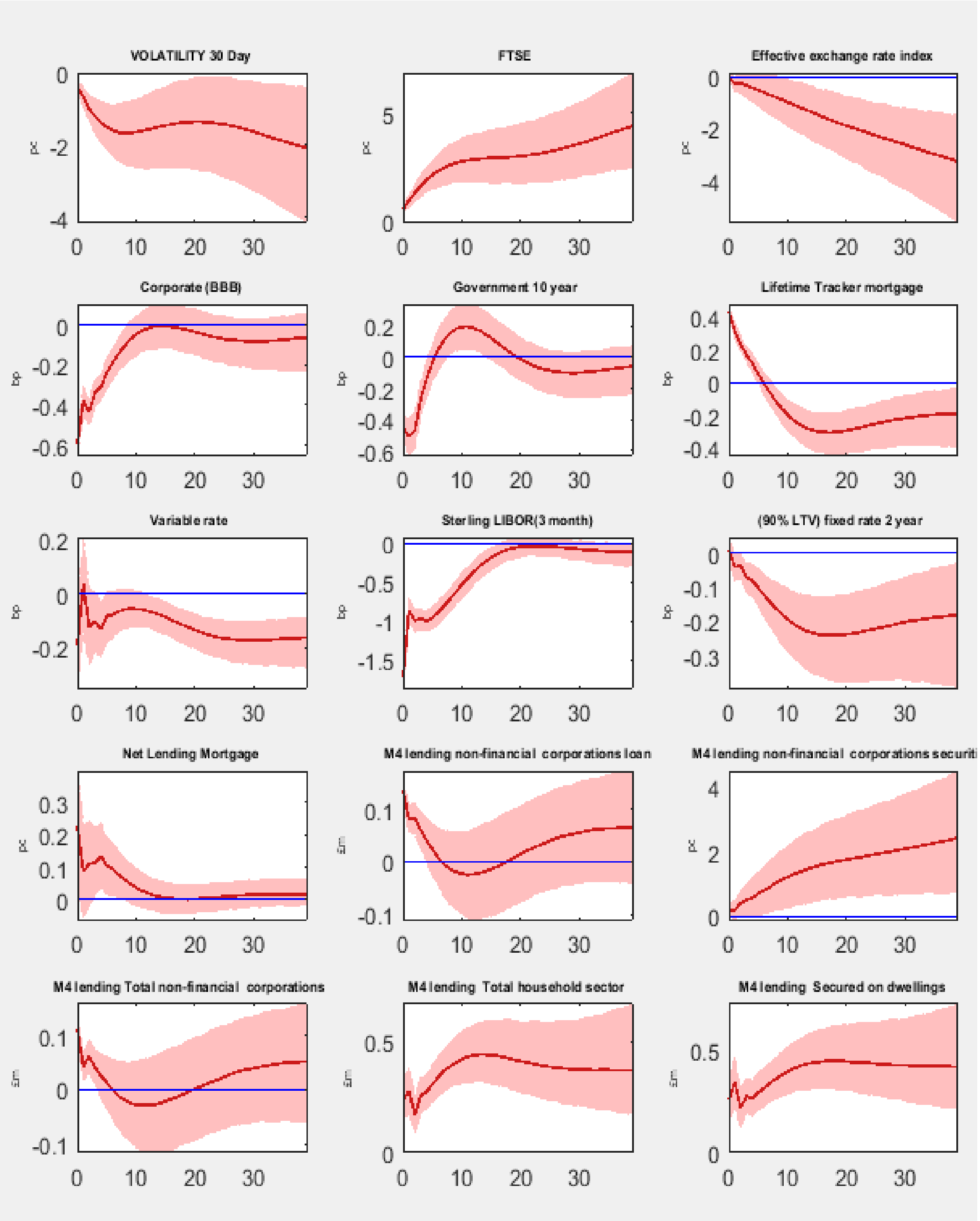
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The spread between the Italian to German 10-year Gov. Bond Yield is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-25: C- Results with spread between the Italian to German 10-year Gov. Bond Yield as Control Variable (House Prices England)



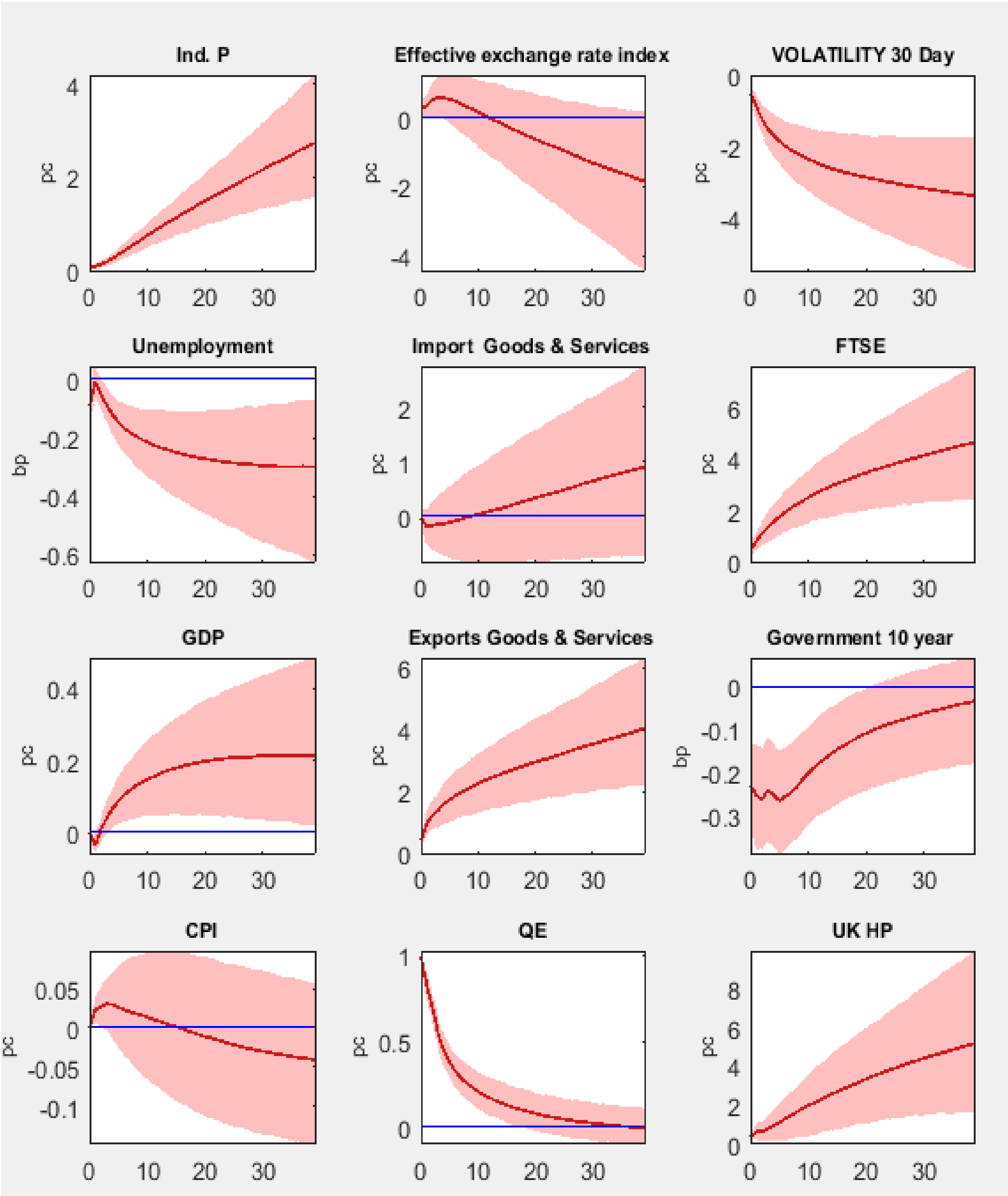
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The spread between the Italian to German 10-year Gov. Bond Yield is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses

Figure 1-26: D- Results with spread between the Italian to German 10-year Gov. Bond Yield as Control Variable (Financial Market and Lending)



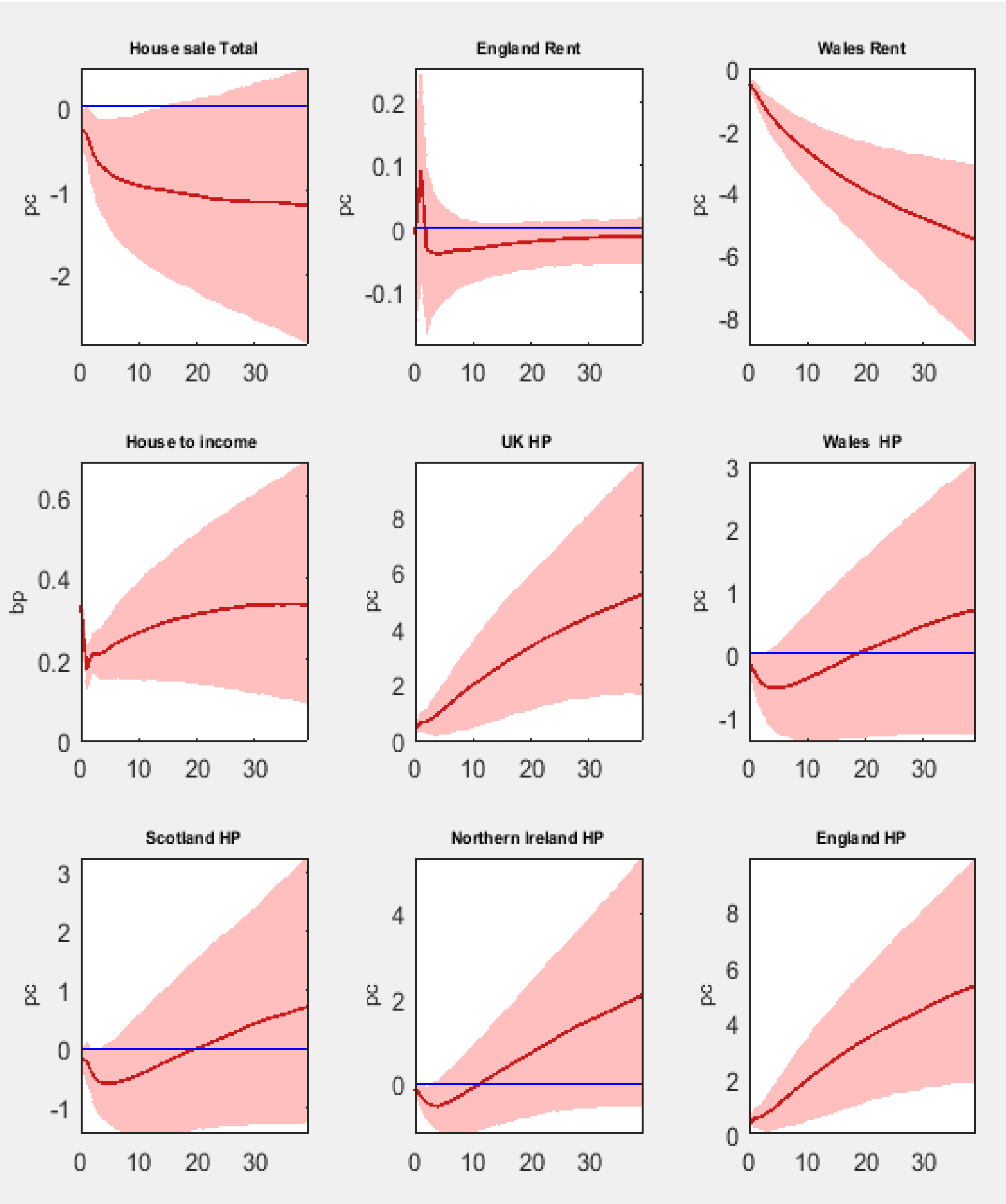
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The spread between the Italian to German 10-year Gov. Bond Yield is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses

Figure 1-27: A- Results with oil price as Control Variable (Macroeconomic Overview)



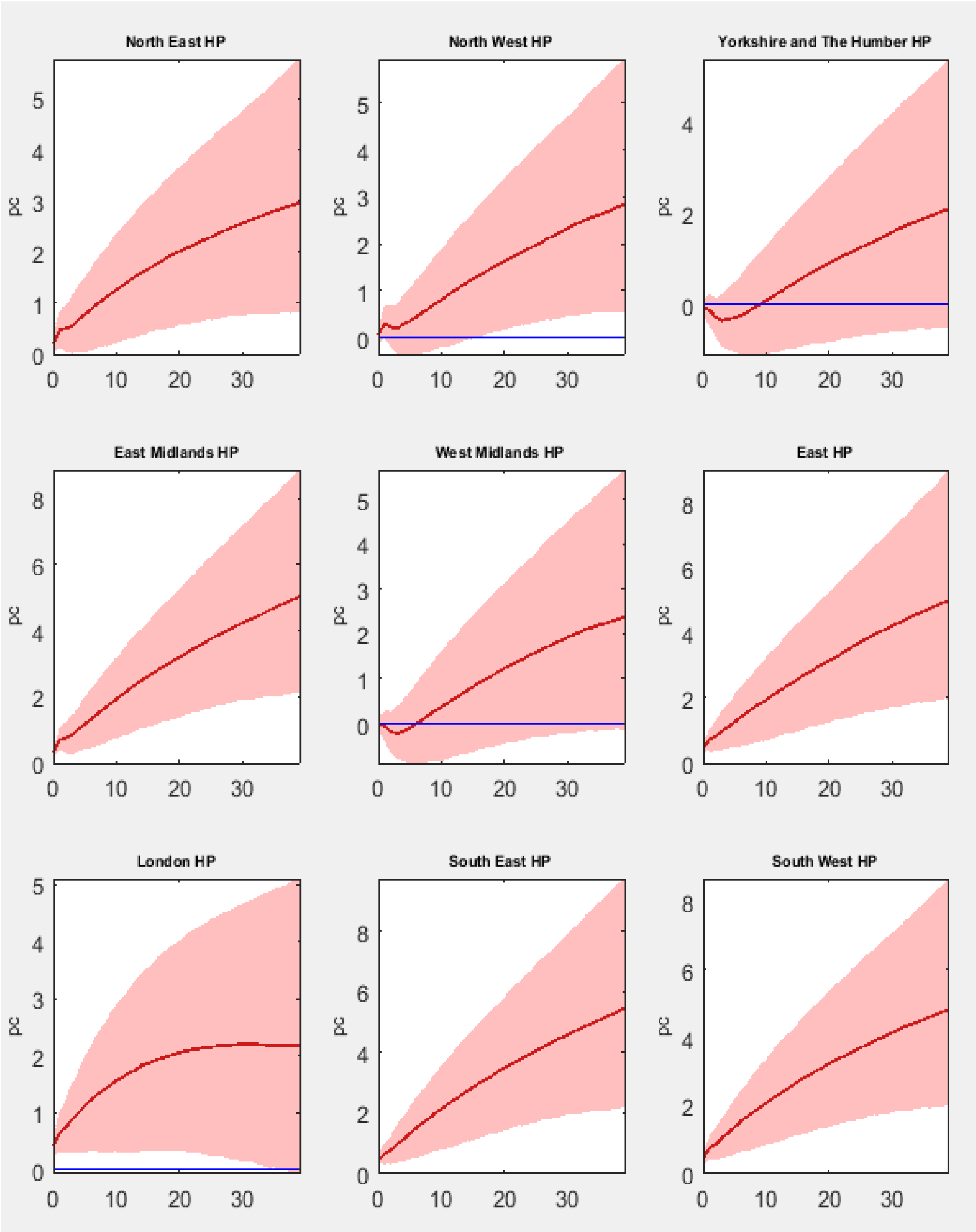
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The oil price is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-28: B- Results with oil price as Control Variable (Housing Market)



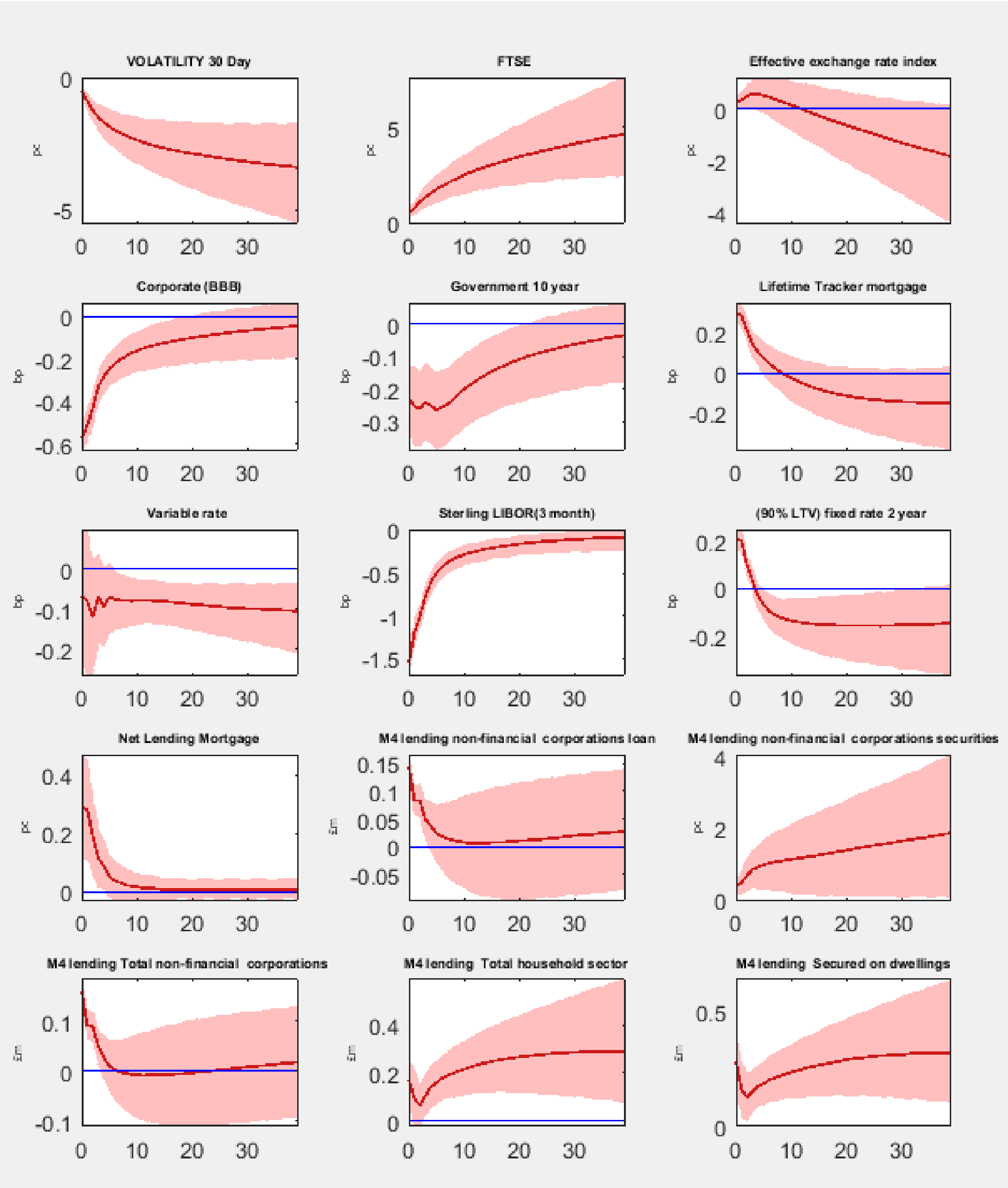
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The oil price is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-29: C- Results with oil price as Control Variable. (House price England)



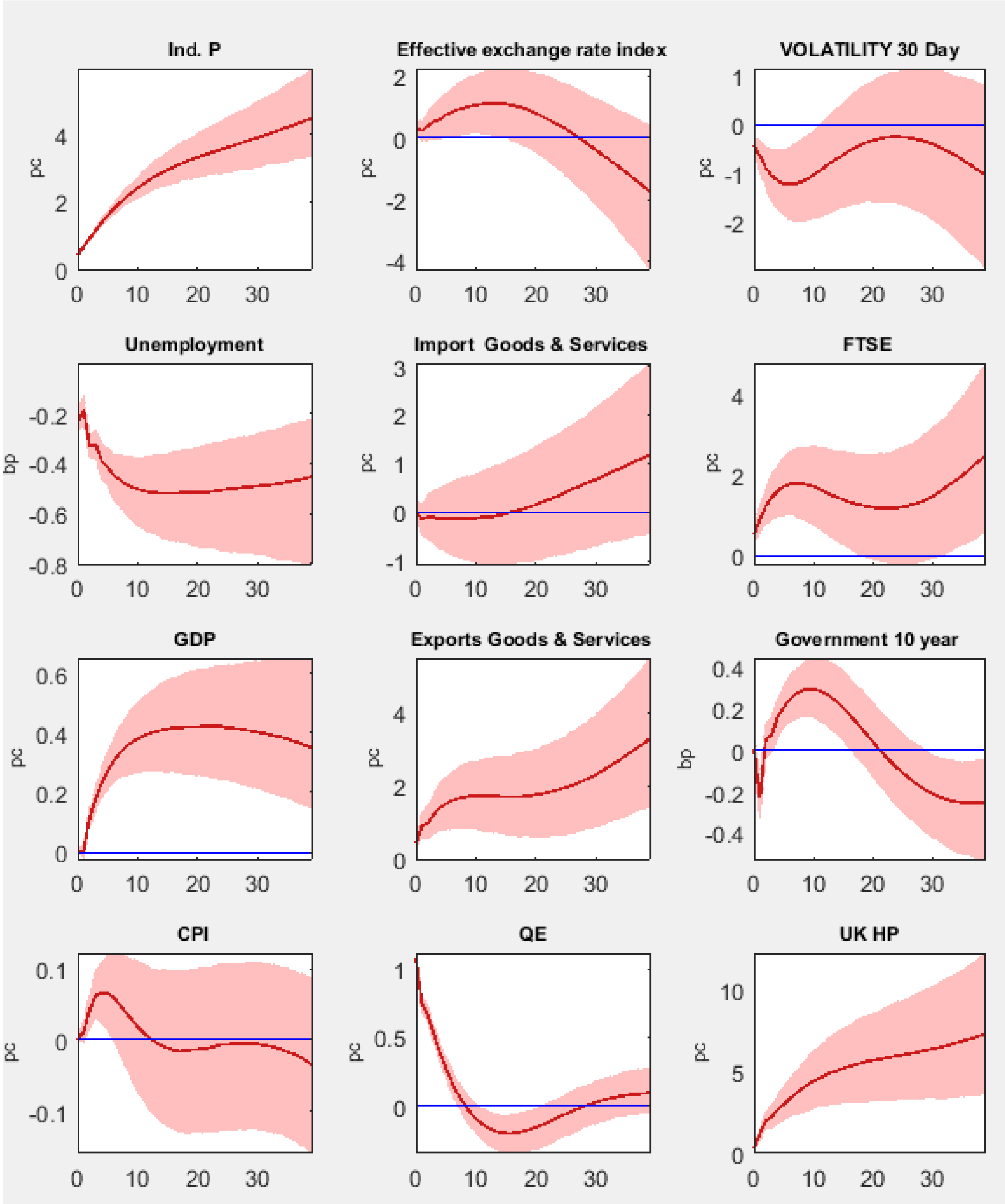
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The oil price is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-30: D- Results with oil price as Control Variable (Financial Market and Lending)



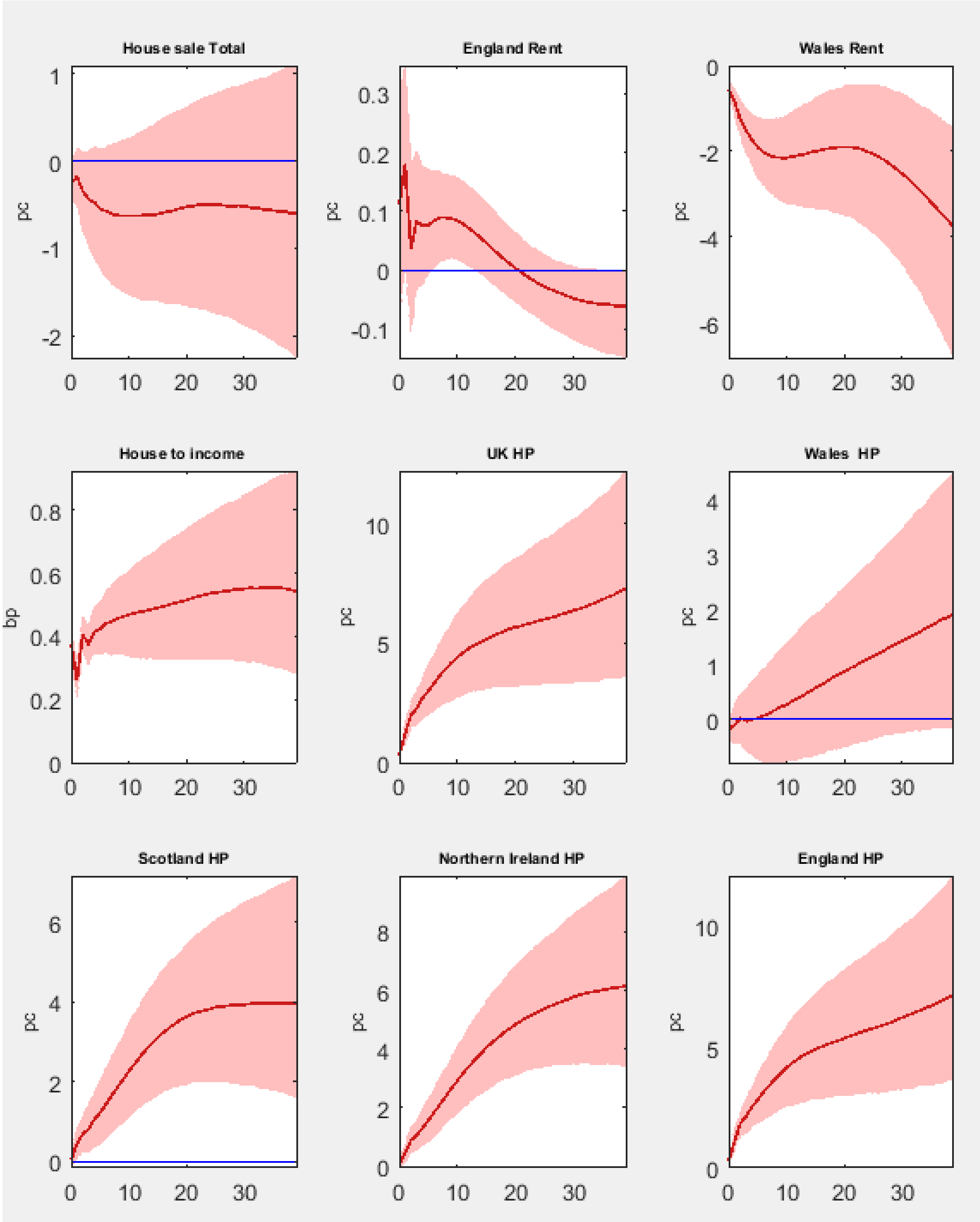
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The oil price is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-31: A- Results with assets purchases by other central banks as Control Variable (Macroeconomic Overview)



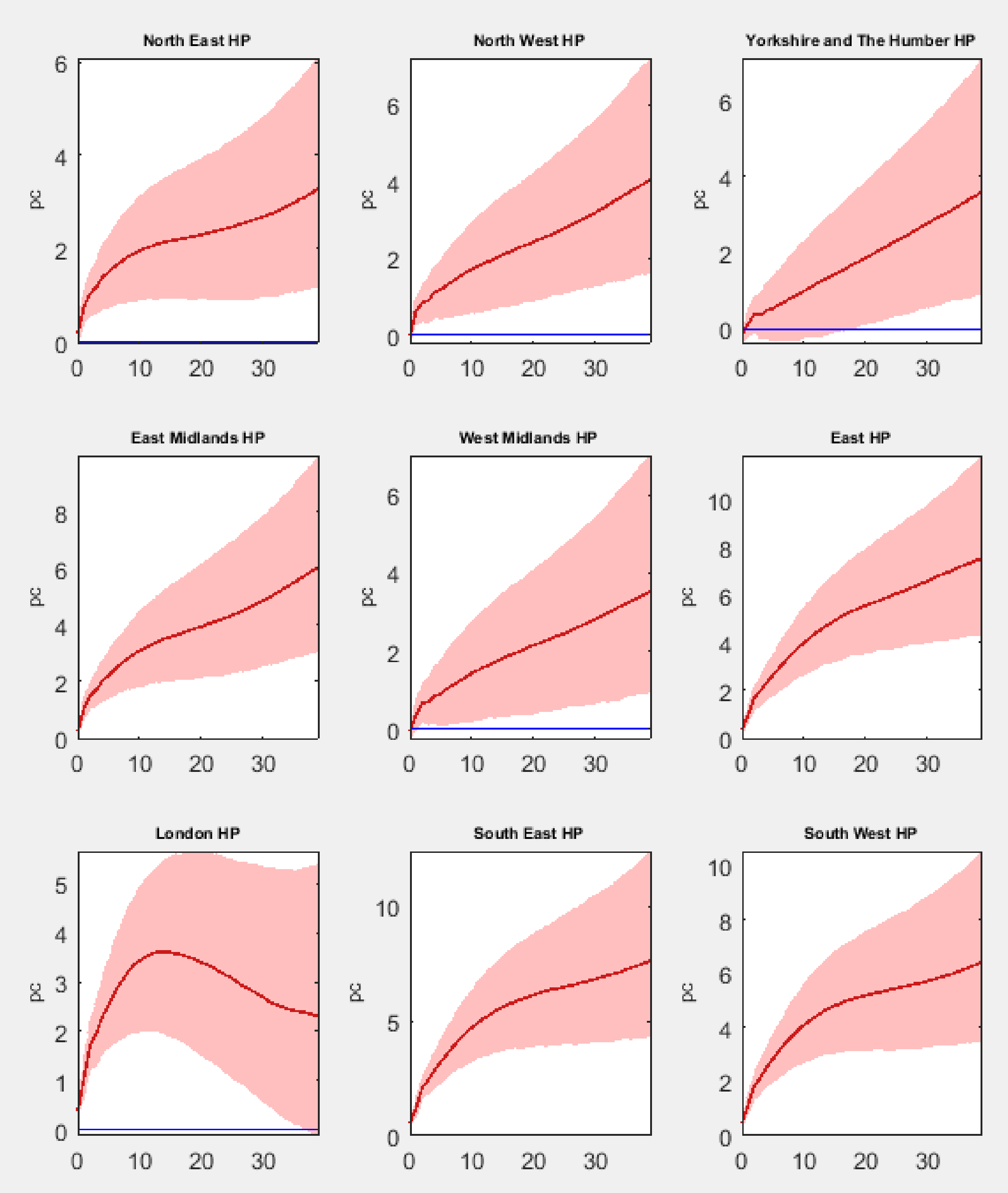
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The assets purchases by Federal Reserve, ECB and Bank of Japan as share of respected GDP, using principal component to take the first factor, is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-32: B- Results with assets purchases by other central banks as Control Variable (Housing Market)



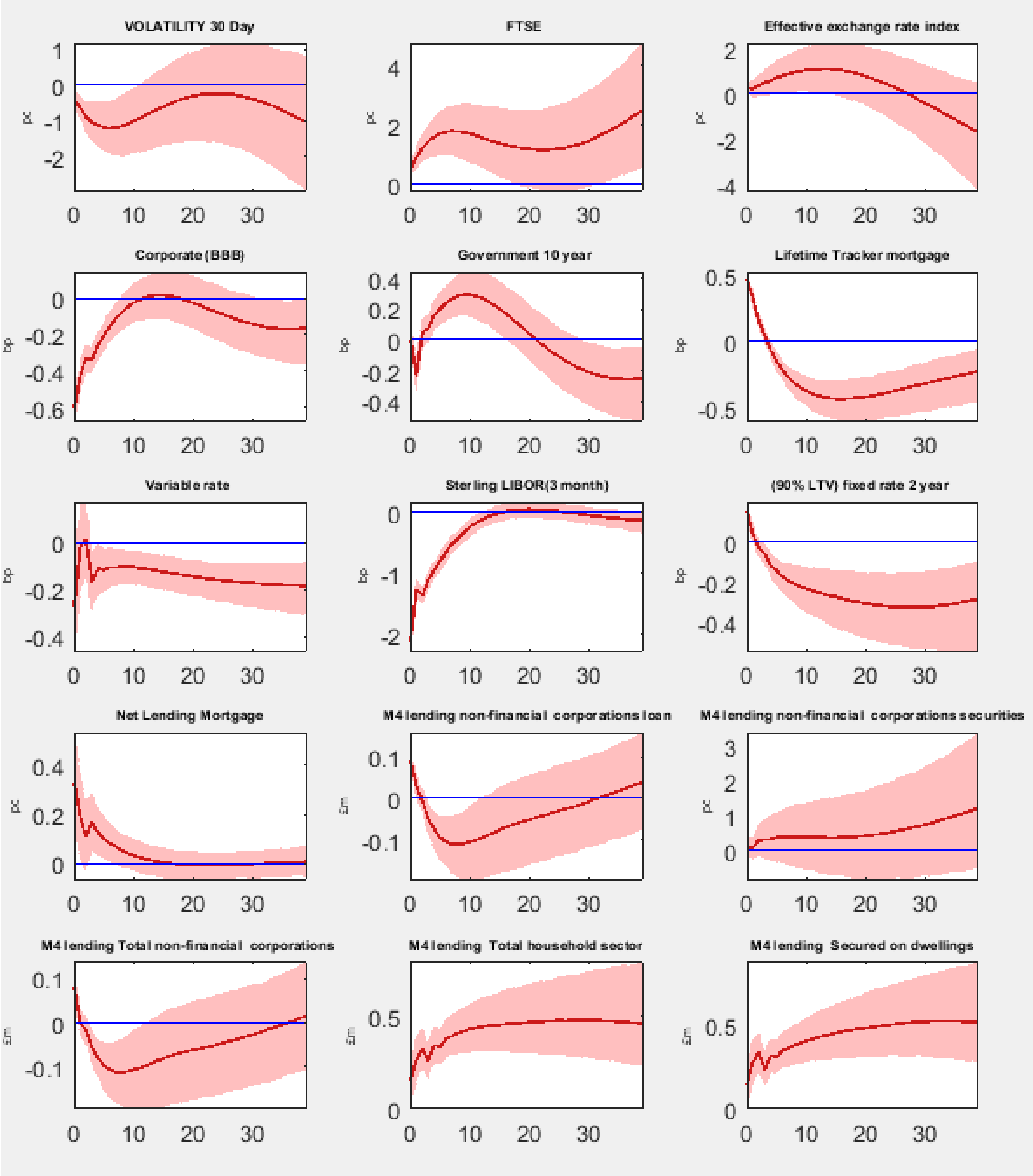
This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The assets purchases by Federal Reserve, ECB and Bank of Japan as share of respected GDP, using principal component to take the first factor, is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-33: C- Results with assets purchases by other central banks as Control Variable (House Price England)



This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The assets purchases by Federal Reserve, ECB and Bank of Japan as share of respected GDP, using principal component to take the first factor, is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Figure 1-34: D- Results with asset purchases by other central banks as Control Variable (House price England) (Financial market and Lending)



This figure shows the median impulse responses in response to one per cent asset purchase increases as a fraction of 2009Q1 GDP, together with 68 per cent Bayesian credible sets. We show results for recursive identification. The assets purchases by Federal Reserve, ECB and Bank of Japan as share of respected GDP, using principal component to take the first factor, is included as a control variable and placed last as part of the observable variable. 15000 simulations, with the first 10,000 as burn-in, were used to generate the responses.

Chapter 2

UK assets management and monetary policy in a small open economy

2.1 Introduction

Since the recent financial crisis, systemic risk in the asset management sector has been a focus for policy makers at the Financial Stability Board (FSB), the International Organization of Securities Commissions (IOSCO) (2014), academics and market representatives such as the Investment Company Institute (Sean Collins and L. Christopher Plantier 2014).

The UK is the second largest market for asset management after the US, with £6.8 trillion under management in 2015. The UK has more in assets under management than the combined amount in the next three largest European countries, and the trend has increased.

Increases in investment in the sector lead to price increases and this leads to further investment in the sector, which creates a "feedback effect" and possibly price volatility, which may have implications in the real economy.

In this chapter, building on the growing literature on the importance of the asset management sector in well-functioning capital markets, we investigate whether the asset manager contributes to financial instability, using unique monthly data from the UK Investment Management Association (IMA).

This chapter follows Feroli et al. (2014), who applied their model to the US data. We apply their methodology to UK data but include more categories of assets and different classes of bonds. This enables us to include the external environment in their model and investigate asset movements between the domestic and international market. In addition, we look at how investors switch between equities and bonds after the monetary policy shock.

Following Feroli et al. (2014), we first investigate whether a feedback effect whereby investment flows increase the price and at the same time the price encourages further investment exists in UK bond and equity markets (Remolona, Kleiman, and Gruenstein, 1997 and Feroli et al., 2014).

Second, we identify monetary policy shock and look at the connection between monetary policy, flows and prices in the bond markets. Change in monetary policy has an impact on investors' decisions, so it can prompt large inflows and outflows. In particular, a rise in policy rate that decreases prices and increases the risk premium, pushes investor demand for risky assets down. This will be studied by three-variable VARs.

Third, we extend the analysis to investors in an open economy and look at whether they favour domestic or foreign bonds. Domestic and foreign bonds may not be exact equivalents due to the difference in default risk or exchange rate risk. In addition, we look at whether investors have switched their portfolios between the bond and equity markets due to monetary policy shock in the UK. We use a vector auto-regression (VAR) model.

The asset management sector with products such as open-end, mutual and hedge funds is increasing in size and number and globally there is $76tn under management. This is 40 per cent more than a decade ago, and is equivalent to the size of the world economy today (IMF April 2015)[5]. The trend is shown in Figure 2-1.

Financial assets that are partly managed by unleveraged institutions are projected to reach $400 trillion by 2050 (Haldane, 2014). The value of assets under the management of the largest global investment firms is now almost the same as the value of assets held by the largest international banks (Haldane, 2014). According to the Financial Times, BlackRock handled around $4.7tn in 2015: this reflects a structural shift in the financial system that moves risk from banks to the asset management sector.

[5] The size of the nominal GDP for the world is around $74 trillion according the World Bank estimate for 2015.

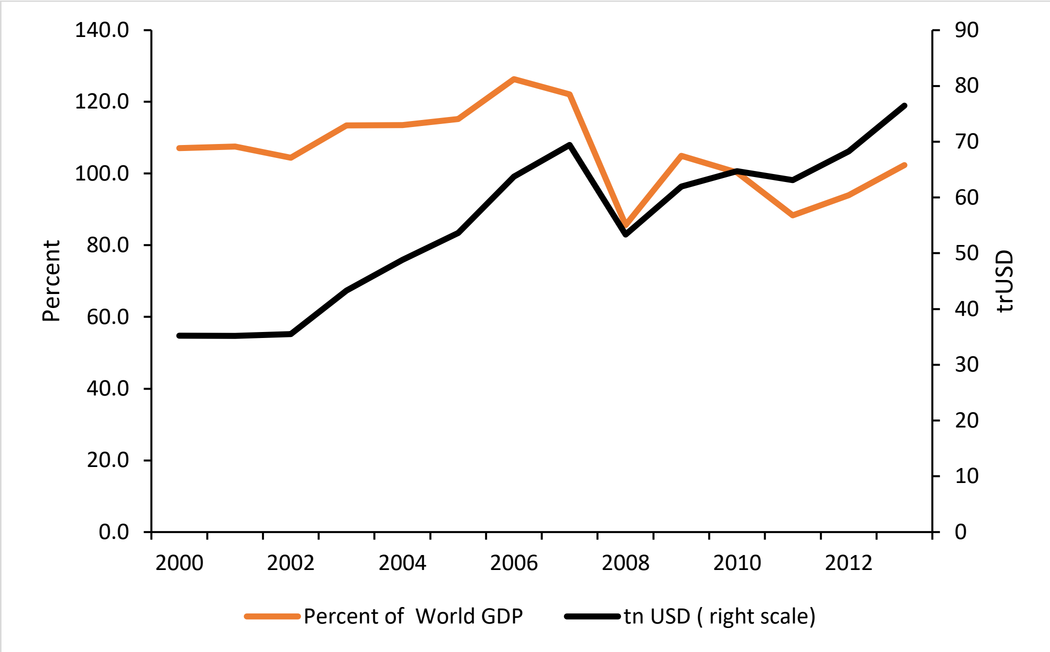


Figure 2-1: Global asset manager assets under management and world GDP, annual 2000-2013

Source: IMF

The main driver for this sector is asset manager and investor behaviour, which may lead to herding and fire sales with implications for the real economy. In this respect there are two important risk channels: the incentive problem for managers and 'run risk' or first mover advantage.

The asset manager (agent) is delegated by the investor (principal) to manage capital. The incentives for the manager might encourage destabilising behaviour and amplify shock. For example, manager compensation can be linked to relative performance or the investor injecting money into funds that perform better relative to the benchmark (Ma, Tang and Gomez 2013; IMF, 2015). These factors reward asset managers for taking excessive risks and may encourage herding (Scharfstein and Stein, 1990, Arora and Yang, 2001; Maug and Naik, 2011; Feroli et al., 2014; IMF , 2015).

The second risk channel is a 'run risk' which is called 'first mover advantage.' It can arise when the principal or asset owner does not want to be last in the queue: if others are redeeming from a fund they should do so as well, which may lead to fire sale dynamics (Feroli 2014, Shin and Moris, 2014 and IMF, 2015). These two risk channels are not mutually exclusive and we will use the word ‘investors’ for both managers and asset owners interchangeably.

To look at these risks in action, assume that as a result of economic shock an asset manager motivated by compensation or an investor seeking the ‘first mover advantage’ sells their securities. The sale pushes asset prices further, and induces more investor flight (herding), redemptions and falling prices. If this is large enough to generate a feedback effect, the process can destabilise financial markets and dampen global economic growth (ICI, 2014).

In this context, Buffa et al. (2014) investigate the theory of how benchmark performance measures lead to exacerbating price distortions. Morris and Shin (2014) have also investigated the possibility that short-term incentive outweighs long-term fundamental value using a global game model. Building on this, Feroli et al. (2014) set up a model that evaluates performance relative to a benchmark, which will create an incentive for the fund manager to sell during a downturn and chase yields during upturns.

They applied their model to the US data. They found evidence of a feedback effect from bond fund flows to bond market price in four categories of the bond market, Mortgage Backed Securities (MBS), High Yield Bonds (HY), Investment Grade Bonds (IG), and Emerging Market Bonds (EM). They also investigated how monetary policy stance impacts the behaviour of asset managers. For instance, low short-term rates prior to 2013 encouraged asset managers who were concerned with their relative performance rankings to seek higher risk in the search for yield. This may have compressed the risk premium and created a source of financial instability when the Fed tapered off one of their QE programmes. This demonstrates that monetary policies such as forward guidance may encourage risk taking and leads to a risk reversal when the monetary authorities change their stance. They found that monetary shocks can drive flows, and flows can drive prices. In particular, in the three-variable VAR they found that due to tightening monetary policy the bond flows and prices responded negatively.

We investigate the existence of such a loop in the UK asset market. Following Feroli et al. (2014) the benchmark model bivariate VAR results in this paper show there is no "feedback effect" in the UK bond market, while we can see a very weak effect in five categories in the equity market. The effect is not statistically significant. In addition, one of the central hypotheses from Feroli et al. (2014) is that monetary policy shock can prompt large shifts in bond market sentiment, moving both flows and price. To some extent, our benchmark models with three-variable VAR results are consistent with their findings. A surprise monetary policy tightening prompts outflow and a fall in price in the bond market. However within the same framework, when we look at impact of flows and price shocks we do not see a positive response on price due to the flow shock, in contrast to Feroli et al. (2014). Moreover, the response of the bond flows to the price shock in our findings is stronger and more statistically significant than in theirs.

As a robustness check, we use different data sets to investigate the feedback effect in benchmark models in both a bivariate and a three-variable VAR. We use a data set with a wider category of bonds, including high frequency daily data from 2013 to September 2016. The result confirms our benchmark result in both the bivariate and trivariate VAR and there is no significant change in the results. In particular, we have found no evidence of a positive "feedback effect" in the bivariate VAR. In the trivariate VAR, as a result of monetary policy tightening and a rise in rates we see outflow from the bond market and falls in prices. However, the magnitude of responses and statistical significance are different compared to the benchmark results.

On the question of how investors shift between domestic and foreign assets in the bond market due to the monetary policy shock in an open economy, we find that as a result of a surprise tightening, both domestic bond flows and prices respond negatively. However, foreign bond flows respond ambiguously and are not significant while their price responds negatively and exchange rates are increasing.

One explanation for the outflow from domestic bonds could be the investor's rush to redeem the fund and avoid portfolio losses stemming from unexpected rate increases and falls in price (ICI, 2016). This is also consistent with the model's predictions: according to Feroli et al. (2014) monetary tightening is likely to set off outflow from the bond market because the demand for risky assets is reduced, due to higher risk premiums. The results for the bond market are also consistent with the narrative description of the event in corporate and other bonds after the Bank of England introduced QE (Joyce et al., 2011). In addition, Joyce et al. (2011) reported that due to QE investors switched to corporate bonds, other bonds, and equity. However as we increase the rate, the investor should sell off the corporate bonds. We should note that corporate bonds compromise around 50 per cent of the bond market in our data set. In addition, the domestic sector has only corporate bonds.

On the question of how the investor switches between equity and bonds, we find that due to tightening monetary policy in the UK, there is an outflow and fall in price in the bond market and inflows and fall in prices in equities. We also see an increase in exchange rates. Falls in price in both the bond and equity markets are statistically significant while the outflows from bonds and inflows into equities are not significant. Nevertheless, the outflow from the bond and inflow into the equity market is consistent with a recent study of the impact of monetary policy tightening on the mutual fund market in US by Banegas et al. (2016). Furthermore, a fall in the price of equities due to monetary policy tightening is in line with Michael Ehrmann and Marcel Fratzscher (2004), Bernanke (2003), Laeven, and Tong (2010). The overall result in the benchmark model with monetary policy and an open economy supports the first mover advantage because the investors rush to redeem as the risk premium increases to avoid portfolio losses.

We use sign restriction to check our results in the open economy bond market: in this, we are imposing restrictions only on the monetary surprise, domestic price and exchange rate while leaving unrestricted the domestic flows, foreign flows and foreign price. We investigate whether our domestic flows or foreign flows and price will support our unrestricted model.

The result for domestic bonds holds when using sign restriction in which a surprise monetary tightening is associated with outflows, while the result for foreign bonds flows falls and is still significant, while the price is falling as before and significant.

2.2 Data

In this section, we describe our data and the creation of market changes (price), and provide statistical information.

2.2.1.1Data Collection

The main data comes from the Investment Management Association (IMA)[6]. The IMA is the trade body that represents UK investment managers and it has about 200 members. IMA members include large, medium and small asset management firms, fund managers, specialist and private client managers and Occupational Pension Scheme (OPS) managers. These entities could be domestic or international. However, our data focuses on the UK-domiciled authorised investment funds. This includes authorised unit trusts and open-ended investment companies (OEICs).

We collected data from information published every month by the IMA website. We selected a month (e.g. December), a year (e.g. 2015) and a category (e.g. fund under management and sale). We present an example of this data in Appendix A. The data captures holdings (funds under management) and flows (net sales) for individual funds on a monthly basis. For example in 2014 the Investment Association collected this data for 2,513 funds domiciled in the UK. The IMA recorded data for at least 53 headings (sectors) on a monthly basis from 2005 to 2016 (Figure 2-2). After cleaning up the data, we have 32 headings that correspond to different sectors. The data can be split between retail and institutional investment, but we use aggregate data, which includes both.

2.2.1.2 Cleaning IMA data

To have consistent data across different sectors, we remove those sectors which are missing either at the beginning of the sample (Jan 2005) or at the end (December

[6] Recently Investment Management Association name has changed to The Investment Association

2015). Some sectors are discontinued, some new sectors are added, while some have merged, so we categorise them as residual and name them "other xxx." We have noted the total funds for each sector: equity, fixed income, money market and flexible investments.

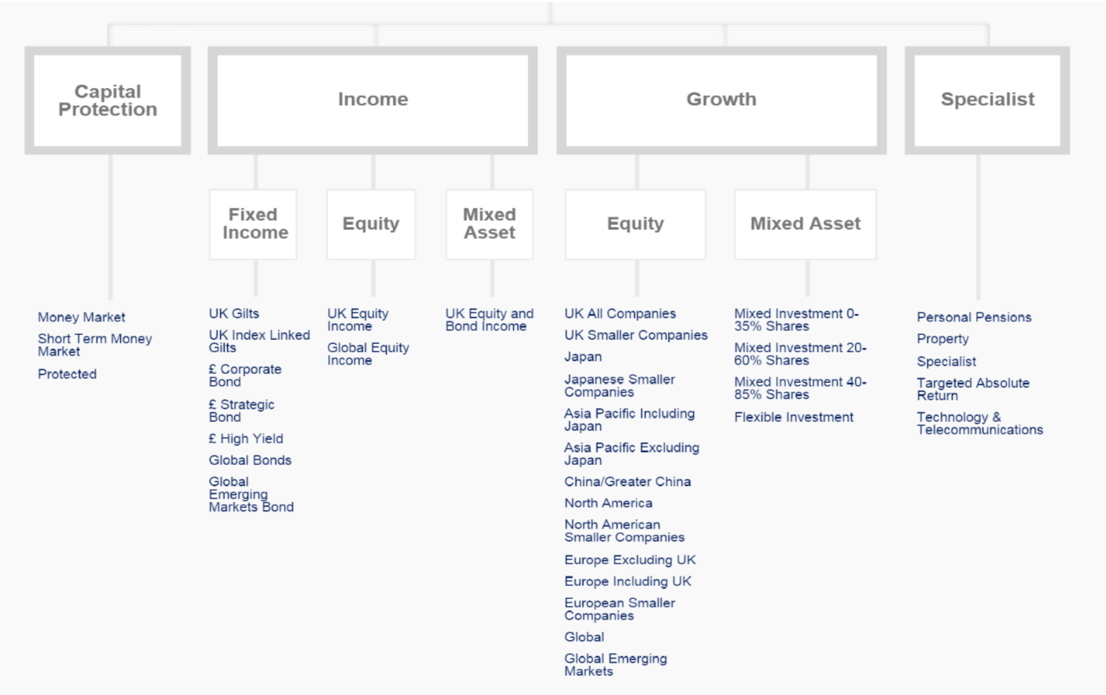


Figure 2-2: Monthly Data Profile Chart

This data file is based on information from the IMA website:

http://www.investmentfunds.org.uk/fund-statistics/full-figures/.

As shown in Figure 2-2, we have wider categories in the equity market compared to Feroli et al. (2014), and limited categories in the bond market. However the time span is shorter (containing data from 2005 to 2015) and we also use a monthly frequency, whereas Feroli et al. (2014) used a weekly frequency.

2.2.1.3 Daily Data comparable to IMA

To address the limitation of our analysis in terms of frequency, we have collected daily data from Thomson Reuters Eikon's global flow of funds: they also provide data for Lipper, the same database from which Feroli et al. (2014) collected their data. The time span for daily data is limited, and ours covers November 2013 to September 2016. Our daily data in the bond market has more categories of bonds than our monthly data, while equity is very limited in terms of categories. We try to match the daily data from Thomson Reuters Eikon's global flow of funds to our monthly IMA data as closely as possible. We collected the following data in the bond and equity market.

Bond market daily: Emerging Markets Global HC, Emerging Markets Global LC, Bond GBP, GBP Corporates, GBP Government, GBP High Yield, GBP Inflation Linked, GBP Short Term, Global, Global High Yield.

Equity market daily: Emerging Markets Global, Europe ex UK, Global ex UK, Equity UK

2.2.1.4 Data for estimating monetary policy surprise

To measure the monetary policy stance for the UK, we follow the methodology employed by Wright (2012). This methodology was also employed by Feroli et al. (2014) to create monetary policy surprise in their estimations. We collected data on the monetary policy decision date, 10-year government bond yield, 2-year government bond yield, 5-year real rate, the 10-year real rate, and the BBB Corporate and AAA corporate. The source of data is the Bank of England and Thomson DataStream on a daily frequency. Our collected data is nearly comparable to the data used by Wright. However, due to the lack of data for TIPS breakeven, 5–10-year forward TIPS breakeven and BAA in our collected data, we collected data on a 5-year real rate, on a 10-year real rate and BBB to fill the missing data set.

2.2.1.5 Exchange rate data

In the extension of our VAR model, we also include the UK pound exchange rate (in log difference) to examine the international dimension of risk-taking channels. The UK pound exchange rate is measured by the nominal effective exchange rate (NEER) of the pound sterling, obtained from the Bank of England database on a monthly frequency.

2.2.2. Data Construction for Change in Market Value

To prepare data for the analysis, we followed Feroli et al. (2014) closely. We collected the following data on a monthly basis from 2005 to the end of December 2015:

- **Total assets (Funds Under Management (FUM))**
- **Net sale (Flow)**

The objective was to create a data set comparable to that of Feroli et al. (2014) who constructed the following identity for US mutual funds from the Lipper database:

Feroli $\quad Assets_{t+1} = Fund\ Flows_t + \textbf{Change in Market value of Assets}_t + Assets_t$

We will create a comparable data identity to Feroli et al. (2014) based on the IMA data for the UK-domiciled authorised investment funds. This includes unit trusts and OEICs for the UK.

As we indicated above, we have the ingredients for the construction of such a data set, (e.g. 'FUM' is the 'Total Assets' and 'Net sale' is 'fund flows') and we will have an identity comparable to Feroli's. However, we are missing one variable from

This P $\quad FUM_{t+1} = Net\ sale_t\ (Flow) + \textbf{Change in Market value of Assets}_t + FUM_t$

this equation, which we will compute based on the available information. The computed Change in Market Values of Assets $_t$ will be as follows:

This P $\quad \textbf{Change in Market value of Assets t} = FUMt+1 - Net\ sale\ t(flow_t) - FUMt$

We have two important variables. This first is **'flows'** and the second is the '**Change in market value of assets'** which is a measure of price in our analysis. We should also note that 'Change in market value of assets' reflects part of the total return because from the investor's point of view, the total return in the bond market consists of interest income and the change in the market value of assets in given periods, as follows:

Total return= price of return + income return.

The interest return is driven by the coupon the bond pays over the given periods and the price return is based on the change in the market price, which is sensitive to the yield demanded by investors and the duration or amortisation of bonds that trade at a discount (premium). In this paper, we do not distinguish between the two parts of the returns. We take 'Change in market value of assets', which is a measure of price, to refer to price in both equity and bond markets.

2.2.2.1 Remove outliers

In the raw data, we observe some abrupt increases or decreases that cannot be explained by any particular event. These could be due to some merging, dissolving or misreporting of the fund. To have consistent data, define outliers as three standard deviations from the median. We then identify the position of the outlier in each vector of the time series, remove the outliers and linearly interpolate over their positions using the closest values that are not outliers. Using a median for removing outliers has an advantage over using the mean, as discussed in Leys et al. (2013).

2.2.2.2 Market value changes (Price) in comparison to IMA returns and select market price changes

After constructing the market value and removing the outliers, we compare our data, price, to the monthly return data published by the IMA. The IMA-published data leads by one period. For example, my calculated price return for Jan 2005 matches closely to the IMA return for Feb 2005. This could be because the IMA reports end-of-month performance while we calculate it at the beginning of the month, using the formula in part 2.2.2.2. However, matching our data to one period ahead will increase the correlation between my calculated returns and those of the IMA. Figure 2-3 below displays the correlation between the calculation of market changes and IMA returns, and shows that the majority of the sector is highly correlated. Figure 2-4 presents a comparison between the calculated market changes (price) and a few selected market returns from DataStream. Figures 2-3 and 2-4 both confirm that our calculation is a good proxy for capturing the market price.

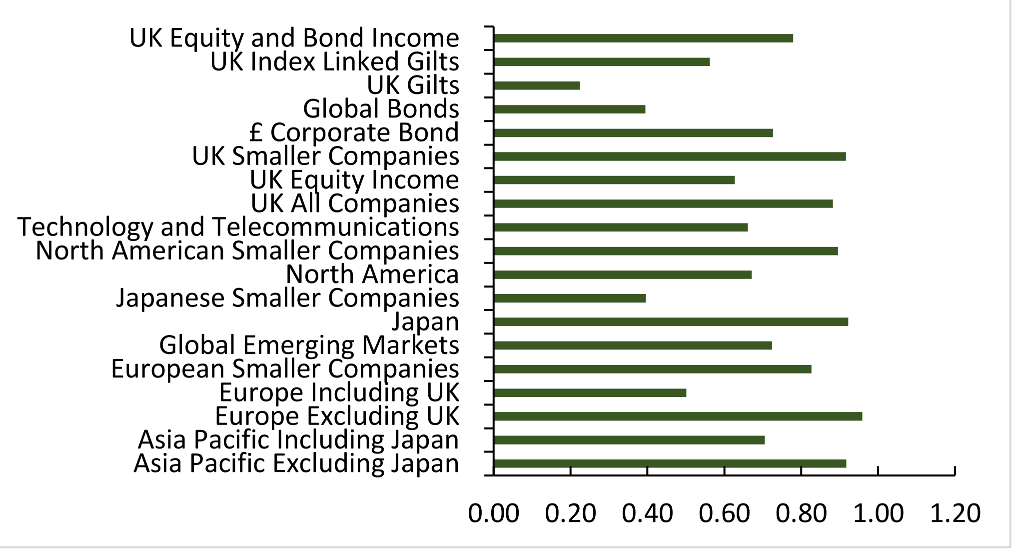


Figure 2-3: Correlation between market changes calculation (price) and returns, as published by IMA sectors

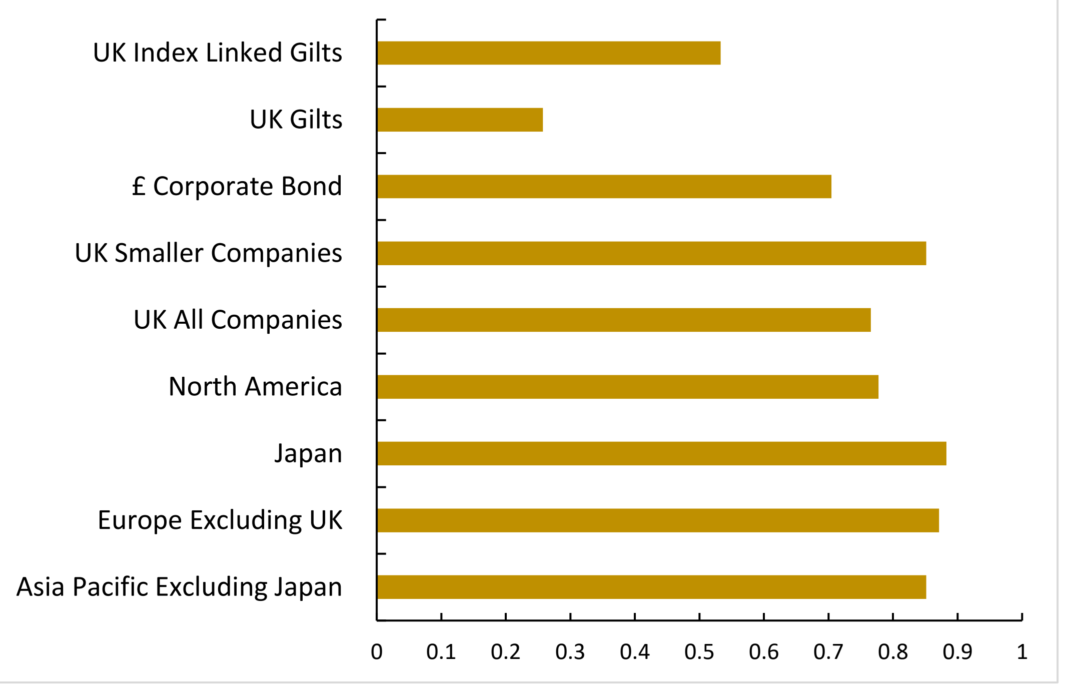


Figure 2-4: Correlation between market changes calculation (price) and selected market returns

Source: DataStream

2.2.3. Statistical analysis

Below we present an overview of our data and compare the profile of each sector for the period 2005 and 2015. In addition, we analyse the market risk premium in both flows and the price in both the equity and bond markets. We compare flows and price correlation in each category.

2.2.3.1. Overview of the total assets under management

Figure 2-5 shows that UK-authorised funds reached £971 billion at the end of December 2015. During the crisis funds under management fell, and started recovering at the beginning of 2009 after the Bank of England commenced QE.

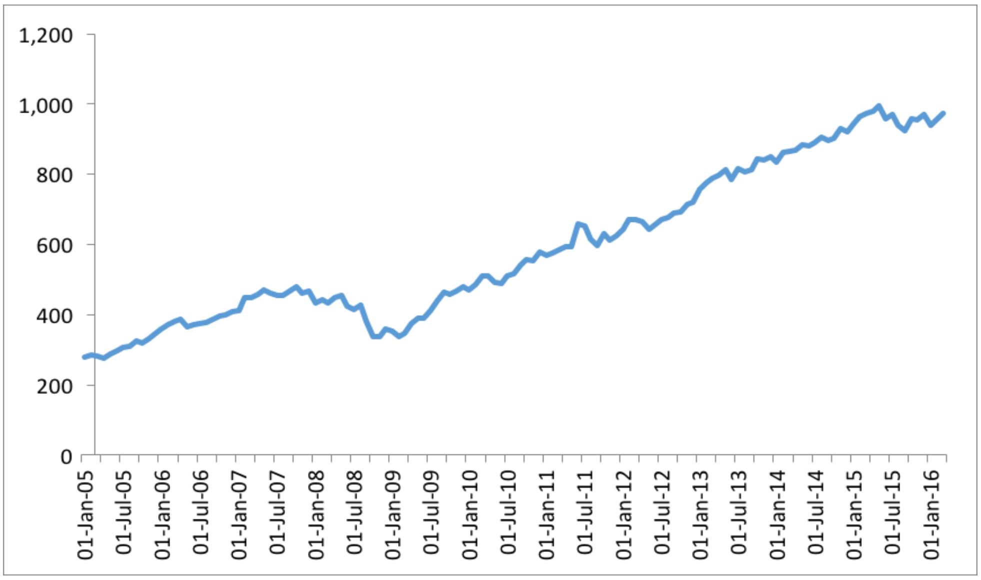


Figure 2-5: Total Managed in UK-Authorised Funds (OEICS and unit trusts) (£ Billion)

Source: Investment Management Association (IMA).

The raw monthly funds under management as the share of total assets for each sector is presented in Figure 2-6. We can see that the equity market is the largest, followed by fixed income, mixed assets and the money market. Over the intense period of the crisis from 2007 to 2009, uncertainty caused the equity trend to decrease and the bond market share - considered as 'safe assets' – to increase. The introduction of QE at the beginning of 2009 reduced yields in the bond market and it lost market share. At the same time, the equity market has become more stable at 53-58 per cent of the total share of assets while the bond market is still trending downward. It reverted to its pre-crisis level (around 14 per cent of total assets) at the end of 2015. This is in line with the aim of QE: purchasing government bonds (gilts), increasing liquidity in the market by returning money to investors and taking back the bond. The asset managers, instead of holding cash, invested in corporate bonds, foreign assets, and equity (Joyce at al., 2011). In particular, purchasing corporate bonds stabilised the corporate bond share of total bonds, which we can see in Figure 2-7, while government bonds disappeared from the investor balance sheet.

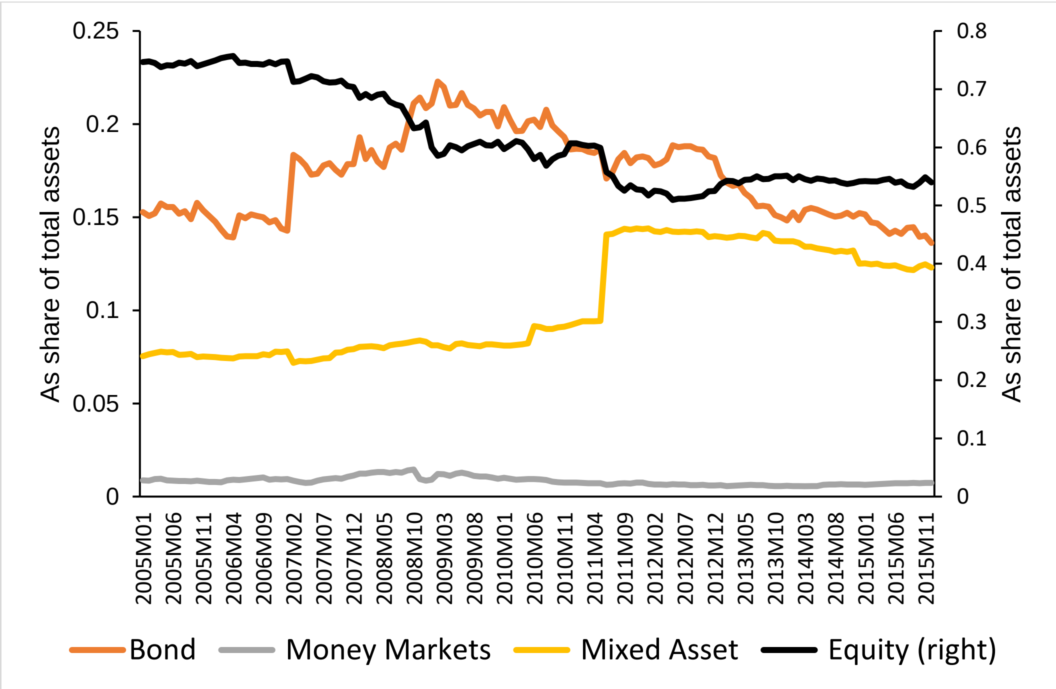


Figure 2-6: Share of total funds under management in each sector over total assets in industry

Please note the jump in the mixed assets is due to the redefining classification by the IMA https://www.theinvestmentassociation.org/assets/files/sectors/20150205-classificationofoutcomefocusedfunds.pdf

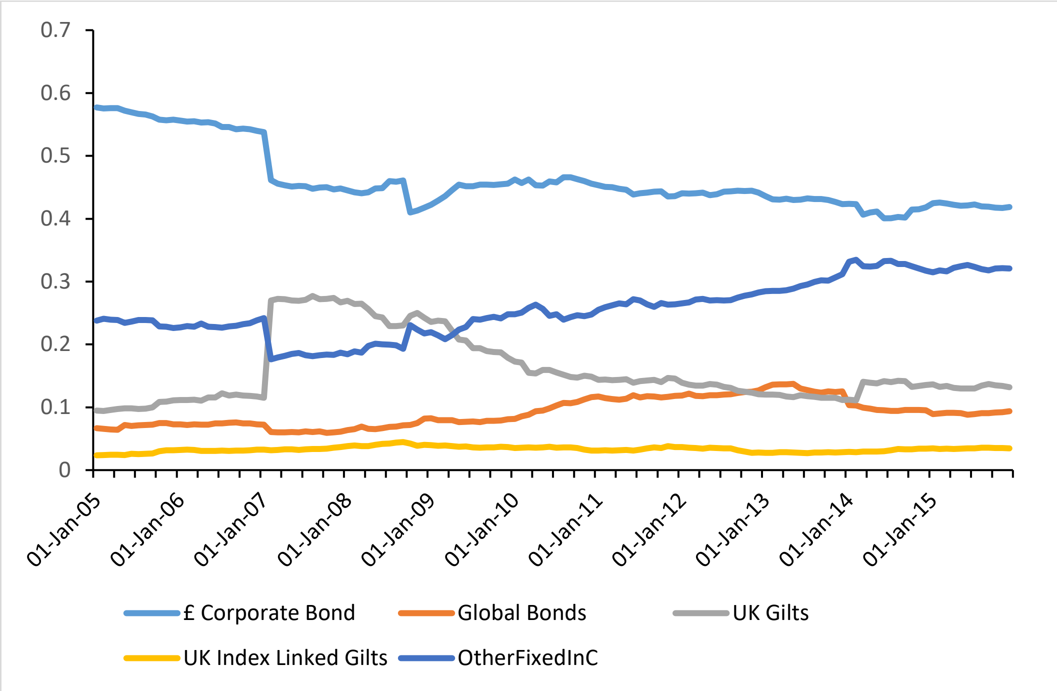


Figure 2-7: Share of total bonds under management in each sector over total bond market

2.2.3.2 The bond and equity markets

In this paper we are focusing on the bond and equity markets. In February 2007, the Federal Home Loan Mortgage Corporation (Freddie Mac) stated that it would no longer buy the "most risky subprime mortgages and mortgage-related securities" (FED).[7] This was the start of the financial crisis. Figure 2-8 shows the volatility (standard deviation) and mean flows for the bond and equity markets. The market risk premium, which reflects uncertainty, has increased in both markets in the post-crisis period. In addition, since the start of the crisis in 2007, comparing the black line in the bond and equity markets, on average, the bond market flow decreased and the equity market flow increased. During the intense period of the crisis, 2007M2 to the start of QE in 2009, the equity market flow fell in favour of the bond markets, which were perceived as safer.

[7] https://www.stlouisfed.org/financial-crisis/full-timeline

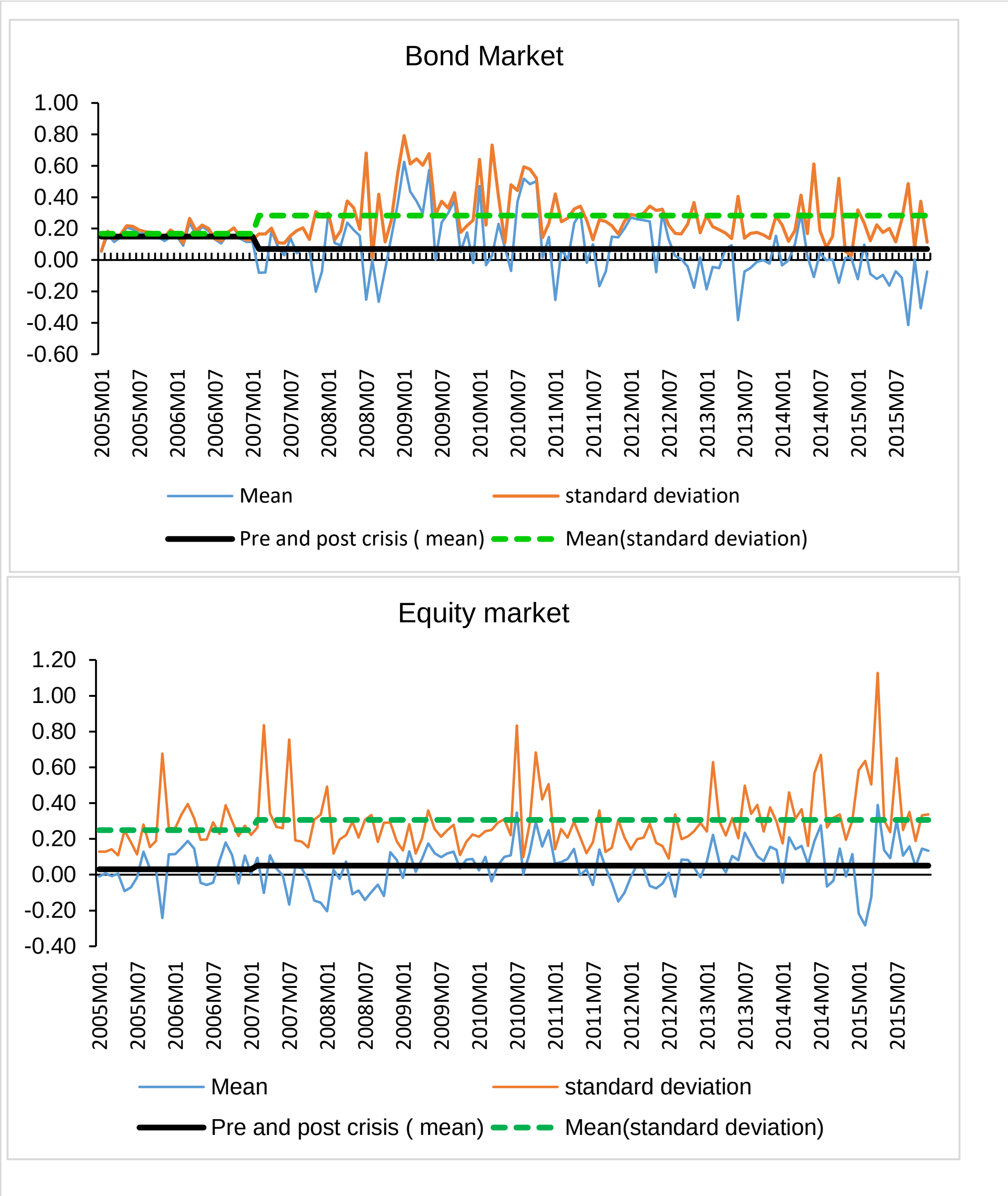


Figure 2-8: Volatility and mean flows in the bond and equity markets

Figure 2-9 illustrates the market changes, a measure of price, and the means in both the bond and equity markets. In the post-crisis period, the mean price in the bond market increased slightly in line with the interest rate decline; equity prices fell in line with the impact of recession. However, equity prices recovered after the recession and particularly since QE. Overall, volatility in the bond and equity market price increased, which is consistent with the uncertainty in the financial market. The fluctuation in bond market prices and the volatility spike in February of 2014 came from the gilt market. The Bank of England announcement intended to maintain the stock of purchased assets and reinvest the cash flow associated with all maturing gilts held in the APF, to help the economy recover (Bank of England 2015).

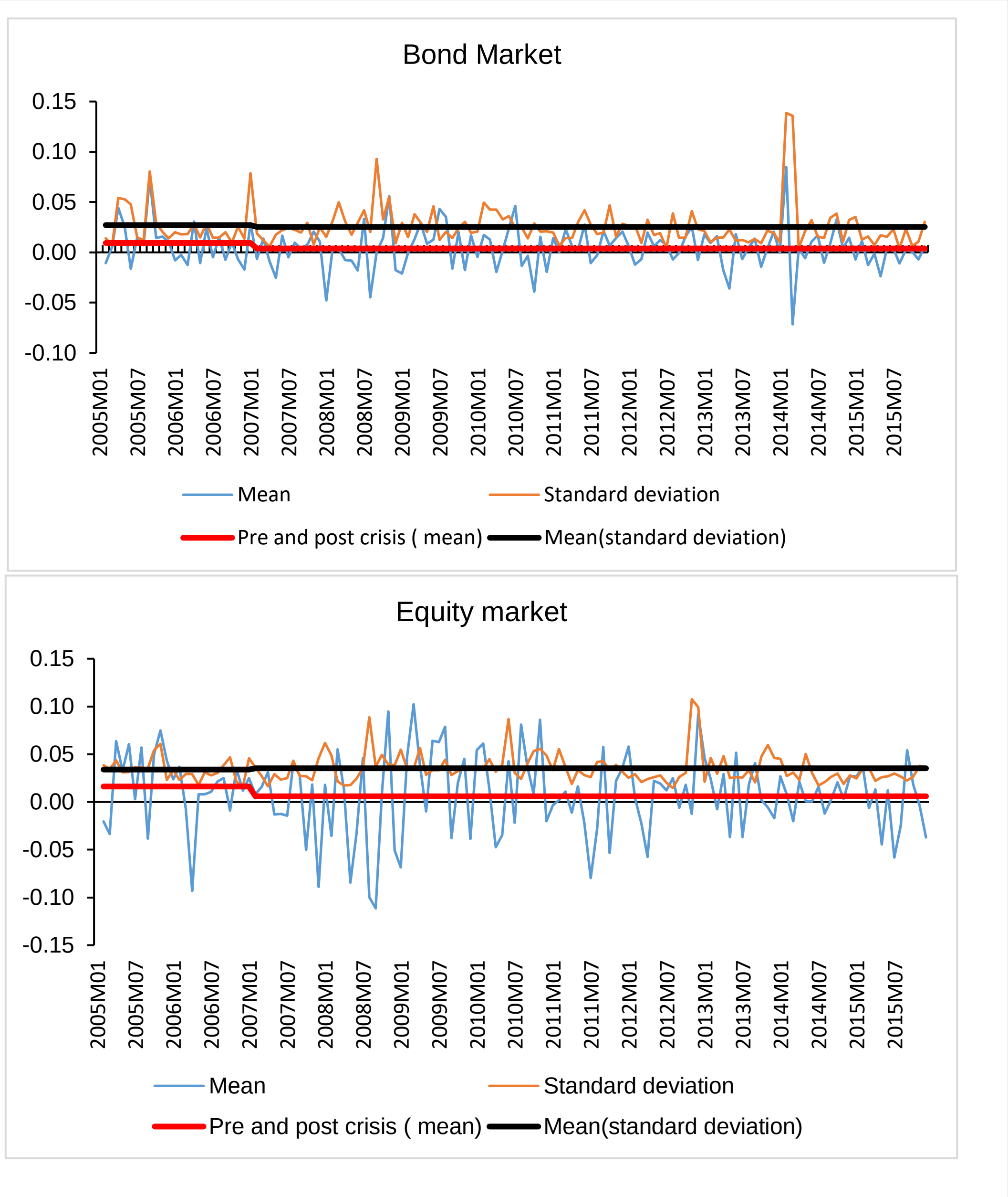


Figure 2-9: Price volatility and mean price in the bond and equity markets

From Figure 2-7, we can see a decrease in the share of bonds since 2009. This could be due to the low interest rate in the bond market and the government purchase of government bonds as part of QE. Nevertheless, comparing Figure 2-6 and Figure 2-9 shows that investors may switch to other asset types such as equity, where prices are higher. As part of our analysis, we will look at the impact of monetary policy on bonds and equity in the extension of the model in Part 2.5.

We present the individual categories' flow and price volatility in both markets in Figure 2-10. Post-crisis volatility has reduced some sector flows in the equity market, including North America, small Japanese companies and specialist equity markets, while in the bond market sub-individual volatility has increased.

Full statistical information about the funds under management and correlation for flows pre-and post-crisis in bonds and equity are presented in Appendix B: Tables 1 to 3. Looking at the individual sector correlation in table 1 (pre-crisis) and table 2 (post-crisis) we can see that overall, the correlation between the equity market and bond flow has increased post-crisis.

Before we set up the bivariate VAR (Benchmark analysis, parts 2.4) we look at the correlation between flows and prices in individual categories. Figure 2-11 shows this correlation, as we can see that just four categories in our data have a positive correlation with the prices. This includes Asia Pacific (excluding Japan), smaller European companies, specialist companies, and smaller UK companies. This shows some evidence of a positive feedback effect between flows and prices in these four sectors in the equity market. In other words, increases in one of them will lead to increases in other variables. In the bivariate VAR, these four categories exhibit a weak feedback effect. Most sectors in the equity and bond markets show a negative correlation, which may indicate that the market is in equilibrium and increases in quantity lead to a fall in prices. We will address this in our empirical analysis.

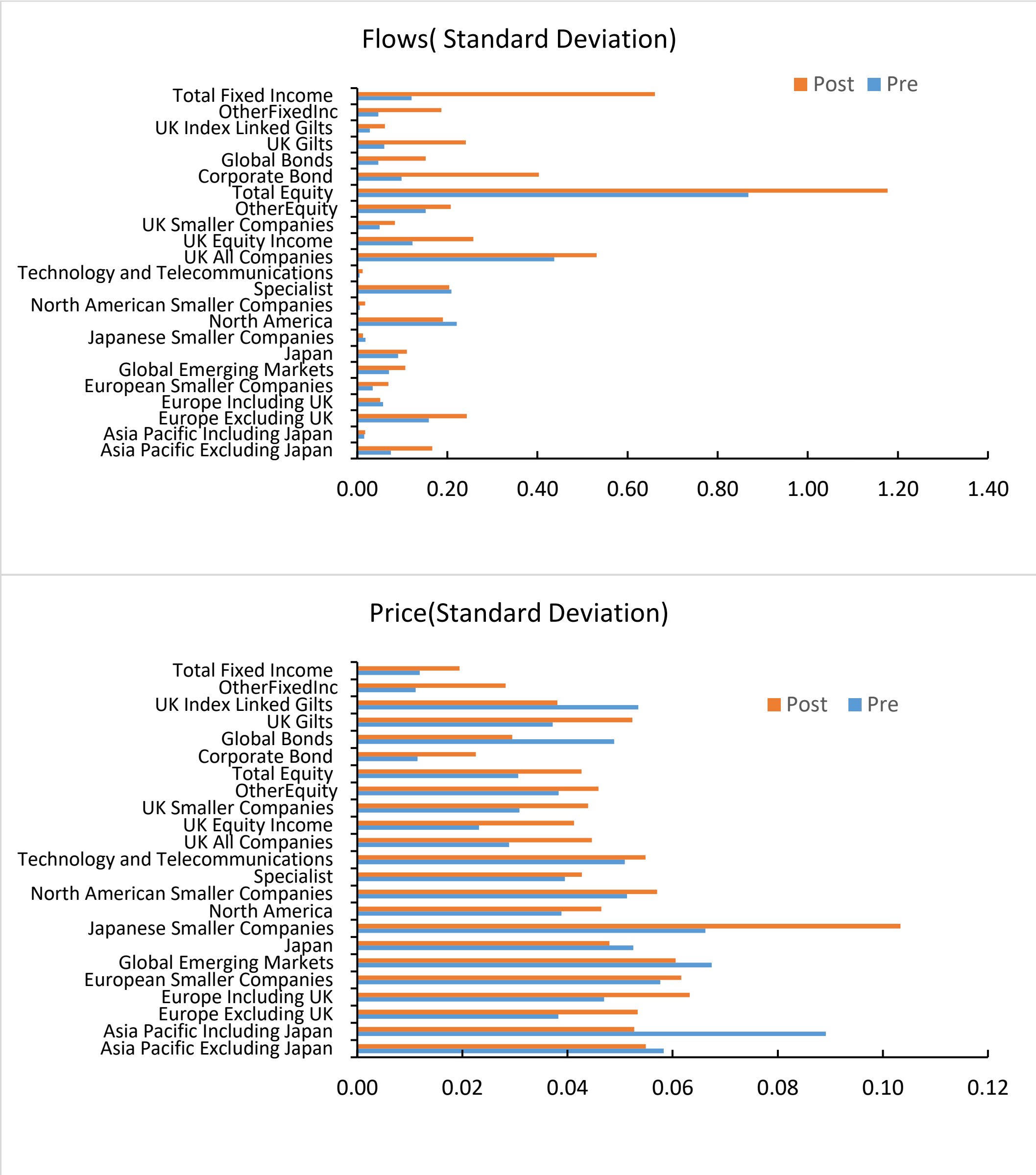


Figure 2-10: The individual categories' flows and price volatility in both markets

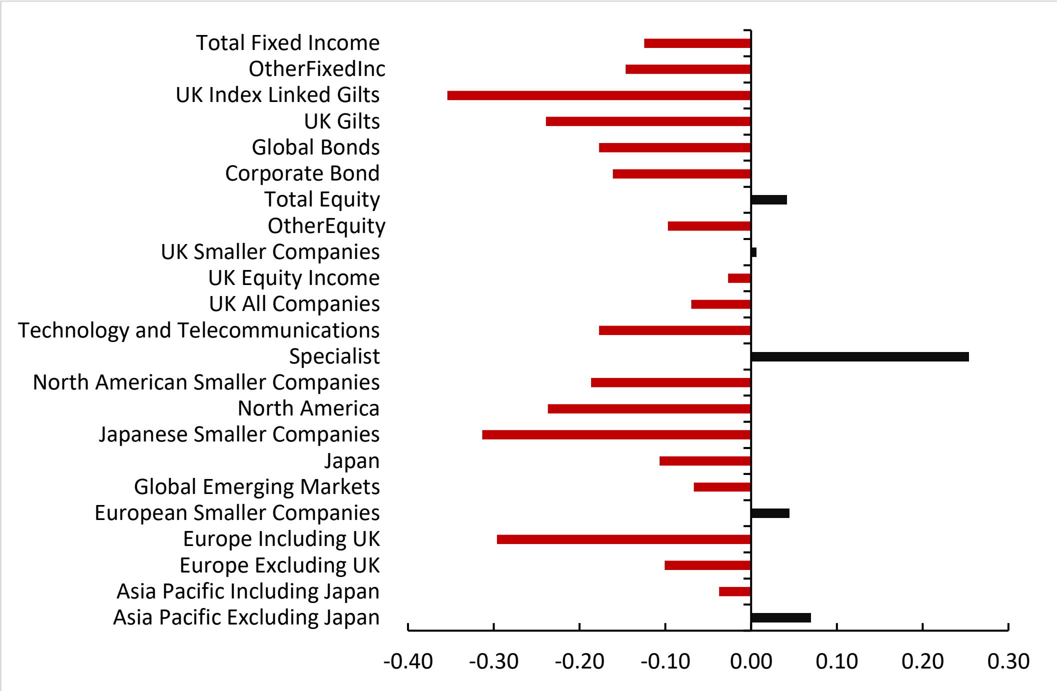


Figure 2-11: Correlation between flows and prices in all categories in the bond and equity markets

2.3 Empirical Framework

2.3.1 Empirical Framework

Our empirical investigation is based on the vector autoregression (VAR), firstly in bivariate VAR [Flow Price] which examines the dynamic relationship (feedback effect) between flows (quantity) and market changes (price) in both the bond and equity markets using monthly data from the IMA. We first test to see if a positive feedback exists between fund flows and price in both equity and bond markets.

Next we estimate monetary policy surprise following the Wright (2012) methodology, using daily data. This, together with first principal components of flows and price in the bond market, will create a three-variable VAR [MP Flow Price]. Note that our bond market is limited compared to Feroli et al. (2014). We have just corporate bonds, global bonds and other bonds. The corporate bond is nearly half of the total bond trading in the bond mark in our data set while global bonds are less than 10 per cent, other bonds are 20 per cent, and the rest are government bonds.

In combination, monetary policy, flow and price will create a three-variable VAR. In this we are looking at the connection between monetary policies, flows and prices in the bond market. We label these two models (bivariate VAR and trivariate VAR) as benchmark models. They will be estimated and discussed in section 3 of the benchmark model estimation.

Thirdly, similarly, we will expand the analysis by splitting the bond market into the domestic (corporate bond and other bonds) and foreign sectors (global bonds). We also include the UK pound exchange rate (in log difference) in our model to examine the international dimension of risk-taking channels and cross-border effects.

Fourthly, we look at how investors choose between equity and bond markets. In particular, we will look at whether investors choose bonds or equity when the central bank increases the rate.

Finally, for a robustness check, we will repeat the main estimation (bivariate and trivariate VAR) using the daily frequency. This includes bivariate model estimation and trivariate estimations. We also use sign restriction to check our result in the extension of the model for open economy bond markets.

2.4 Main estimation (Benchmark)

2.4.1 The feedback effect in bivariate VAR

First, we look for evidence of the feedback effect in UK data, employing bivariate vector auto regression in 20 categories: 16 equity markets and 4 bond markets.

The setup of the VAR following Feroli et al. (2014) is as follows for all categories in both the bond and equity markets.

$$\begin{bmatrix} Flow_t \\ Price_t \end{bmatrix} = \begin{bmatrix} C \\ C \end{bmatrix} + \begin{bmatrix} Flow_{t-1} \\ Price_{t-1} \end{bmatrix} + \begin{bmatrix} (\sum_t^{t-13} fundinflow_t)/assest_{t-13} \\ (\sum_t^{t-13} fundinflow_t)/assest_{t-13} \end{bmatrix} + \begin{bmatrix} e1_t \\ e2_t \end{bmatrix} \quad (2\text{-}1)$$

In this model, ordering flows first reflects the decisions of investors or of their portfolio managers in driving the flow that could trigger the destabilising dynamics. Additionally, the shock to flow in a given month is exogenous to change in the valuation in that month. In each of the VARs, Cholesky decomposition used for identification includes a 4-month lag of flows and market changes (price) which is scaled by total asset at the beginning of the periods, as well as a 1-year accumulation of past fund inflows, normalised by the asset at the beginning of the period as a control indicator that proxies for sustained fund accumulation.

The findings from these exercises and their individual impulse response are in Figures 2-12 to 2-22 in part 2.4.2 (Individual bivariate VAR results). We report the specific regression coefficients and other summary statistics in the appendix D, table 1.

In nearly all categories in the equity and bond markets, flows respond positively to the increase in price. This is in line with the literature such as Chevalier and Ellison (1997), Sirri and Tufano (1998) and Feroli et al. (2014). However, there was no response to bond market price from flow shocks, while in the equity market the response of price to flow shocks is very weak, and positive for the following categories: Asia Pacific excluding Japan, European smaller companies, specialist, and UK smaller companies.

This confirms a weak feedback effect in some of the categories in the equity market. These four sectors also have a positive correlation between price and flows, as shown in Figure 2-11 in our preliminary data analysis.

As demonstrated, we are unable to support the positive feedback effect for all categories and specifically in the bond market. The bond market results are in line with a recent study by Ramos-Francia et al. (2017) in which they test the first implication of Feroli et al.'s (2014) model using bond flow and CDS as their proxy for price for 20 advanced economies, including the UK. However, there is a partial positive feedback loop between prices and quantities in the equity market.

As suggested by Feroli et al. (2014), the lack of a feedback effect could be due to high liquidity in these markets, which makes them less likely to face sudden reversals because of investors who rush to sell illiquid assets first, or because of identification issues in using monthly frequency. Specifically, Feroli et al. (2014) claimed that "…over the course of the month, there are likely to be some fundamental shocks that could lead to both higher inflows and higher returns. So using a Cholesky ordering to identify a feedback loop between flows and returns for monthly data would not be convincing. Ideally, we would have liked to have used even higher frequency data (such as daily observations) to test for the feedback loop. At the daily frequency, it would be even easier to defend the assumption that flow movements cause price adjustments."

To capture a feedback effect it would be good to use daily data as Feroli et al. (2014) suggested. Specifically, for robustness, we investigate frequency using daily data but the result did not change significantly. We present the full evidence of the daily result in section 5.

2.4.2 Individual bivariate VAR results.

Figures 2-12 to 2-22 present the VAR impulse response for individual categories following Feroli et al. (2014) based on a Cholesky ordering. For each of the categories of the fund, there is a panel of four charts that show cumulative impulse response over 18 months to one standard deviation shock in flows to flows (top left), flows to price (top right), price to flows (bottom left), and price to price (bottom right). For there to be a feedback effect we should observe diagonal increases in both flows and price which is price to flows (bottom left) and flows to price (top right). Furthermore, the vertical scale displays the flows and price over the assets at the beginning of the month (or last periods). To generate such an impulse response, we used Monte Carlo simulations of 1000 repetitions. The cumulative response is shown in red and two standard deviation bandwidth in blue. Below we present the selected individual categories in bond and equity markets. Specifically, we present all individual bond markets, but from equity markets only those categories that show a positive feedback effect. We also present the aggregate sector response in each market.

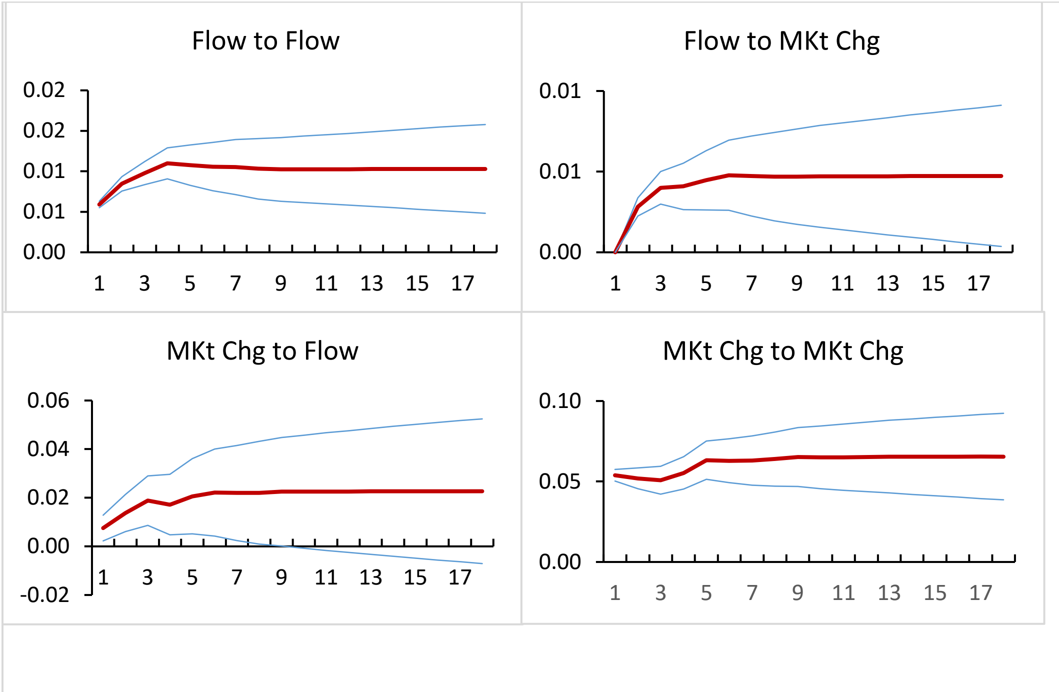


Figure 2-12: Asia Pacific Excluding Japan*

*This sector shows feedback effect

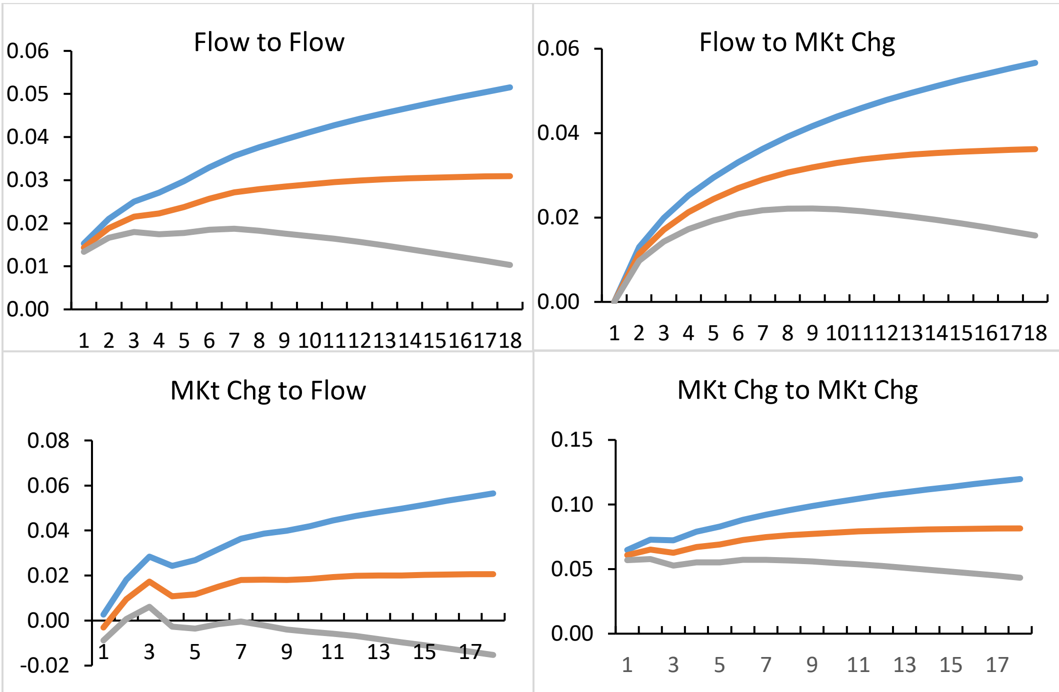


Figure 2-13: European Smaller Companies *

*This sector shows feedback effect

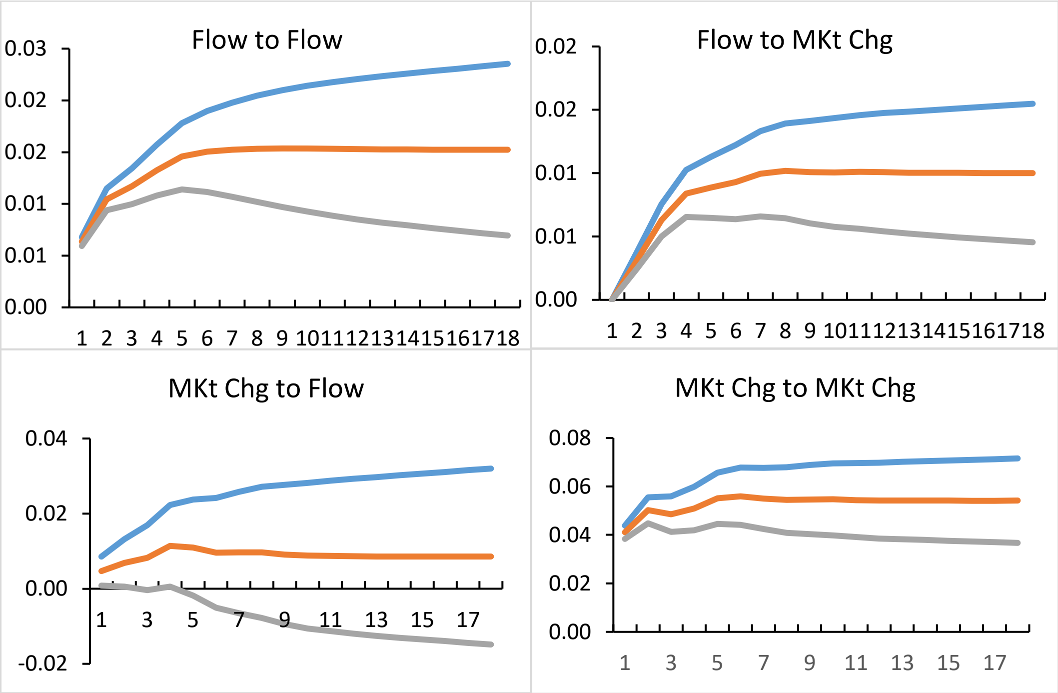


Figure 2-14: Specialist*

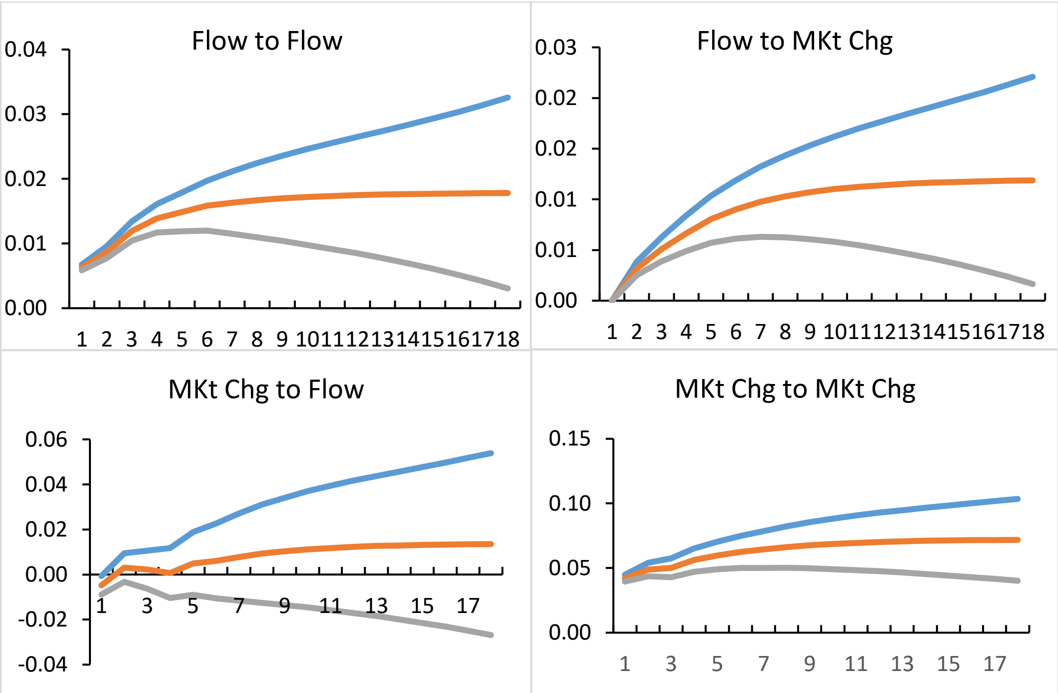


Figure 2-15: UK Smaller Companies*

*This sector shows feedback effect

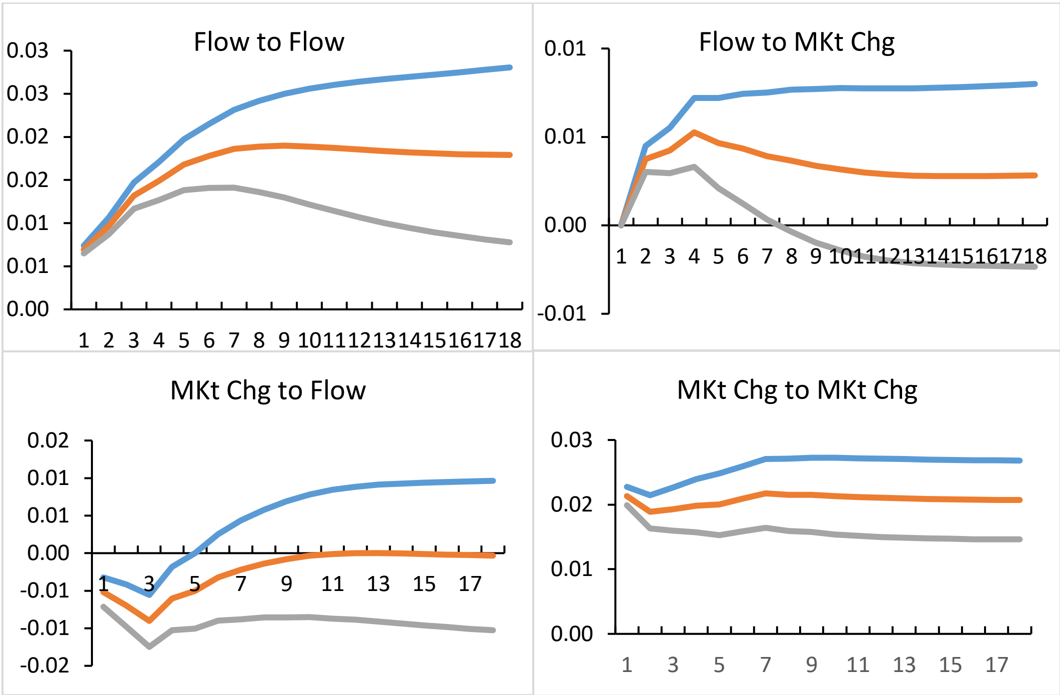


Figure 2-16:£ Corporate Bonds.

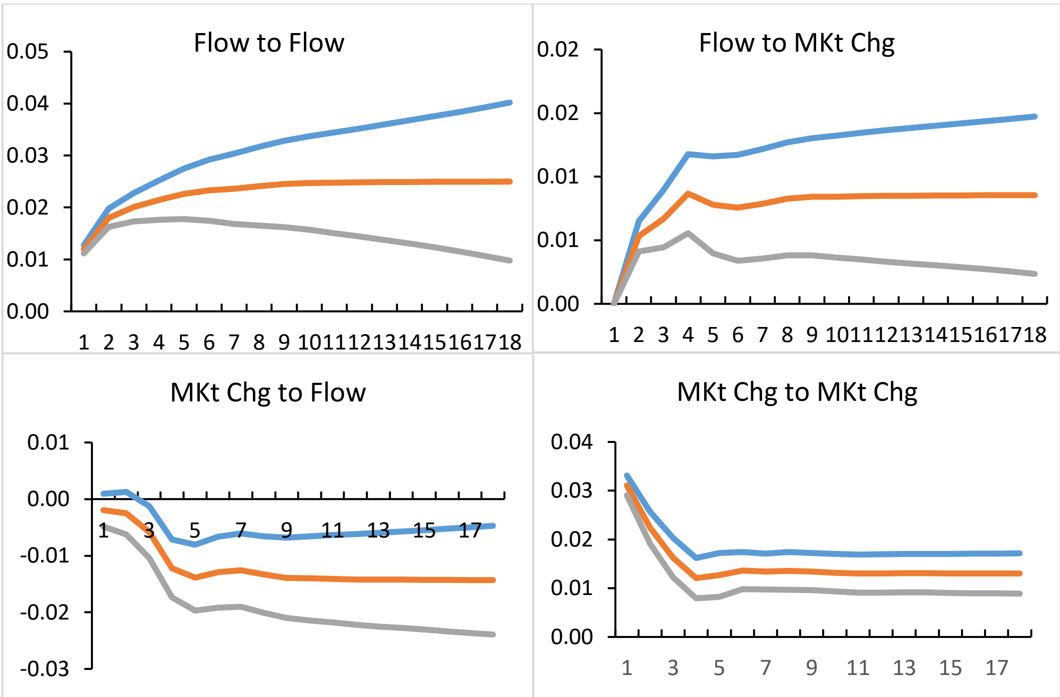


Figure 2-17: Global Bonds.

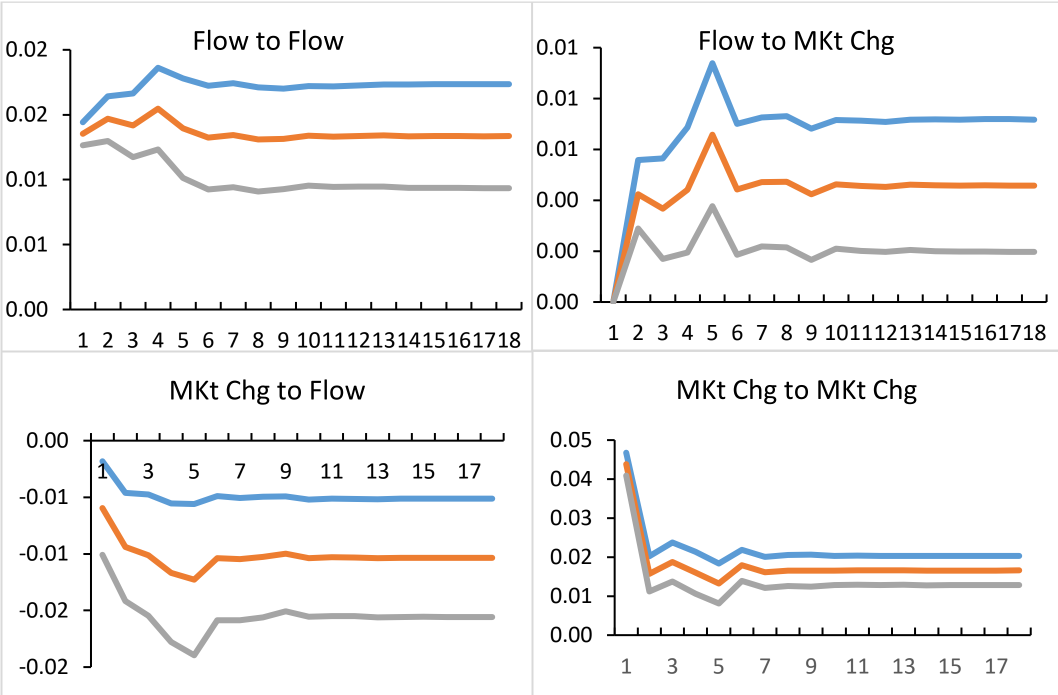


Figure 2-18: UK Gilts.

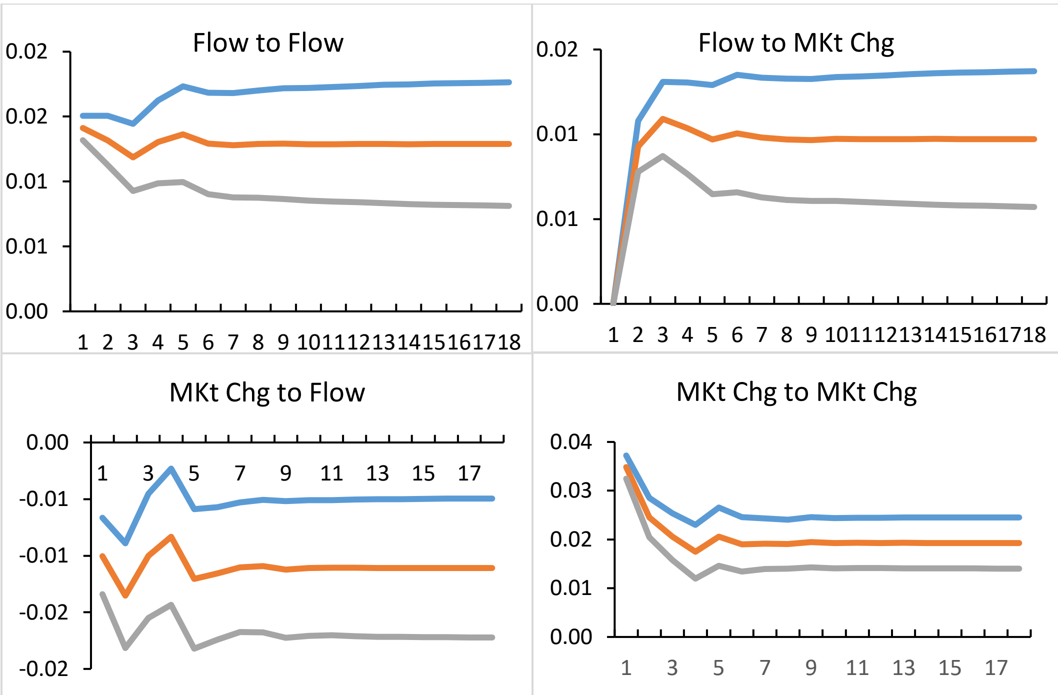


Figure 2-19: UK Index Linked Gilts.

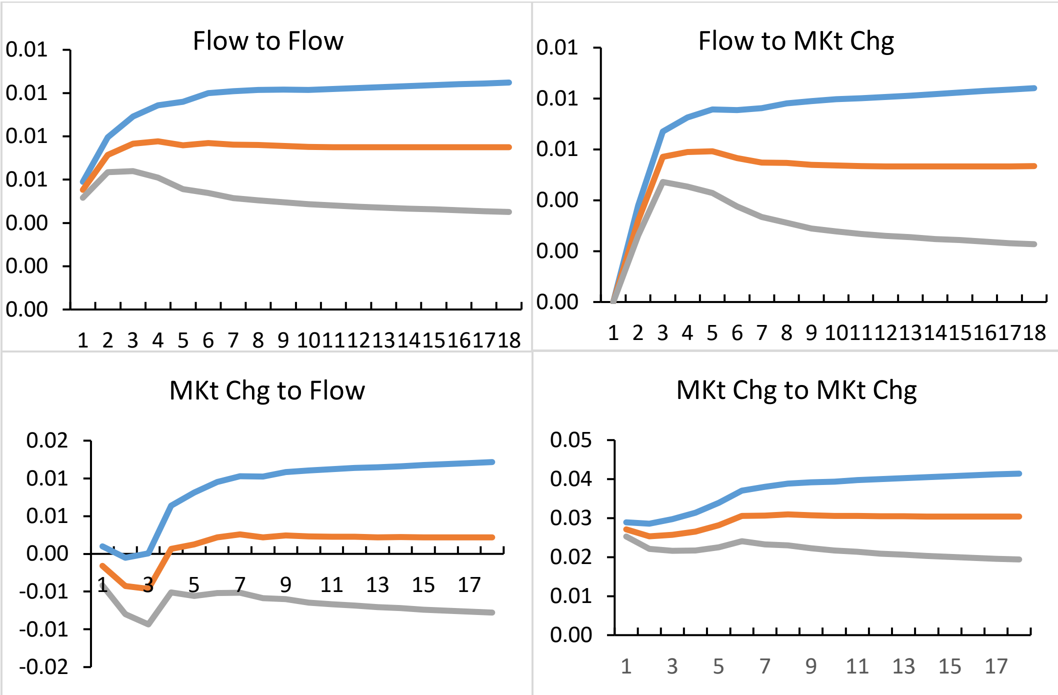


Figure 2-20: Other Fixed Income.

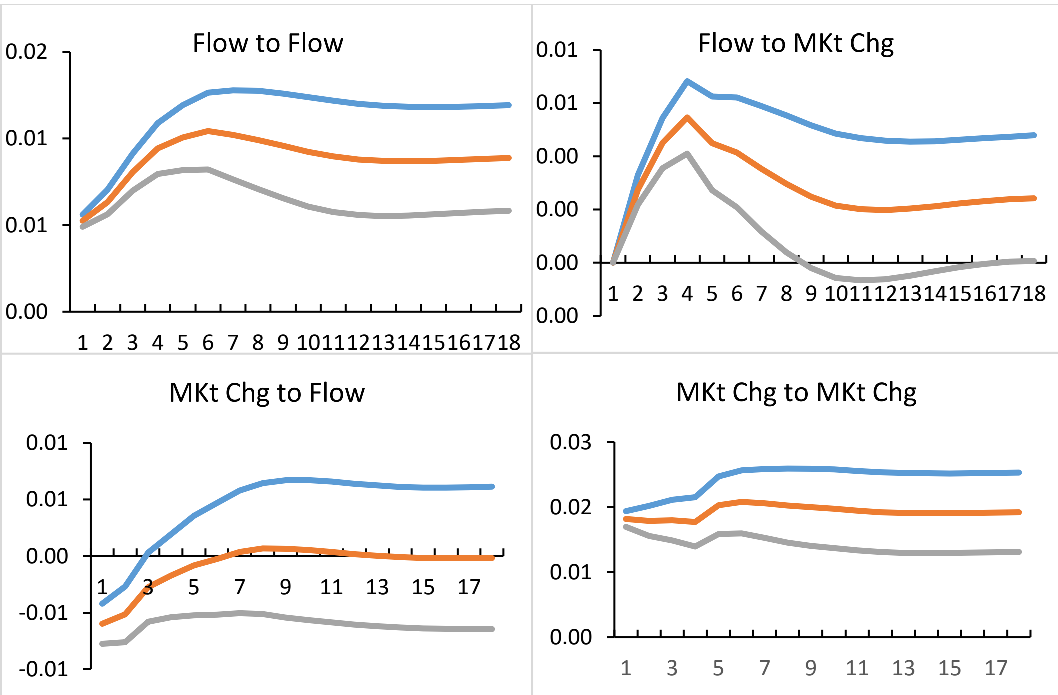


Figure 2-21: Total Fixed Income.

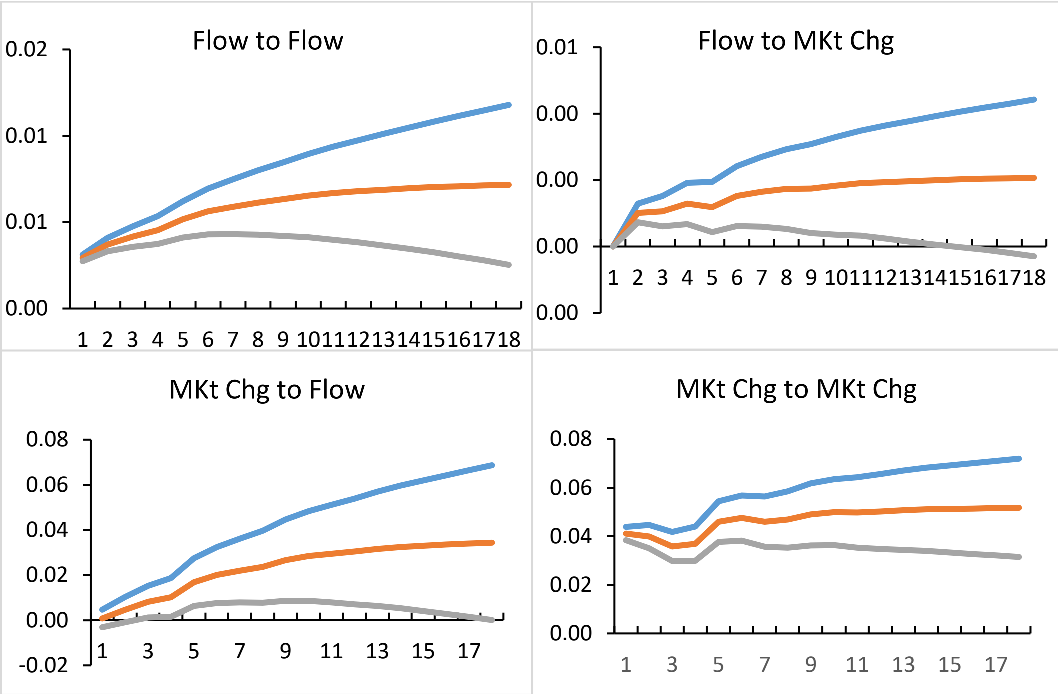


Figure 2-22: Total Equity.

It is clear that there is little evidence for a full feedback effect in the bond market, whereas a weak feedback effect appears in some equity market categories. This also evident from the aggregate data results in Figure 2-21 and 2-22. Full results for those categories in equity that do not show a feedback effect can be found in Appendix C, Figures 1 to 13, and the full statistical summary such as confidence and standard error for bivariate VAR can be found in Appendix D.

2.4.3 Monetary policy identification and the feedback effect

Feroli et al. (2014) propose that monetary policy can change market perception, which can move both flows and prices. The paper also suggests that market participants will accommodate big changes in the monetary policy stance. This includes a case of a large accumulation of price driving inflows, and if the monetary policy stance shifts direction, it then leads to a large outflow. The analysis predicts that monetary policy can drive flows, and flows can drive prices.

To measure the monetary policy stance for the UK we follow Wright (2012). The full description of the methodology, which Feroli et al. (2014) also used to create monetary policy surprise in their estimations, is in Appendix E. To estimate the monetary policy surprise, we use daily frequency data on 10-year government bonds real and nominal, 2-year nominal government bonds, and 5-year real government bond, BBB corporate and AAA corporate bonds.

To estimate monetary policy surprise we lowered the 10-year government bonds by 25 basis points and estimated the structural shock on a daily frequency, to be consistent with Wright (2012). We took these daily observations and matched them against the policy event. On the day of the policy announcement, we select the impact of the shock; otherwise, we put zero. In this way, we could isolate the monetary policy shock to that day. In our sample, we have at least one policy announcement in a given month. As the structural shock on that specific day is matched to the policy announcement of that day, we call that structural shock our monetary policy surprise in that month (e.g. if we had an announcement on 15 Jan 2012, then we searched for the structural shock on 15 Jan 2012 in the daily shock). If we had two or more announcements, we averaged the structural shock size on those days and called it monetary policy shock for that month.

To test the connection between monetary policy, flows, and price, we set up a three-variable VAR that includes monetary policy surprise, the first principal components flows and price of bonds. This includes corporate[8], global[9] and other bonds; we exclude gilts and the gilt index as Feroli et al. (2014) did not include government bonds, due to the lack of positive feedback in bivariate VAR. Feroli et al. (2014) only included bonds for which there was a positive feedback effect in the bivariate VAR model. However, despite lacking a positive feedback effect in our bivariate VAR estimation for corporate bonds, global bonds and other bonds, for testing the model in a monetary policy context we selected bond categories which are a close substitute to those bond categories that Feroli et al. (2014) used in their paper.

The data is monthly from January 2005 to December 2015. We order monetary policy shock first, then flow and prices. Ordering monetary policy first ensures the exogeneity of the monetary policy surprise. As we discussed in the bivariate VAR section, putting flows before the price would ensure flows as a driver of price. Both flow and prices are scaled to the total assets under management in each sector.

Figures 2- 23 and 2-24 show the result presented by the impulse response of VAR using Monte Carlo simulations of 1000 repetitions. While the first figures show the instantaneous response, the second shows the accumulation response to the monetary policy shock. The time period, 18 months, is on the horizontal axis the vertical axis shows the response to the one-unit shock of each variable.

---

[8] "Funds which invest at least 80% of their assets in Sterling denominated (or hedged back to Sterling), Triple BBB minus or above corporate bond securities (as measured by Standard & Poors or an equivalent external rating agency). This excludes convertibles, preference shares and permanent interest bearing shares (PIBs)". (IMA)

[9] "Funds which invest at least 80% of their assets in fixed interest securities. All funds which contain more than 80% fixed interest investments are to be classified under this heading regardless of the fact that they may have more than 80% in a particular geographic sector, unless that geographic area is the UK or GEM, when the fund should be classified under the relevant UK (Sterling) or GEM heading. This sector has a wide range of funds, which invest in bonds and currencies across geographic areas with differing characteristics". (adapted from IMA)

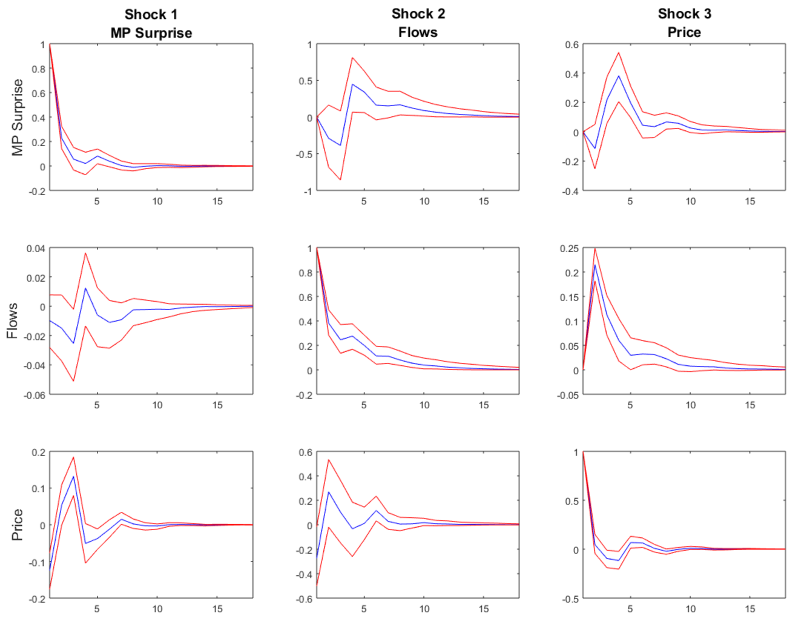


Figure 2-23: Instantaneous Response to Monetary Surprise, Monthly data.

The impact of monetary surprise illustrated by instantaneous impulse response in three variable VAR identified by a Cholesky ordering with the Monetary surprise first, flow second and return third. The 84 percentile bands are shown.

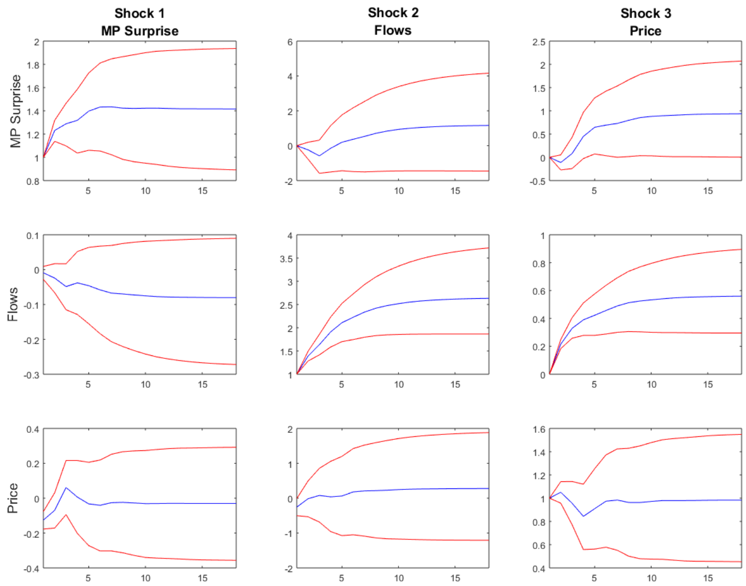


Figure 2-24: Accumulation Response to Monetary Surprise, Monthly data.

The impact of monetary surprise illustrated by cumulative impulse response in three variable VAR identified by a Cholesky ordering with the monetary surprise first, flow second and return third. The 84 percentile bands are shown.

From these figures we can infer:

- A surprise tightening of monetary policy prompts a negative response to both flows and prices (column 1, rows 2 and 3). This is consistent with Feroli et al. (2014).
- The response of the flow to price shock (row 2, column 3) is statistically significant. The response is similar to the bivariate VAR studied earlier. This shows that price is an incentive for the majority of the fund inflows. This is in line with the previous literature: Chevalier and Ellison (1997), Sirri and Tufano (1998) and Feroli et al. (2014).
- Price shows an immediate negative response to flows shock (column 2, row 3). However, it will increase over time. The initial response of the price is not similar to Feroli et al. (2014).

From these results, using UK monthly data, we can confirm that the impact of monetary policy is similar to Feroli et al.'s (2014) model outcome except the response of prices to the flows. In our analysis, increases in flows and decreases in initial prices can be due to equilibrium in the market. As the flows, a measure of quantity, increase, and price should fall. Furthermore, if we look at the cumulative response (Figure 2-24) we can see that over time the price increases as the flow increases. This is consistent with the model outcome.

We test this further by increasing the size of universe (more categories of bond) and using high frequency data from November 2013 to September 2016 from Thomson Reuter Eikon's global flow. We found that the overall result is the same and in particular, monetary policy tightening causes outflow and price falls in line with expectations of the model. We provide the detail for this exercise in the robustness check analysis in part 2.6.

2.5 Extended analysis

2.5.1 The Bond Market in an Open Economy

We next look at how investors in a small open economy such as the UK, react to a monetary policy shock in the bond market. We split the bond market data into domestic - corporate and other bonds, and global bonds. We include the nominal effective exchange rate (NEER) (in log difference) in our model to capture the international dimension of risk-taking channels. The UK pound exchange rate is measured by the nominal effective exchange rate (NEER) of the pound sterling, which is a trade-weighted index of the value of the pound, obtained from the Bank of England database. An increase in NEER indicates an appreciation in the pound sterling relative to its trade-weighted basket of other currencies.

We estimate the VAR consisting of six variables, order monetary policy shock first, then the first principal components of flows and prices for domestic bonds, the first principal components of flows and prices for foreign bonds, and finally the NEER. The setup and the shock is the same as those in the three-variable VAR model. In Figure 2-25, we show the dynamic effect of monetary policy shock on domestic flows, domestic price, foreign flows, foreign price, and NEER, while Figure 2-26 shows the impulse response of the VAR for all variables.

From Figure 2-25, we can see that the response of domestic bond flows to the tightening monetary policy is negative and significant while the reaction of foreign bond flows is ambiguous and not significant. The price in both foreign and domestic bonds is falling initially as we expected. NEER appreciates in line with the rate rise. We do not observe an exchange rate puzzle.

As we can see, the model predicts that monetary tightening is likely to set off outflow because the demand for risky assets, corporate bonds and other bonds is reduced due to increases in their risk premium (i.e. a fall in price leads to increases in risk premium). This is consistent with the model outcome and considering the zero lower bound.

As Joyce et al. (2011) reported during zero lower bound as part of monetary transmission portfolio rebalancing, investors sell gilts, which are government bonds, to the Bank of England. Corporate bonds, other assets and equity are a close substitute for holding money, which puts upward pressure on the price of corporate, foreign assets. However, in our scenario as we unwind (tightening) monetary policy then we should expect outflow and a fall in prices of bonds.

The ambiguity in foreign bond demand needs to be investigated using sign restriction in the robustness check (part 2.6), but the result confirms our current finding. The mean foreign bond flows show a negative response in line with domestic bonds, but the response is not as significant.

Furthermore, because of tightening monetary policy, we can see an immediate appreciation in the NEER as expected and a future depreciation in line with uncovered interest rate parity (UIP).

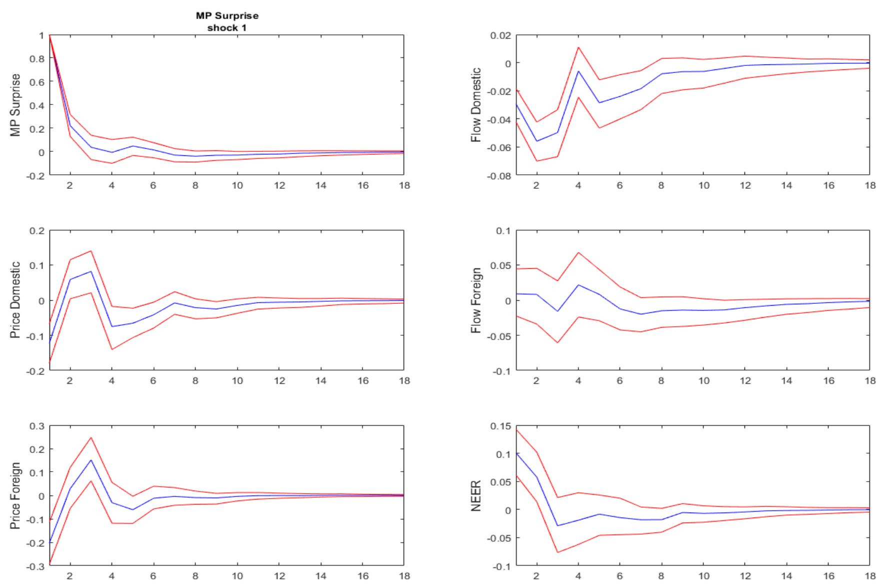


Figure 2-25: Instantaneous Response to Monetary Surprise, in UK Domestic and Foreign Bonds.

Conclusions from Figures 2- 26 show that the overall response is intuitive and we can summarise the following from it.

- A shock to the domestic bond price (Column 3, Row 3) will encourage more flows into domestic bond markets and this leads to an appreciation of the pound sterling relative to its trading partners.

- An increase in foreign bond price (Column 5, Row 5) leads to an immediate depreciation of the pound sterling and increases inflow to foreign bonds. However, over time the pound starts to appreciate, which leads to increases in price and more inflow to the domestic economy. This is not statistically significant.

- A positive shock to the exchange rate increases the domestic price, making domestic bonds less attractive than foreign bonds. We can see outflow from domestic bonds and increases in foreign bond flows. The price for domestic bonds increases and the foreign bond price is falling, but the decline is not significant.

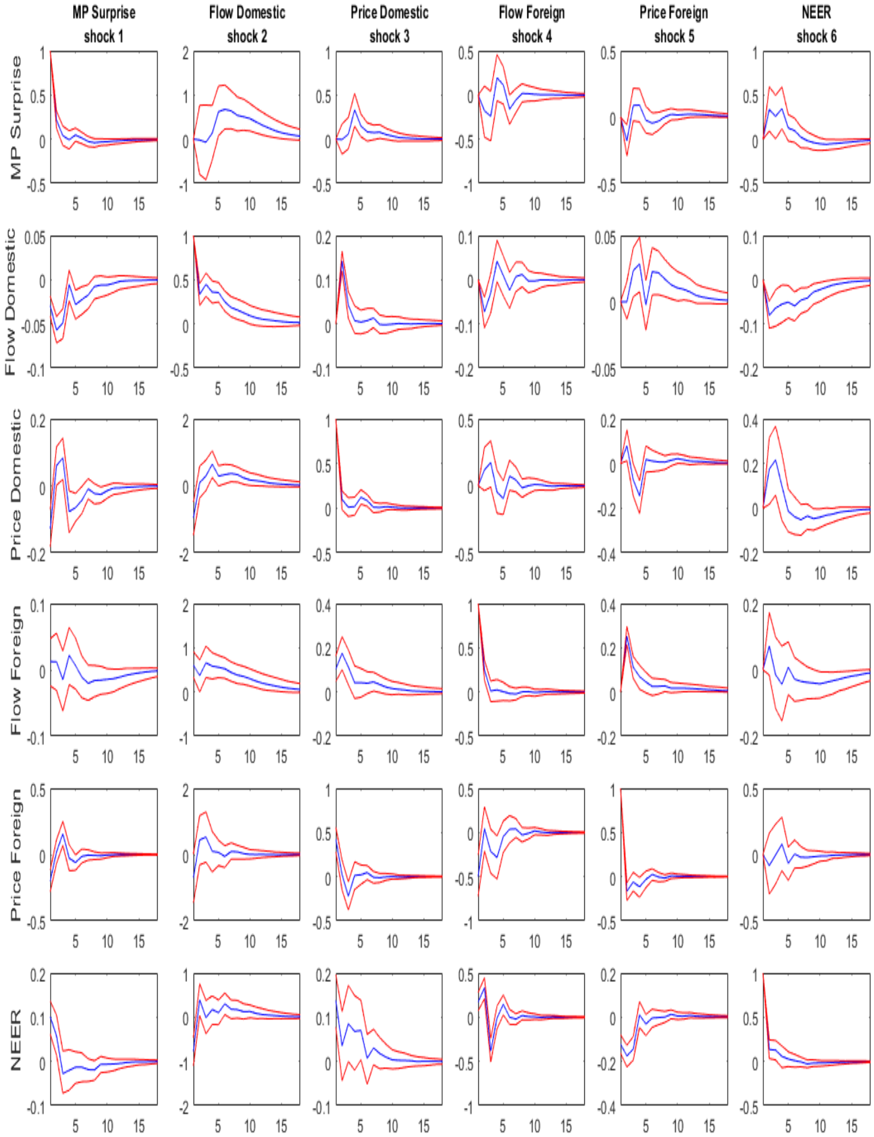


Figure 2-26: Instantaneous Response to Monetary Surprise, in UK Domestic and Foreign Bonds.

The impact of monetary surprise illustrated by instantaneous impulse response in six-variable VAR identified by a Cholesky ordering with the monetary surprise first, domestic flow second, domestic return third, foreign flow fourth , foreign price fifth and NEER last. The 84 percentile bands are shown.

2.5.2 The Bond Market and the Equity Market in an Open Economy

Traditionally, equity markets and bond markets move in opposite directions i.e. when economic risk is low equity is more attractive, whereas bonds are the preferred choice during periods of high risk (NLD Bank, 2015). This is clear in our basic data analysis in Figure 2-6. We set up a six-variable VAR, which consists of monetary policy surprise, first principal component flows and prices in the bond market (corporate, others and global), first principal component of equity market flows and prices and the log difference of NEER.

It is evident from Figure 2-27 that tightening monetary policy will decrease bond market flows and decrease prices, and have a positive impact on the equity market; we can see a drop in price in the equity market as well. These results are in line with a recent study by Banegas et al. (2016) into the US data. They look at the impact of monetary policy tightening on bond and equity markets in mutual funds and conclude that a rise in rate will cause outflows from bonds and inflows into equity markets. Furthermore, the fall in the price of equity is consistent with literature that monetary policy tightening will decrease equity prices - see Michael Ehrmann and Marcel Fratzscher (2004), Bernanke (2003) and Laeven and Tong (2010).

Furthermore, a shock to both flows and prices in the bond market increases equity prices and reduces equity flows. In contrast, a shock to equity flows and prices will cause an outflow from the bond market and falling prices for the first 3 months. The increases in the NEER show that the price of equity increases and this leads to a boost in equity flows and a reduction in bond flows and increases in prices.

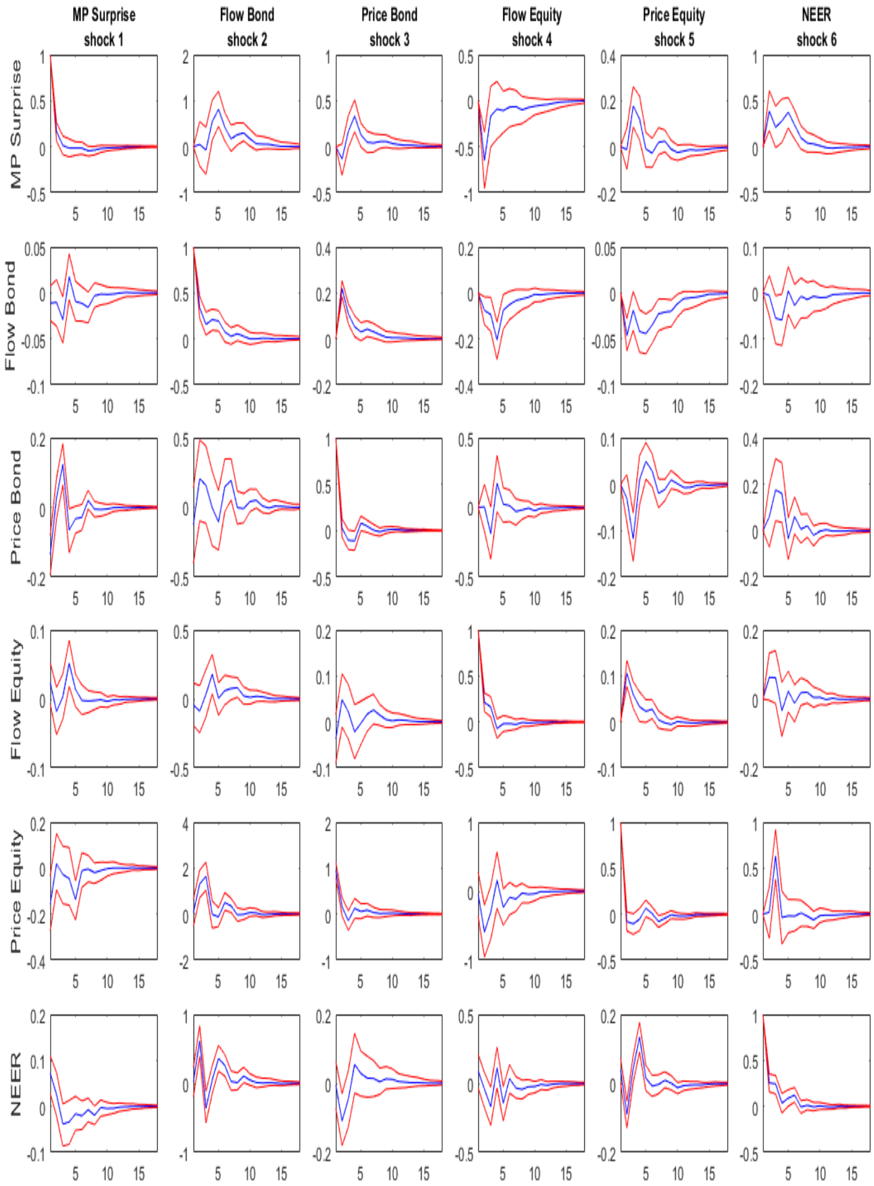


Figure 2-27: Instantaneous Response to Monetary Surprise in the Bonds and Equity Markets.

2.6 Robustness checks

We redo the main result using wider categories of bonds and daily frequency data from November 2013 to September 2016, as a response to the issue of using monthly frequency. We are estimating bivariate VAR (part 2.4.1.) and then trivariate VAR (2.4.3) using daily data and looking at the impact of monetary policy in the bond market. We also scrutinise the open economy results by employing sign restriction VAR and look at the impact of monetary policy on domestic and foreign bonds. The source of daily data is Thomson Reuter Eikon's global flow.

2.6.1 Bivariate VAR Result from Daily Data

To see the discrepancy between our estimation in bivariate VAR and that of Feroli et al. (2014), we use a wider category of bond, daily frequency and estimated bivariate VAR from November 2013 to September 2016. The setup for the VAR is the same as it was for monthly data. We set 4-day lags rather than the 4-month lags in the monthly data, and Cholesky decomposition was used for identification as well as a 90 days accumulation of past fund flows, normalised by the asset control indicator that proxies for sustained fund accumulation. The impulse response is shown over 18 days rather than 18 months. Two selected categories, corporate and global bond outcomes for the daily study, are presented below in Figures 2-28 and 2-29. As these figures demonstrate, using daily data with more comprehensive bond data categories, we do not see any feedback effect in our analysis.

The full daily impulse response figures for all categories in the bond and equity markets can be found in appendix F.

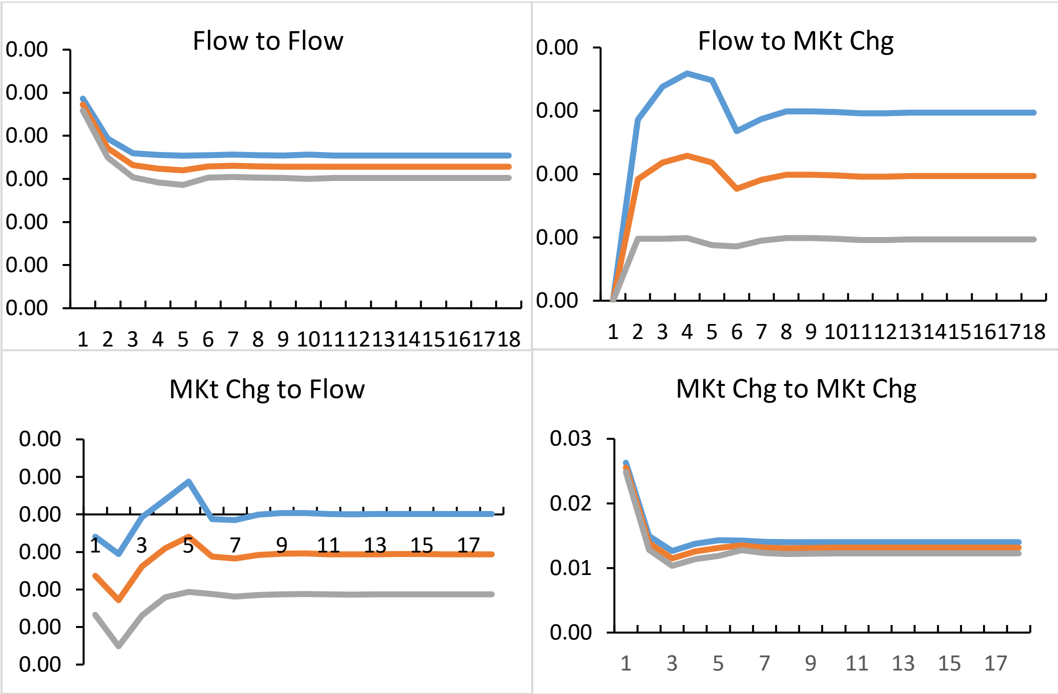


Figure 2-28: Corporates bonds

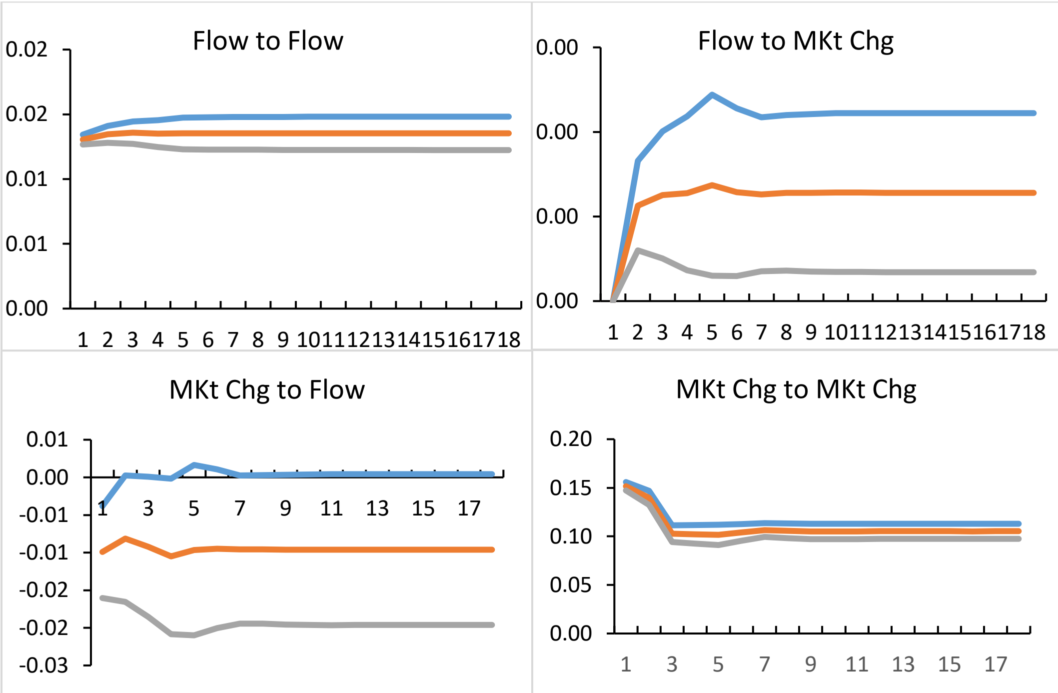


Figure 2-29: Global bonds

2.6.2 Trivariate VAR, Result from the Daily Data

We also check a three-variable VAR that looks at the impact of monetary policy, using data from Bloomberg. In this exercise we are using daily frequency from November 2013 to September 2016 with wider categories of bonds, which include Emerging Markets Global LC, Bond GBP, Corporates, GB High Yield, Global and Global High Yield.

Daily result

The setup is the same as in the main analysis trivariate VAR in part 2.4.3. However in this scenario we are using daily data. Therefore we measure monetary policy surprise as follows: we estimate the daily monetary policy surprise by filtering a daily monetary shock against the policy announcement date (i.e., in a day with policy we take the shock; otherwise we put zero). This daily monetary policy along with first principal components of flow and prices will create a system of trivariate VAR, as in the main part.

In Figure 2-30, the impact of monetary policy on flow and prices for both models is presented. The monthly main estimation impulse response (benchmark model) top row in Figure 2-23 is similar to the daily data lower row.

In particular, because of tightening monetary policy we can see an outflow and a fall in price in the bond market. Using comprehensive bond categories, the high frequency shorter time span confirms our original results. In addition, the initial negative response in prices is intuitively correct: as the yield rises in line with monetary policy the price should fall. This confirms that monetary policy transmission channels work as the model predicted: monetary policy can cause outflows and a price decrease.

The overall picture of the daily response is in Figure 2-31. This is the equivalent to Figure 2-23, however, the magnitude and statistical significance is slightly different. This could be because we are using a different dataset.

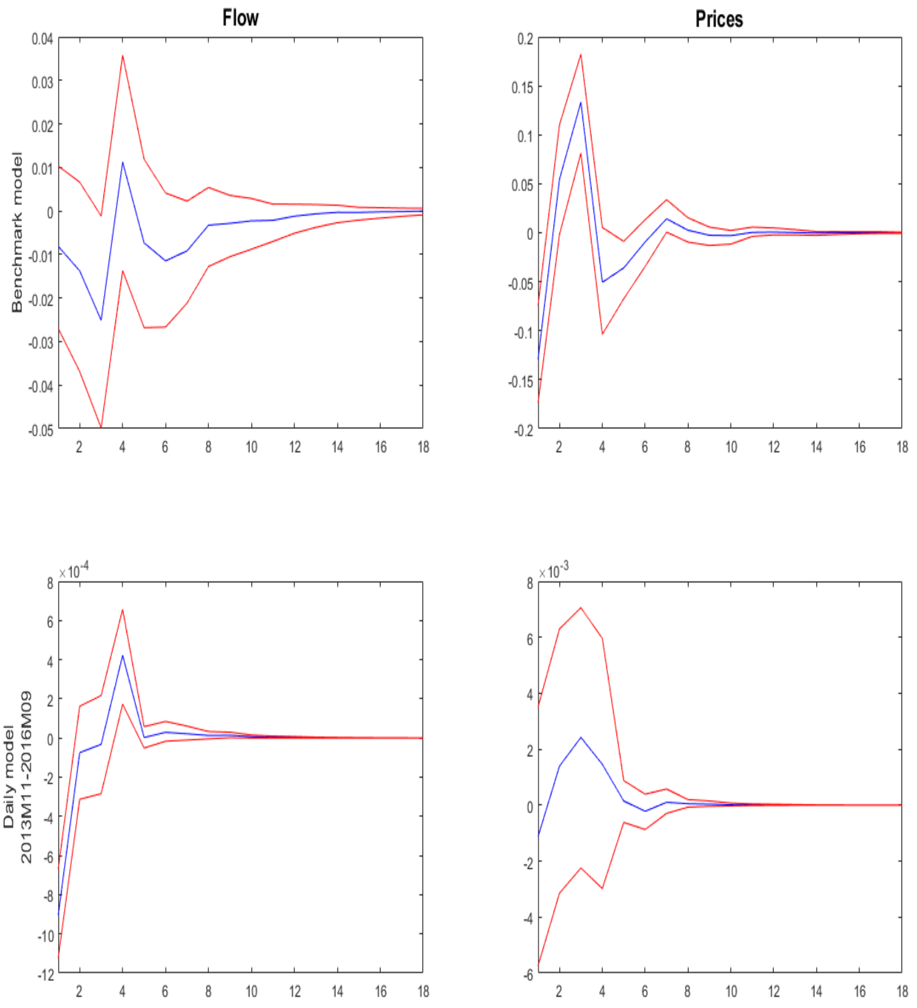


Figure 2-30: Response to Monetary Surprise, three model comparison

The impact of monetary policy on flow and price for IMA data (2005m1 to 2015M12) and daily (01/11/13-30/09/16).

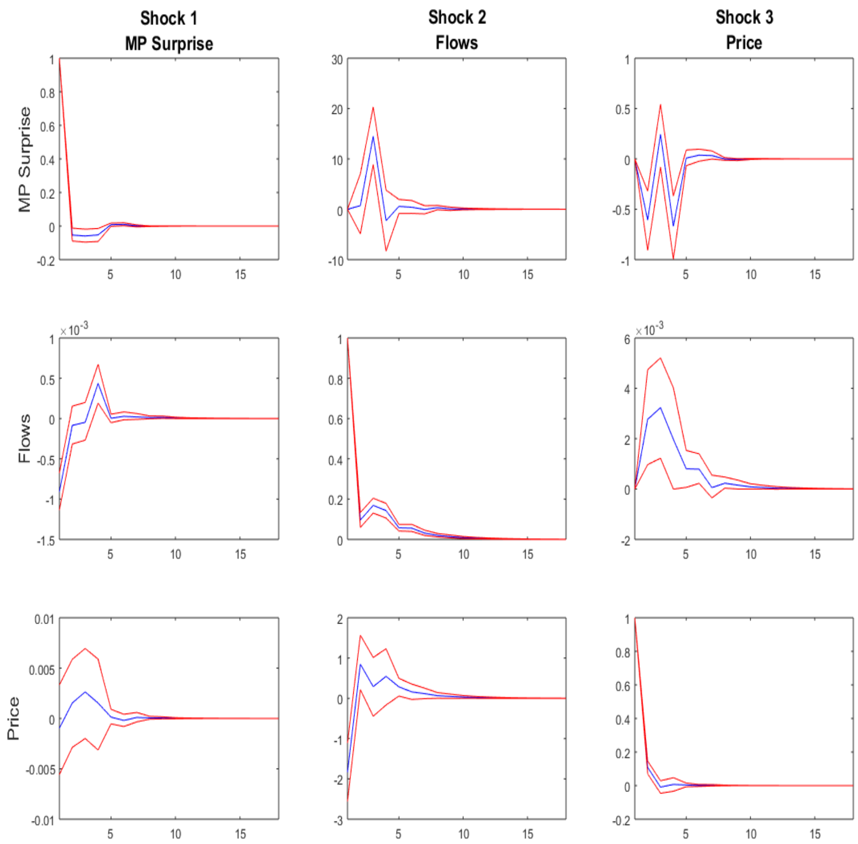


Figure 2-31: Response to Monetary Surprise: Daily data (01/11/13-30/09/16)

The impact of monetary surprise illustrated by Instantaneous impulse response in three-variable VAR identified by a Cholesky ordering with the monetary surprise first, flow second and return third. The 84 percentile bands are shown.

2.6.3 Sign restriction results

We further test the impact of monetary policy in an open economy. In this we are checking the impact of monetary policy on domestic and foreign bonds by imposing sign restriction following Mumtaz et al. (2009). (+) indicates a positive, (-) shows a negative impact and (x) is a free estimate in the foreign block.

In this model, we try to find how domestic flow and foreign bonds will respond to the monetary policy shock. In this we only restrict monetary policy, price of domestic bonds and NEER. We are uncertain about domestic bond flows, foreign bonds flow, and price. Thus, we did not restrict them. This test is shown below.

- MP = Monetary surprise
- Flow. D= Flows domestic bond
- Price. D= Price Domestic bond
- Flow. F= Flows foreign bond
- Price. F= Price Foreign bond
- NEER = Nominal effective exchange rate

Model Restriction:

	MP	*Flow D.*	*Price. D*	*Flow F.*	*Price F.*	*NEER*
MP shock	+	x	-	x	x	+

Therefore, a monetary surprise shock (+) is associated with falling bond prices (-) and increases in the nominal-effective exchange rate (+). The impact on domestic bond flows, foreign bonds flows, and prices will be determined in the model (x). Figure 2-32 shows the outcome of impulse response.

Imposing sign restriction shows that a surprise tightening of monetary policy leads to an immediate and statistically significant decrease in domestic bond flows. This confirms that bond flows decrease and price falls are in line with expectations as the investor may rush to redeem funds to avoid portfolio losses due to unexpected increases in interest rates (ICI, 2016).

Foreign bond flows on average are decreasing but statistically less significantly and there is a wide uncertainty around it. If we consider that as a result of domestic monetary policy shock people will switch to global bonds, then one explanation of this could that the initial fall in price in the bond market makes investors worry about portfolio loss and start redeeming from the fund. This, combined with the appreciation of the pound sterling, makes sterling denominated assets less attractive to new international investors. Although the price increases over time and probably attracts new investors, due to uncovered interest rate parity (UIP) falls in the expected exchange rate, current investors shift to global bonds to diversify their portfolio and prevent losses.

Overall the results confirm our earlier results in section 2.5.1, The Bond Market in an Open Economy, and in particular figure 2-25. This is also in line with expectations of first mover advantage and confirms the key model implication of Feroli et al. (2014) and the results of Cohen and Shin (2002). In this, a monetary policy shock can drive flows and flows can drive prices, which supports the transmission channels.

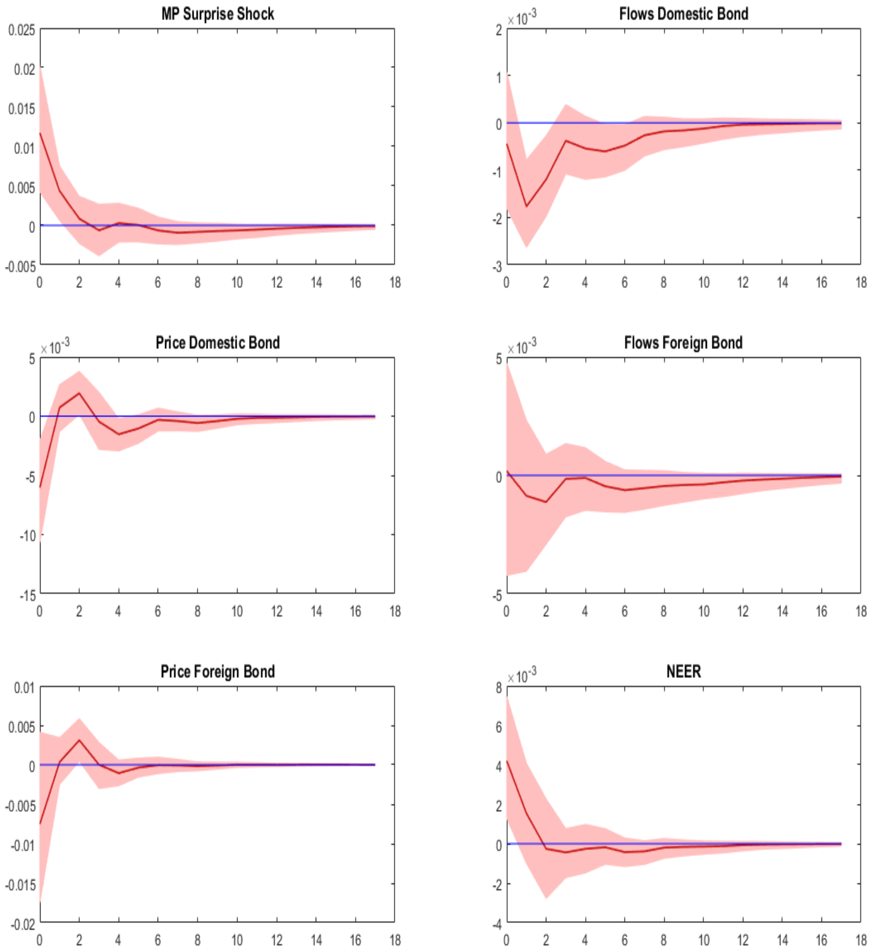


Figure 2-32: Instantaneous Response to Monetary Surprise using Sign Restriction *

*Note: Restriction imposed just on Price domestic (-) and NEER (+) while Flows domestic, Flow foreign and Price foreign in the model is unrestricted.

2.7 Conclusion

In this chapter, we investigated the feedback effect in the bond and equity markets following Feroli et al. (2014), using IMA data for the UK. We used bivariate VAR and tested the first hypothesis of the model in which there is positive feedback between fund flows and price. We only observed the response of flows to prices, and only four sectors in the equity market showed a very weak positive feedback effect. We were unable to observe a full feedback effect in the bond market in our dataset. In other words, we do not observe any response in prices because of a shock in flows. We tested the same model using daily rather than monthly data. The result did not change, and the daily data confirms the outcome for the monthly set. Therefore, we are unable to confirm the first hypothesis of the model.

Next, we measured monetary policy surprise using Wright's methodology (2012) using high-frequency data to assess the impact of monetary policy on flows and price, which is the second model implication. In the three variable model VAR a surprise tightening of monetary policy leads to outflows and a fall in prices. This is a confirmation of the second hypothesis and in line with Feroli et al. (2014). We could see the transmission channels as the model predicted, with monetary policy influencing both flows and prices. In the same framework, our results showed that flows respond positively to price shock which is in line with literature such as Chevalier and Ellison (1997), Sirri and Tufano (1998) and Feroli et al. (2014). This shows that price is an incentive for the majority of the fund inflows. However, prices respond negatively initially to flow shocks, which is in direct contrast to the positive response found in the US data by Feroli et al. (2014).

Further, we scrutinise our result by testing with a different data set and wider categories of bonds. We used a daily frequency but a shorter time span and the result holds.

We demonstrated how investors would respond by shifting their balances from domestic to foreign bonds, or vice versa. Due to tightening monetary policy, we can see outflow from domestic bonds while the foreign bonds response is ambiguous. We also checked our result using sign restriction: the result did not change in domestic bonds while foreign bond flows became less significant and were falling. The result for domestic bonds is line with the model prediction and Joyce et al. (2011).

We further established how investors in the UK allocate their assets between equities and bonds due to monetary policy shock. As result of monetary policy shock, we can see outflows from bonds into equities while the prices in both assets are falling in line with expectations. The switch between bonds and equities due to monetary policy is in line with a recent study by Banegas et al. (2016) at the Federal Reserve. This may be a sign of first mover advantage in the bond market predicted by Feroli et al. (2014).

Falls in equity prices are consistent with Michael Ehrmann and Marcel Fratzscher (2004), Bernanke (2003) and Laeven and Tong (2010). They found that as a result of tightening monetary policy, equity price falls.

This chapter contributes to the policy debate on the risk of financial instability coming from asset management and possible contagion of the real sector. For example, on 6 February 2018 market participants expected interest rates to rise and shifted their assets from equities to bonds and other assets. This wiped about 4 trillion US dollars from the world’s stock markets within a week (Reuters 6 Feb 2018). This is in line with one of the predictions of the extension of the model that investors may switch to bonds when the interest rate goes up. Asset management has become an important player in the financial sector, triggering a structural shift that moves risk from banks to asset management.

Unlike the banking sector, which is regulated and scrutinised due to its role in the recent financial crisis, asset management is unregulated. The lack of regulation and risk of financial instability make regulators anxious, putting the topic at the heart of the policy debate.

Appendix A: Example of PDF file for data collection.

SECTOR SUMMARY DECEMBER 2015

	Funds Under Management £		Gross Sales £				Net Sales £			ISA^	ISA^	ISA^
INVESTMENT ASSOCIATION SECTOR	TOTAL	sector as % of total	TOTAL	sector as % of total	RETAIL	INSTITUTIONAL	TOTAL	RETAIL	INSTITUTIONAL	Funds Under Management £	Gross Sales £	Net Sales £
Asia Pacific Excluding Japan	24,369,650,696	2.5%	290,650,233	1.7%	264,090,495	26,559,738	-86,625,009	-14,773,672	-71,851,337	2,391,408,122	21,923,950	-5,162,945
Asia Pacific Including Japan	1,843,519,706	0.2%	16,337,394	0.1%	5,584,198	10,753,196	-36,683,213	-5,313,662	-31,369,551	419,402,947	694,113	-958,423
China/Greater China	1,561,546,173	0.2%	63,124,357	0.4%	58,827,948	4,296,409	33,448,288	31,215,483	2,232,805	375,942,893	1,537,586	-2,286,104
Europe Excluding UK	50,270,437,162	5.2%	925,941,326	5.4%	733,351,657	192,589,669	314,573,683	268,159,854	46,413,829	7,064,791,258	40,961,750	-12,246,929
Europe Including UK	2,167,778,369	0.2%	35,326,221	0.2%	23,296,631	12,029,590	15,448,457	10,361,868	5,086,589	535,478,853	708,854	10,875
European Smaller Companies	5,733,883,328	0.6%	243,821,693	1.4%	240,889,392	2,932,301	101,230,589	100,286,918	943,671	417,561,370	6,413,761	2,669,962
Global	78,467,168,859	8.1%	925,505,757	5.4%	658,774,102	266,731,655	-54,036,465	45,986,447	-100,022,912	11,471,748,018	63,493,515	-5,914,052
Global Emerging Markets	13,293,894,477	1.4%	274,073,510	1.6%	188,058,680	86,014,830	-13,536,537	3,769,136	-17,305,673	1,123,165,160	14,572,022	1,115,592
Global Equity Income	14,479,271,425	1.5%	400,591,697	2.3%	322,129,773	78,461,924	36,528,580	39,169,571	-2,640,991	2,307,513,054	23,942,526	1,978,385
Japan	15,371,349,215	1.6%	373,143,650	2.2%	278,755,147	94,388,503	134,826,956	64,620,323	70,206,633	817,934,787	16,924,831	5,232,989
Japanese Smaller Companies	366,356,905	0.0%	9,333,765	0.1%	9,113,083	220,682	-8,095,914	5,278,263	-13,374,177	42,907,738	1,673,106	968,703
North America	37,788,255,205	3.9%	867,513,183	5.0%	675,576,912	191,936,271	-64,362,662	-21,720,431	-42,642,231	2,624,287,336	36,064,441	1,525,016
North American Smaller Companies	1,511,868,128	0.2%	30,091,702	0.2%	28,933,561	1,158,141	-15,041,554	-13,993,045	-1,048,509	239,686,128	2,052,093	-233,876
Specialist	38,638,843,124	4.0%	478,872,712	2.8%	314,464,192	164,408,520	-25,983,953	-30,391,410	4,407,457	2,724,535,020	18,817,534	-5,754,208
Technology and Telecommunications	949,650,639	0.1%	30,214,869	0.2%	26,412,376	3,802,493	-21,424,165	-17,852,402	-3,571,763	254,973,993	2,589,856	-4,483,857
UK All Companies	163,774,231,881	16.9%	2,016,168,192	11.7%	1,520,998,857	495,169,335	142,150,225	128,158,404	13,991,821	34,044,104,694	172,494,194	-58,507,871
UK Equity Income	61,049,424,291	6.3%	1,190,909,088	6.9%	989,051,736	201,857,352	491,631,534	441,579,954	50,051,580	12,513,678,707	137,447,229	53,390,667
UK Smaller Companies	12,629,012,758	1.3%	526,720,232	3.0%	205,471,527	321,248,705	364,388,227	75,935,805	288,452,422	2,404,596,351	32,827,442	9,469,938
Total Equity	**524,266,142,341**	**54.0%**	**8,698,339,581**	**50.4%**	**6,543,780,267**	**2,154,559,314**	**1,308,437,067**	**1,110,477,404**	**197,959,663**	**81,773,716,429**	**595,138,803**	**-19,186,138**
Global Emerging Markets Bond	2,073,548,436	0.2%	113,692,661	0.7%	13,570,809	100,121,852	-137,028,458	-77,903,691	-59,124,767	55,255,095	960,115	-158,988
£ Corporate Bond	55,319,185,373	5.7%	643,690,030	3.7%	499,905,996	143,784,034	21,903,143	66,688,674	-44,785,531	9,576,867,215	47,684,734	-26,439,202
£ High Yield	8,517,299,955	0.9%	112,378,056	0.7%	98,595,683	13,782,373	-143,212,487	-143,377,341	164,854	1,910,559,423	12,461,959	-7,906,447
£ Strategic Bond	31,853,740,487	3.3%	872,706,677	5.1%	475,575,812	397,130,865	230,337,437	26,762,058	203,575,379	6,804,172,493	58,619,565	-9,713,523
Global Bonds	12,406,002,159	1.3%	262,912,075	1.5%	221,858,513	41,053,562	-10,002,337	11,207,842	-21,210,179	1,222,471,922	11,867,795	-3,193,318
UK Gilts	17,466,356,531	1.8%	258,795,837	1.5%	181,179,934	77,615,903	-209,250,559	37,868,698	-247,119,257	456,736,379	8,123,377	1,673,939
UK Index Linked Gilts	4,585,951,159	0.5%	83,701,912	0.5%	74,152,672	9,549,240	24,452,395	30,852,859	-6,400,464	334,122,685	4,628,358	106,842
Total Fixed Income	**132,222,084,100**	**13.6%**	**2,347,877,248**	**13.6%**	**1,564,839,419**	**783,037,829**	**-222,800,866**	**-47,900,901**	**-174,899,965**	**20,360,185,212**	**144,345,903**	**-45,630,697**
Money Market	1,327,626,317	0.1%	48,333,134	0.3%	39,592,038	8,741,096	11,316,587	3,633,881	7,682,706	64,139,292	5,146,422	286,817
Short Term Money Market	5,720,103,671	0.6%	799,076,973	4.6%	109,800,340	689,276,633	30,393,262	41,048,250	-10,654,988	134,856,261	6,618,132	3,687,905
Total Money Markets	**7,047,729,988**	**0.7%**	**847,410,107**	**4.9%**	**149,392,378**	**698,017,729**	**41,709,849**	**44,682,131**	**-2,972,282**	**198,995,553**	**11,764,554**	**3,974,722**
Flexible Investment	17,790,413,164	1.8%	175,417,003	1.0%	156,725,032	18,691,971	-22,905,447	-16,681,086	-6,224,361	2,936,561,441	17,794,629	-8,647,375
Mixed Investment 0-35% Shares	5,012,077,243	0.5%	110,045,644	0.6%	100,906,143	9,139,501	-197,663,448	25,439,790	-223,103,238	1,171,695,383	12,634,888	5,756,953
Mixed Investment 20-60% Shares	41,215,972,161	4.2%	714,615,363	4.1%	641,032,184	73,583,179	124,720,336	154,821,263	-30,100,927	9,952,255,747	88,356,979	-3,031,048
Mixed Investment 40-85% Shares	53,027,864,020	5.5%	625,225,773	3.6%	400,156,348	225,069,425	229,820,749	116,049,986	113,770,763	8,163,407,590	58,319,356	3,911,347
UK Equity and Bond Income	2,417,151,678	0.2%	28,739,044	0.2%	26,749,692	1,989,352	7,844,546	10,025,439	-2,180,893	1,044,237,362	4,713,527	-1,223,587
Total Mixed Asset	**119,463,478,266**	**12.3%**	**1,654,042,827**	**9.6%**	**1,325,569,399**	**328,473,428**	**141,816,736**	**289,655,392**	**-147,838,656**	**23,268,157,523**	**181,819,379**	**-3,233,710**
Property	29,156,031,932	3.0%	699,878,651	4.1%	575,694,039	124,184,612	209,627,981	151,015,029	58,612,952	3,172,569,254	52,211,152	18,217,175
Total Property	**29,156,031,932**	**3.0%**	**699,878,651**	**4.1%**	**575,694,039**	**124,184,612**	**209,627,981**	**151,015,029**	**58,612,952**	**3,172,569,254**	**52,211,152**	**18,217,175**
Targeted Absolute Return	56,050,830,851	5.8%	1,840,759,461	10.7%	781,899,039	1,058,860,422	1,213,617,394	374,289,252	839,328,142	1,487,820,932	31,337,924	8,901,689
Personal Pensions	1,169,246,764	0.1%	7,535,939	0.0%	0	7,535,939	2,277,388	0	2,277,388	0	0	0
Protected	1,418,921,154	0.1%	2,738,842	0.0%	2,624,270	114,572	-50,457,232	-45,716,963	-4,740,269	438,995,727	233,334	-9,151,764
Unclassified Sector	100,105,543,560	10.3%	1,170,941,842	6.8%	551,717,874	619,223,968	324,884,162	23,267,714	301,616,448	9,284,002,435	64,780,584	-27,093,104
Total Others	**158,744,542,329**	**16.4%**	**3,021,976,084**	**17.5%**	**1,336,241,183**	**1,685,734,901**	**1,490,321,712**	**351,840,003**	**1,138,481,709**	**11,210,819,094**	**96,351,842**	**-27,343,179**
UK Total	**970,900,008,956**	**100.0%**	**17,269,524,498**	**100.0%**	**11,495,516,685**	**5,774,007,813**	**2,969,112,479**	**1,899,769,058**	**1,069,343,421**	**139,984,443,065**	**1,081,631,633**	**-73,201,827**
Targeted Absolute Return - Offshore	7,090,561,771	8.0%	247,312,363	9.9%	167,233,568	80,078,795	-18,639,165	92,046,848	-110,686,013	0	0	0
Total Overseas	**88,785,208,106**	**100.0%**	**2,490,326,305**	**100.0%**	**1,821,588,025**	**668,738,280**	**-363,014,027**	**-404,139,524**	**41,125,497**	**223,234,917**	**601,357**	**-3,389,122**
Grand Total	**1,059,685,217,062**	**-**	**19,759,850,803**	**-**	**13,317,104,710**	**6,442,746,093**	**2,606,098,452**	**1,495,629,534**	**1,110,468,918**	**140,207,677,982**	**1,082,232,990**	**-76,590,949**

Notes:
(1) All sales and repurchases of funds of funds are included. To avoid double counting, transactions between funds of funds and their underlying funds are excluded.
(2) Industry funds under management includes money invested in the underlying funds in which funds of funds invest, but excludes money invested in funds of funds themselves (other than funds of overseas funds) to avoid double-counting.
(3) ^ISA figures are based on ISAs provided by fund companies and five platforms (Cofunds, Fidelity, Hargreaves Lansdown, Skandia and Transact). The figures do not include ISAs provided by other platforms or where the ISA provider is an intermediary other than a platform. ISA figures include FOFs.
(4) ISA figures exclude a small number of funds held on fund platforms but not in an sector. These are, however, included in Table 6 and all relevant tables in The Investment Association's monthly press release, unless otherwise footnoted.
(5) On 1st January 2012 some of the sectors changed their names - 'Flexible Investment' was previously 'Active Managed', 'Mixed Investment 40-85% Shares' was previously called 'Balanced Managed', 'Mixed Investment 20-60% Shares' was previously called 'Cautious Managed'
(6) The asset type 'Fixed Income' was previously called 'Bond'. The 'Mixed Asset' was previously called 'Balanced'.
(7) Until June 2013 the 'Targeted Absolute Return' sector was known as the 'Absolute Return' sector.
(8) The 'Global Emerging Markets Bond' sector launched in January 2014.
(9) From March 2014, the FUM of mixed asset funds is reduced and the FUM of other funds is increased due to funds re-classified from the Mixed Asset sectors to the Unclassified sector.

Appendix B: Summary statistics

Table 1: funds under management for each category in equity and bond markets (figure in £billion)

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Asia Pacific Excluding Japan	20.9	23.3	30.5	8.1	6.6	131.0
Asia Pacific Including Japan	1.4	1.4	2.1	0.7	0.4	131.0
Europe Excluding UK	33.4	32.4	50.3	20.8	6.5	131.0
Europe Including UK	2.5	2.3	4.1	1.4	0.7	131.0
European Smaller Companies	3.0	2.8	5.7	1.3	1.0	131.0
Global Emerging Markets	10.9	10.0	20.1	3.4	5.0	131.0
Japan	8.5	7.8	14.6	5.6	2.2	131.0
Japanese Smaller Companies	0.4	0.3	1.1	0.2	0.2	131.0
North America	21.1	19.5	38.0	11.8	7.8	131.0
North American Smaller Companies	1.1	1.0	1.7	0.6	0.3	131.0
Specialist	21.6	21.8	39.5	6.9	8.4	131.0
Technology and Telecommunications	0.8	0.8	1.3	0.5	0.2	131.0
UK All Companies	111.9	105.4	173.1	67.1	26.7	131.0
UK Equity Income	49.2	53.0	73.3	20.5	13.0	131.0
UK Smaller Companies	8.4	8.2	12.6	4.0	2.2	131.0
Other Equity	51.4	50.2	98.7	17.0	24.7	131.0

Total Equity	346.6	326.3	543.7	198.5	93.7	131.0
Corporate Bond	44.4	46.3	60.8	24.7	10.9	131.0
Global Bonds	9.6	10.4	18.3	2.8	4.6	131.0
UK Gilts	15.4	16.3	22.6	4.0	5.1	131.0
UK Index Linked Gilts	3.3	3.5	5.0	1.0	1.0	131.0
Other Fixed Income	26.4	25.9	45.6	10.3	11.9	131.0
Total Fixed Income	99.2	101.1	143.1	42.9	30.3	131.0

Table 2: correlation between flows in equity categories and bond markets categorise before crisis (2005m2-2007M2)

	LFL1	LFL2	LFL3	LFL4	LFL5	LFL6	LFL7	LFL8	LFL9	LFL10	LFL11	LFL12	LFL13	LFL14	LFL15	LFL16	LFL17	LFL18	LFL19	LFL20	LFL21	LFL22	LFL23
LFL1	1.00																						
LFL2	0.07	1.00																					
LFL3	0.25	-0.11	1.00																				
LFL4	0.50	0.19	0.28	1.00																			
LFL5	0.70	0.14	0.50	0.49	1.00																		
LFL6	0.05	-0.06	-0.30	0.02	0.04	1.00																	
LFL7	0.47	0.07	0.06	0.50	0.28	0.11	1.00																
LFL8	-0.07	-0.04	0.29	0.10	0.15	-0.03	0.09	1.00															
LFL9	0.22	-0.07	0.50	0.10	0.11	-0.38	0.26	-0.04	1.00														
LFL10	0.16	0.46	-0.09	0.21	0.07	0.14	0.23	-0.39	0.04	1.00													
LFL11	-0.03	-0.27	0.28	0.01	-0.16	-0.12	0.02	0.12	0.27	-0.08	1.00												
LFL12	0.10	0.18	0.16	0.25	-0.03	-0.27	0.30	-0.04	0.36	0.20	0.53	1.00											
LFL13	0.24	0.05	0.35	0.19	0.31	0.03	-0.14	0.09	0.23	0.08	-0.24	0.02	1.00										
LFL14	0.35	-0.06	0.57	-0.07	0.38	-0.12	-0.22	0.29	0.17	-0.36	0.22	-0.10	0.17	1.00									
LFL15	0.01	-0.15	0.63	0.00	0.28	-0.27	-0.05	0.39	0.39	-0.01	0.14	0.01	0.48	0.35	1.00								
LFL16	0.16	0.16	0.17	0.10	0.16	-0.14	-0.18	-0.13	0.26	0.10	-0.26	-0.05	0.56	0.09	0.03	1.00							

LFL17	0.48	-0.04	0.67	0.36	0.51	-0.07	0.09	0.18	0.50	0.04	0.15	0.27	0.82	0.43	0.52	0.56	1.00						
LFL18	-0.06	0.42	0.04	0.27	0.13	0.01	0.33	0.19	-0.15	0.23	-0.24	0.34	0.03	-0.13	-0.10	-0.10	-0.02	1.00					
LFL19	0.14	-0.16	-0.43	0.09	-0.25	-0.05	0.18	-0.18	-0.06	0.15	-0.25	-0.06	0.03	-0.36	-0.29	0.24	-0.07	-0.28	1.00				
LFL20	-0.01	0.03	-0.06	0.19	-0.24	0.28	-0.02	-0.28	-0.03	0.25	-0.08	0.15	0.25	-0.02	-0.09	0.38	0.22	-0.05	0.38	1.00			
LFL21	-0.27	0.06	-0.17	-0.30	-0.12	-0.03	-0.38	0.17	0.09	-0.07	-0.17	-0.34	-0.04	-0.13	0.14	0.16	-0.13	-0.31	-0.01	-0.23	1.00		
LFL22	-0.26	-0.24	0.19	-0.21	0.08	-0.23	-0.26	0.27	-0.01	-0.37	0.12	-0.15	-0.07	0.23	0.26	-0.23	-0.03	-0.01	-0.27	-0.39	0.19	1.00	
LFL23	-0.18	0.23	-0.15	0.21	-0.13	0.04	0.14	0.09	-0.16	0.23	-0.36	0.20	0.15	-0.23	-0.12	0.18	0.03	0.64	0.30	0.46	-0.06	0.14	1

Equity Market: LF1: Asia Pacific Excluding Japan, LF2 Asia Pacific Including Japan, LF3 Europe Excluding UK, LF4 Europe Including UK, LF5 European Smaller Companies LF6 Global Emerging Markets, LF7 Japan, LF8 Japanese Smaller Companies, LF9 North America, LF10 North American Smaller Companies LF11 Specialist, LF12 Technology and Telecommunications, LF13 UK All Companies, LF14 UK Equity Income, Lf15 UK Smaller Companies, Lf16 Other ,LF17 Total equity

Bond Market: Lf18 £ Corporate Bond, Lf19 Global Bonds, LF20 UK Gilts, LF21 UK Index Linked Gilts, Lf22 Other Fixed Income LF23Total Bond

Table 3: correlation between flows in equity categories and bond market categories post crisis (2007m2-2015M12)

	LFL1	LFL2	LFL3	LFL4	LFL5	LFL6	LFL7	LFL8	LFL9	LFL10	LFL11	LFL12	LFL13	LFL14	LFL15	LFL16	LFL17	LFL18	LFL19	LFL20	LFL21	LFL22	LFL23
LFL1	1.00																						
LFL2	0.12	1.00																					
LFL3	-0.27	-0.08	1.00																				
LFL4	0.06	0.07	0.01	1.00																			
LFL5	-0.07	0.02	0.47	0.22	1.00																		
LFL6	0.41	0.20	-0.08	0.06	0.15	1.00																	

LFL7	-0.37	0.07	0.36	0.06	0.19	-0.17	1.00																
LFL8	-0.13	0.11	0.17	0.22	0.16	0.00	0.26	1.00															
LFL9	-0.01	0.16	0.12	0.10	0.05	0.23	0.11	0.12	1.00														
LFL10	0.06	0.20	-0.04	-0.08	0.13	0.05	0.09	0.09	0.26	1.00													
LFL11	0.09	0.11	0.11	-0.07	0.16	0.14	-0.07	-0.12	-0.02	0.22	1.00												
LFL12	0.05	0.13	0.05	0.16	0.06	0.25	0.17	0.08	0.25	0.16	0.05	1.00											
LFL13	-0.01	0.09	0.19	0.12	0.15	-0.17	-0.01	-0.16	0.06	-0.12	-0.05	0.08	1.00										
LFL14	-0.14	-0.25	0.23	-0.15	0.02	-0.12	0.06	-0.28	-0.13	-0.18	0.22	-0.17	0.02	1.00									
LFL15	-0.09	0.15	0.31	0.19	0.42	0.13	0.22	0.34	0.29	0.25	0.18	0.20	0.24	-0.13	1.00								
LFL16	0.18	0.09	0.00	0.26	-0.04	0.10	0.09	0.09	0.26	0.14	0.11	0.19	0.28	-0.04	0.33	1.00							
LFL17	0.11	0.13	0.54	0.23	0.41	0.14	0.23	0.16	0.34	0.07	0.18	0.24	0.60	0.10	0.48	0.40	1.00						
LFL18	0.37	0.13	-0.31	0.01	-0.16	-0.11	-0.27	-0.13	0.07	-0.06	-0.09	-0.04	0.02	-0.07	-0.11	0.05	-0.10	1.00					
LFL19	0.37	0.35	-0.13	0.12	0.23	0.33	-0.18	0.07	0.04	0.09	0.01	0.03	-0.01	-0.21	0.11	-0.05	0.08	0.29	1.00				
LFL20	-0.09	0.02	0.09	0.07	0.05	0.01	0.00	-0.07	-0.04	0.05	0.18	0.02	0.03	-0.11	0.10	0.00	0.07	-0.06	-0.02	1.00			
LFL21	0.11	-0.03	-0.18	0.05	-0.22	-0.03	-0.21	-0.15	-0.08	-0.14	0.00	-0.11	0.04	0.14	-0.15	0.07	-0.02	0.07	-0.03	-0.02	1.00		
LFL22	0.29	0.16	-0.06	-0.08	-0.03	0.13	-0.03	0.05	0.20	0.13	0.11	0.23	0.05	-0.18	0.19	0.19	0.15	0.16	0.15	-0.10	0.03	1.00	
LFL23	0.32	0.28	-0.25	0.03	-0.05	0.03	-0.24	-0.08	0.09	0.10	0.06	0.03	0.09	-0.15	0.15	0.10	0.02	0.74	0.44	0.27	0.11	0.40	1

Equity Market: LF1: Asia Pacific Excluding Japan, LF2 Asia Pacific Including Japan, LF3 Europe Excluding UK, LF4 Europe Including UK, LF5 European Smaller Companies LF6 Global Emerging Markets, LF7 Japan, LF8 Japanese Smaller Companies, LF9 North America, LF10 North American Smaller Companies LF11 Specialist, LF12 Technology and Telecommunications, LF13 UK All Companies, LF14 UK Equity Income, Lf15 UK Smaller Companies, Lf16 Other ,LF17 Total equity **Bond Market:** Lf18 £ Corporate Bond, Lf19 Global Bonds, LF20 UK Gilts, LF21 UK Index Linked Gilts, Lf22 Other Fixed Income LF23Total Bond.

Appendix C: Bivariate VAR impulse Figure monthly data

Impulse response from equity monthly data, Cholesky identification that do not show feedback effect

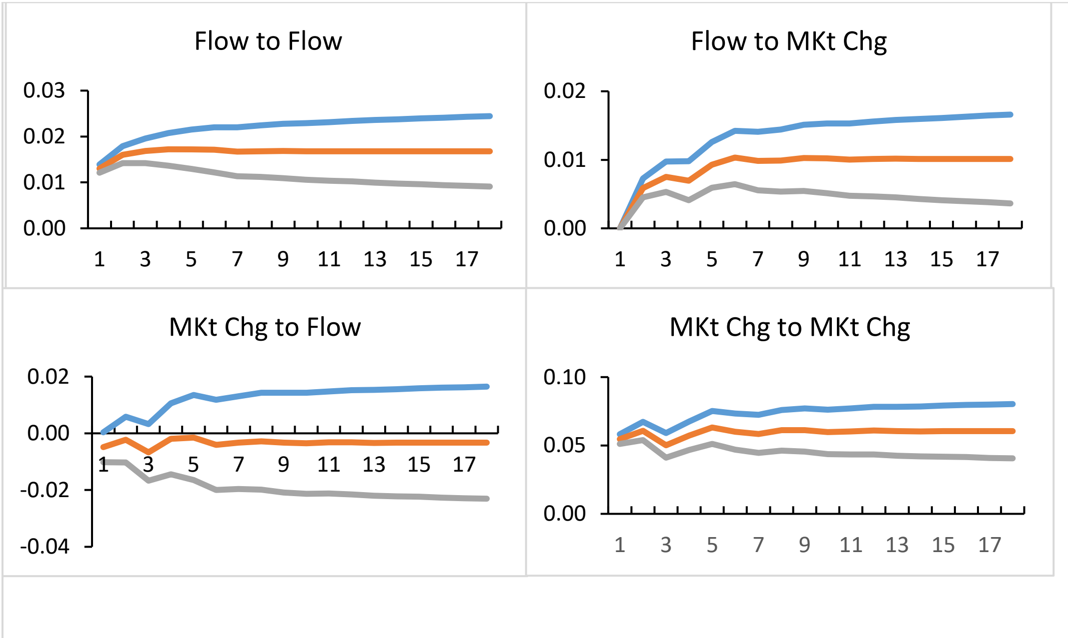


Figure 1: Asia Pacific Including Japan

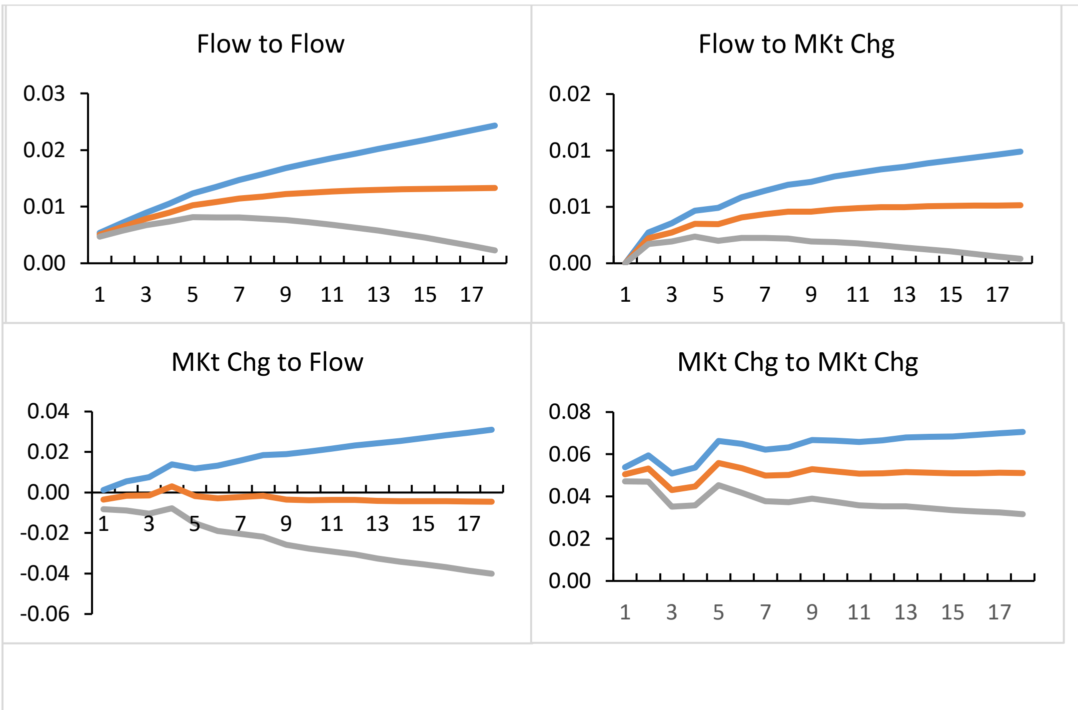


Figure 2: Europe Excluding UK

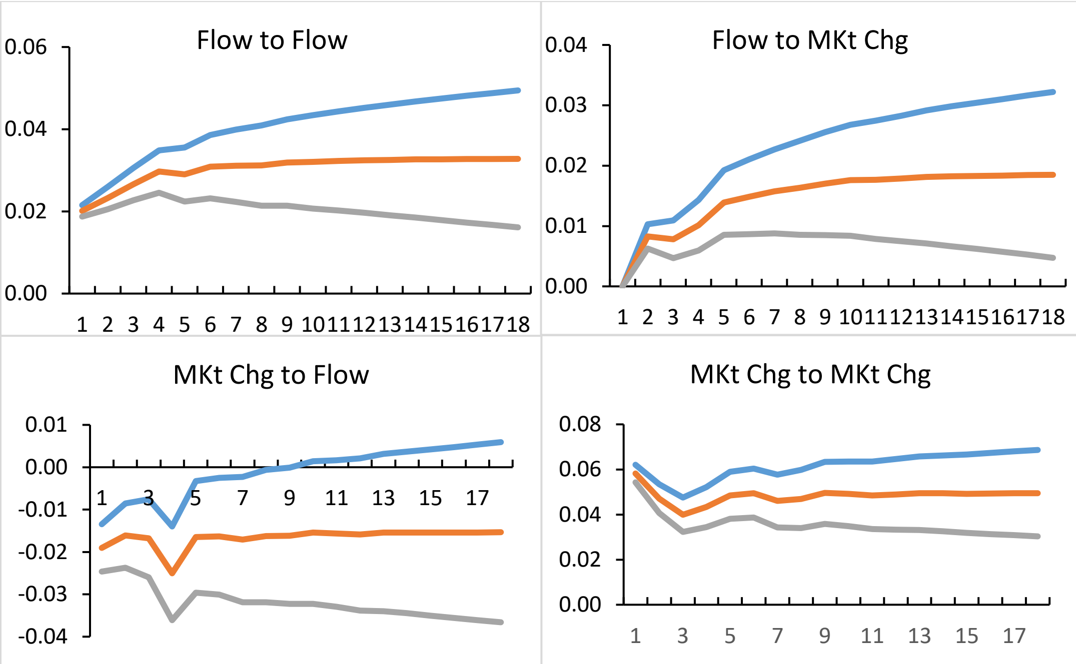


Figure 3: Europe Including UK

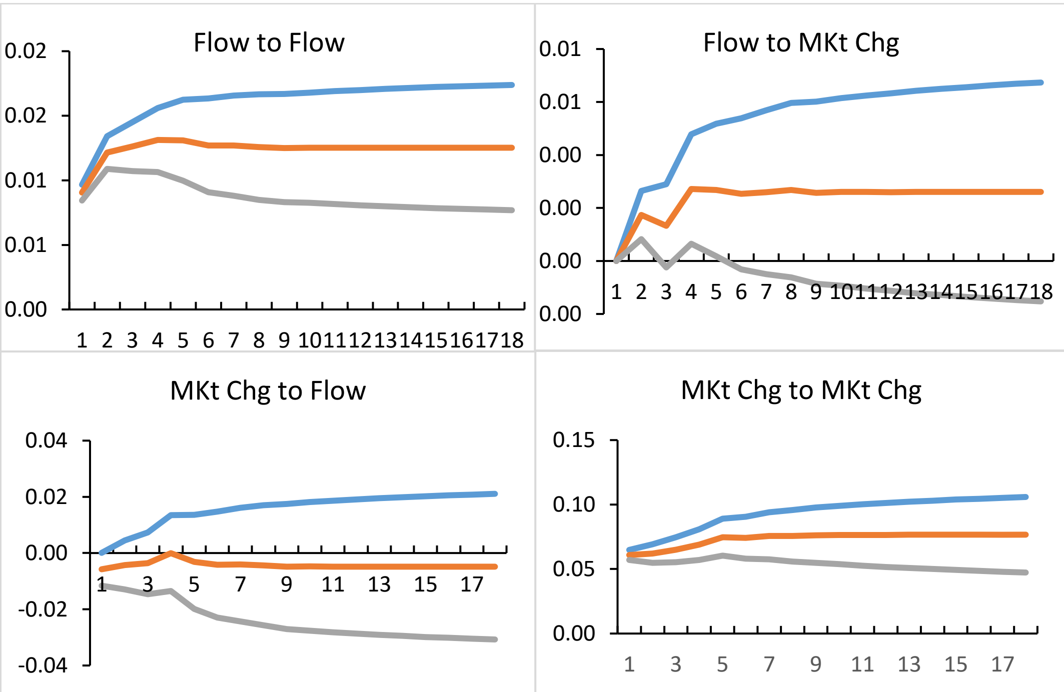


Figure 4: Global Emerging Markets

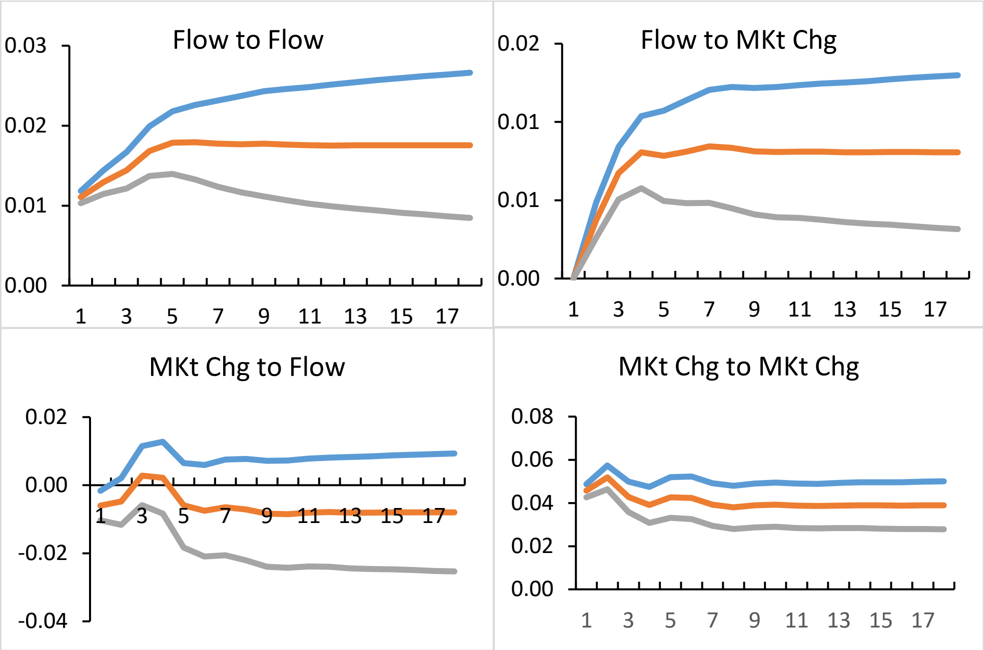


Figure 5: Japan

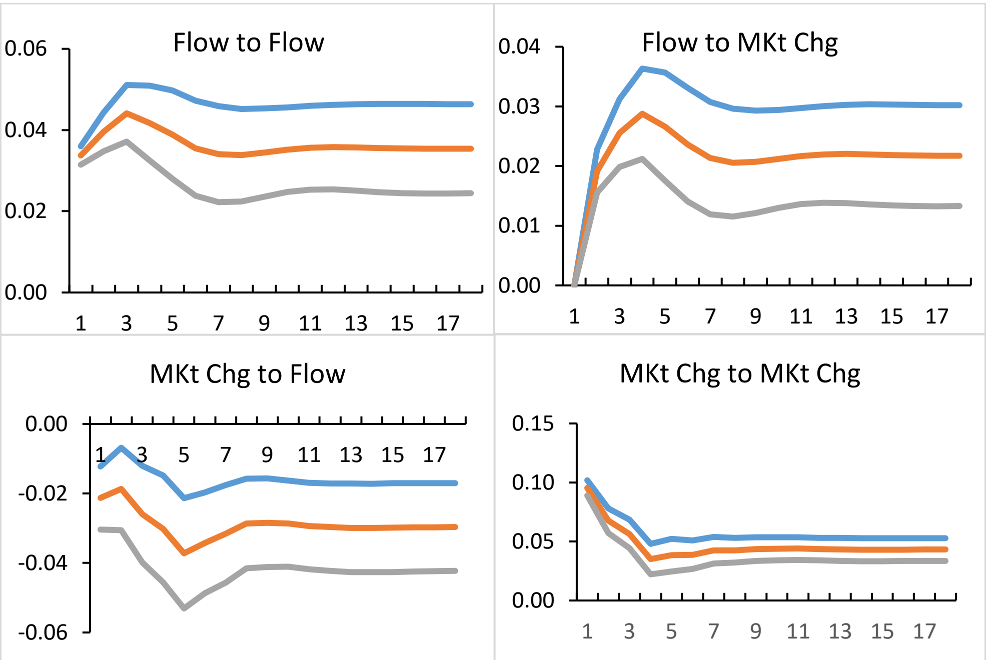


Figure 6: Japanese Smaller Companies

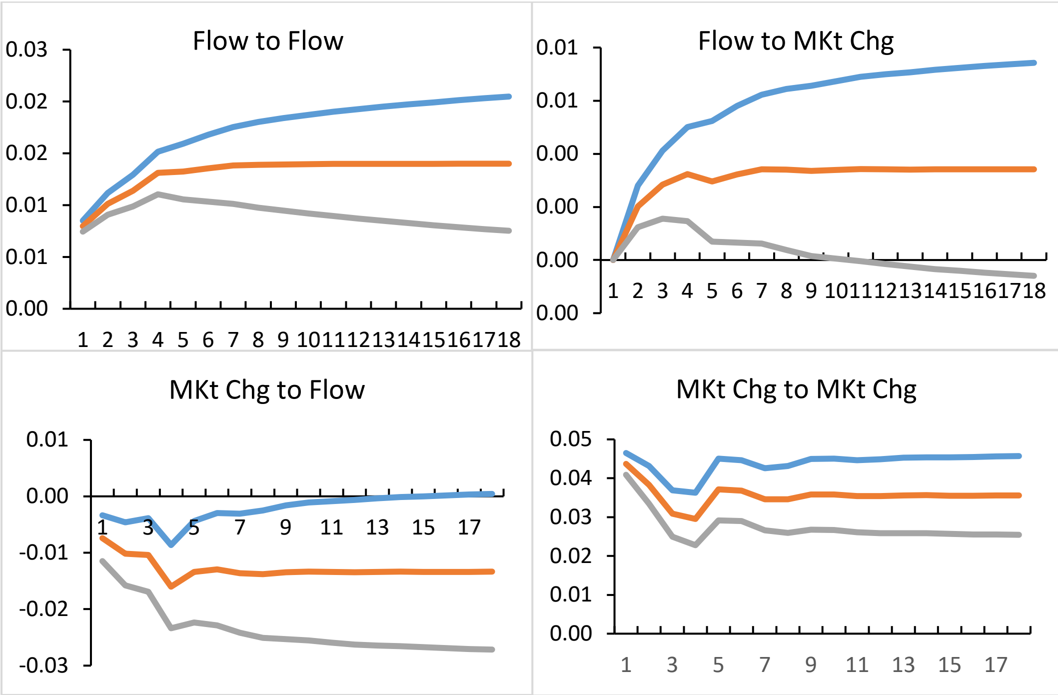


Figure 7: North America

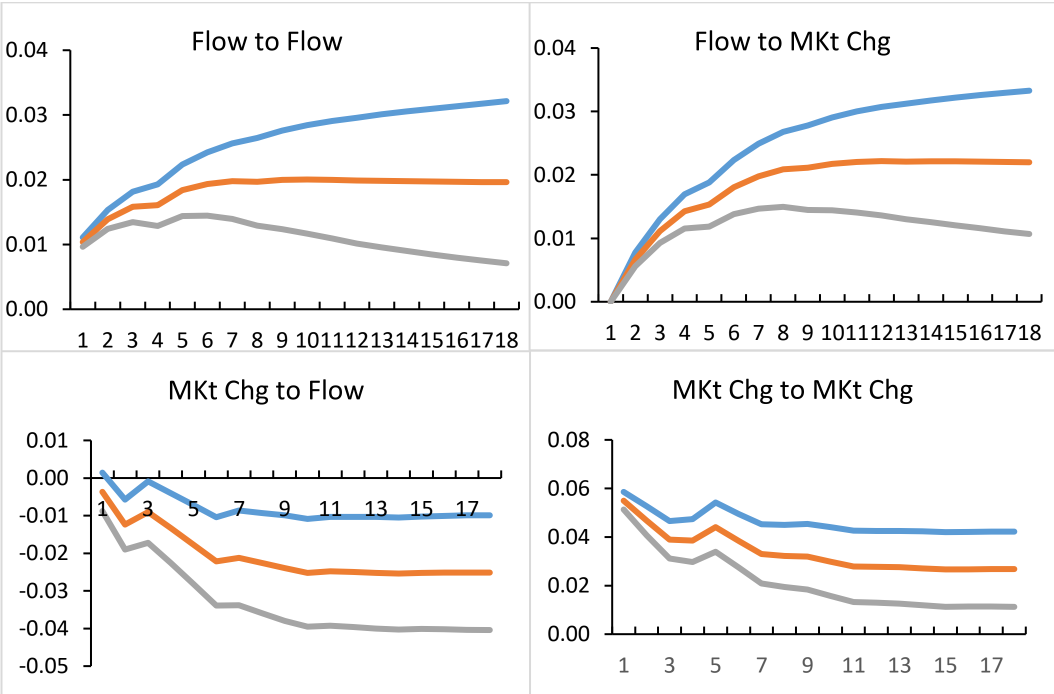


Figure 8: North American Smaller Companies

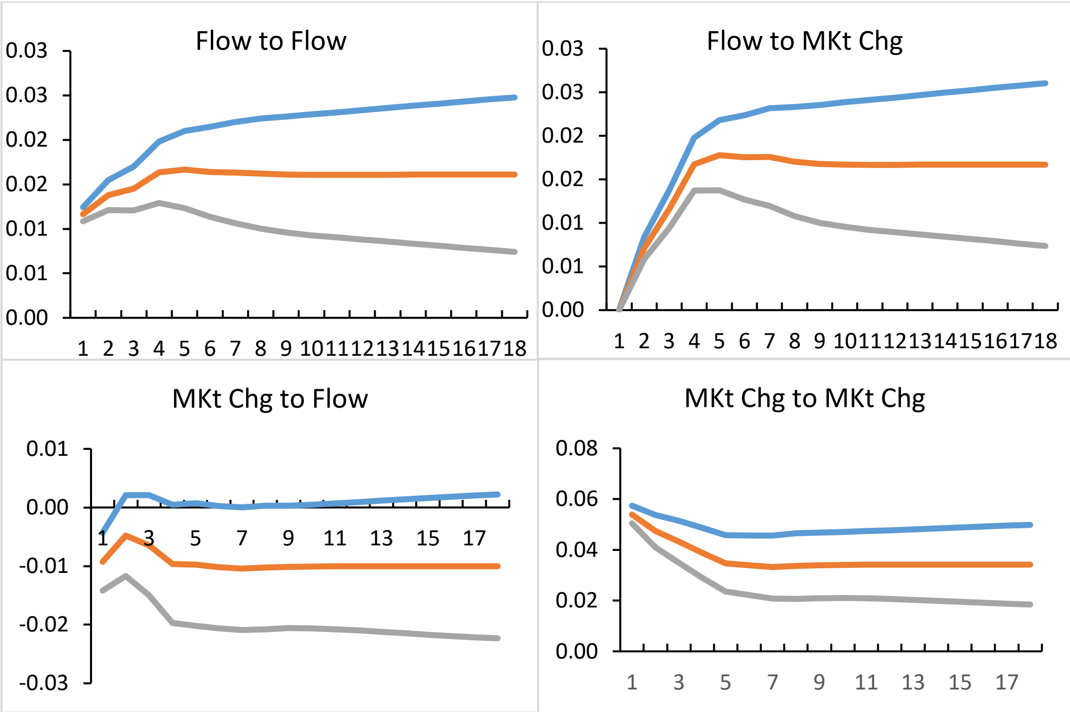


Figure 9: Technology and Telecommunications

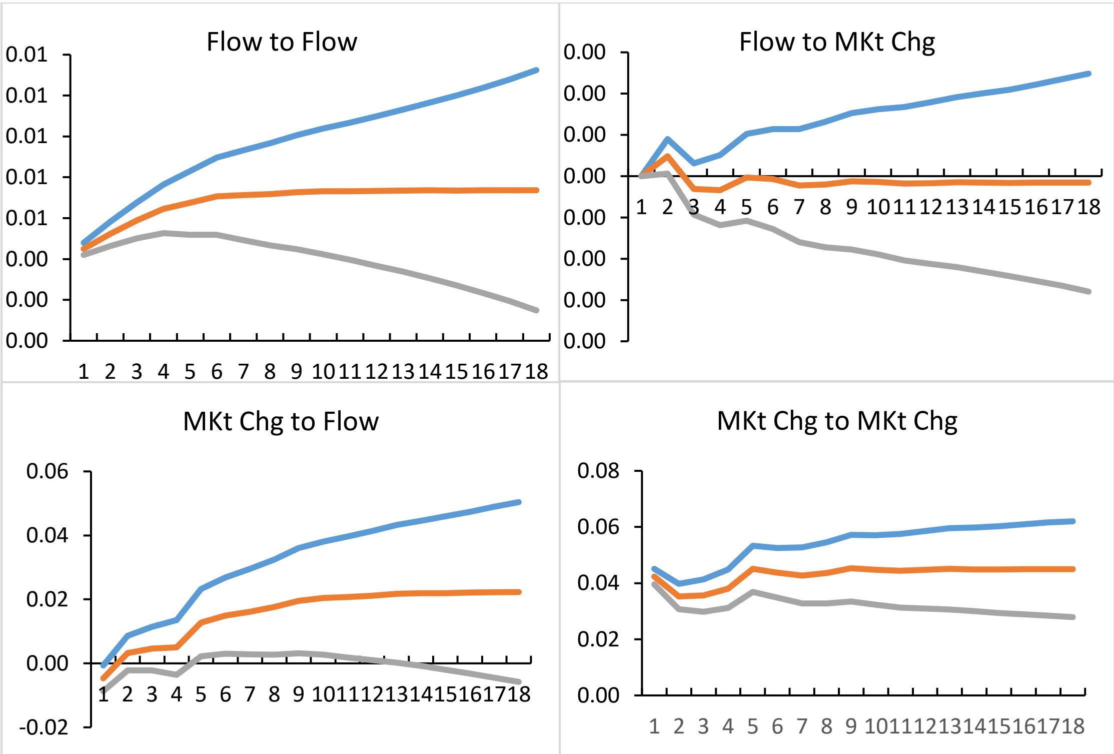


Figure 10: UK All Companies

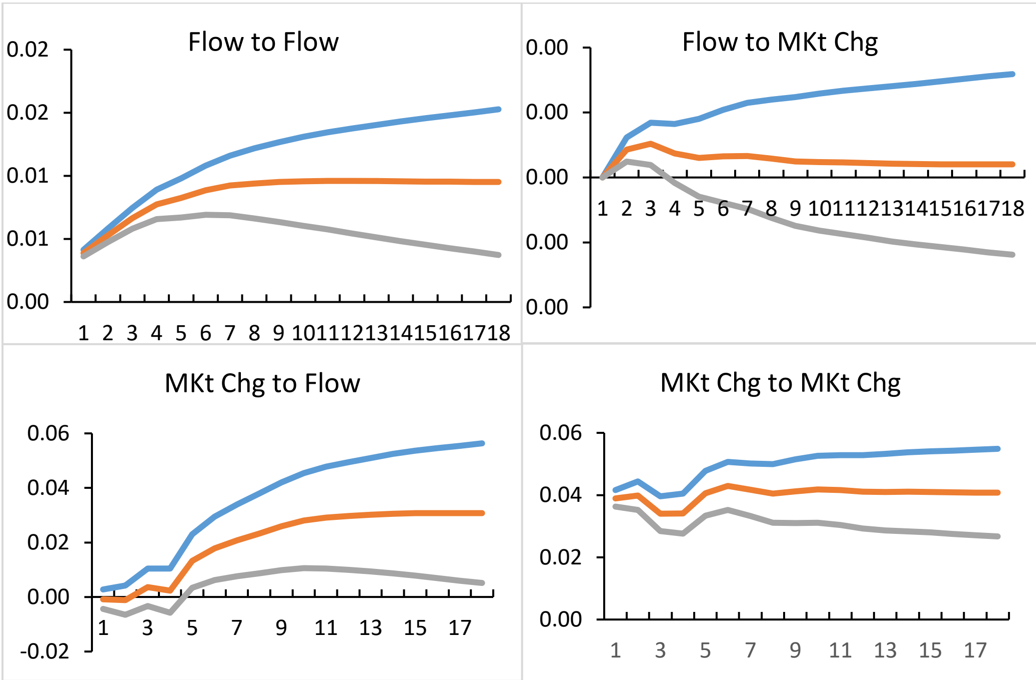


Figure 11: UK Equity Income

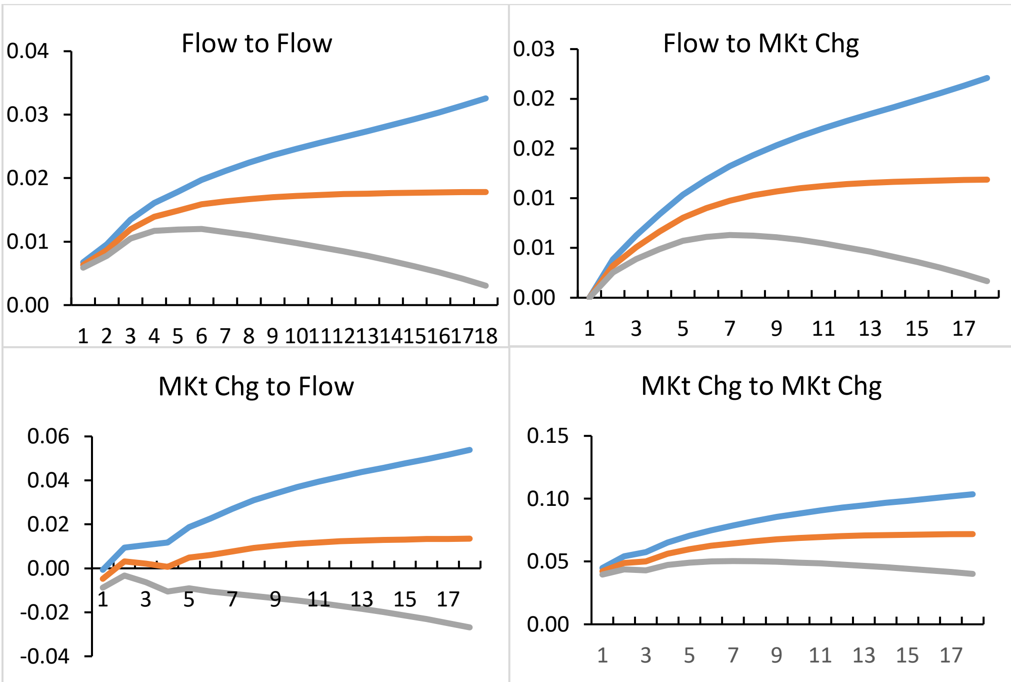


Figure 12: UK Smaller Companies

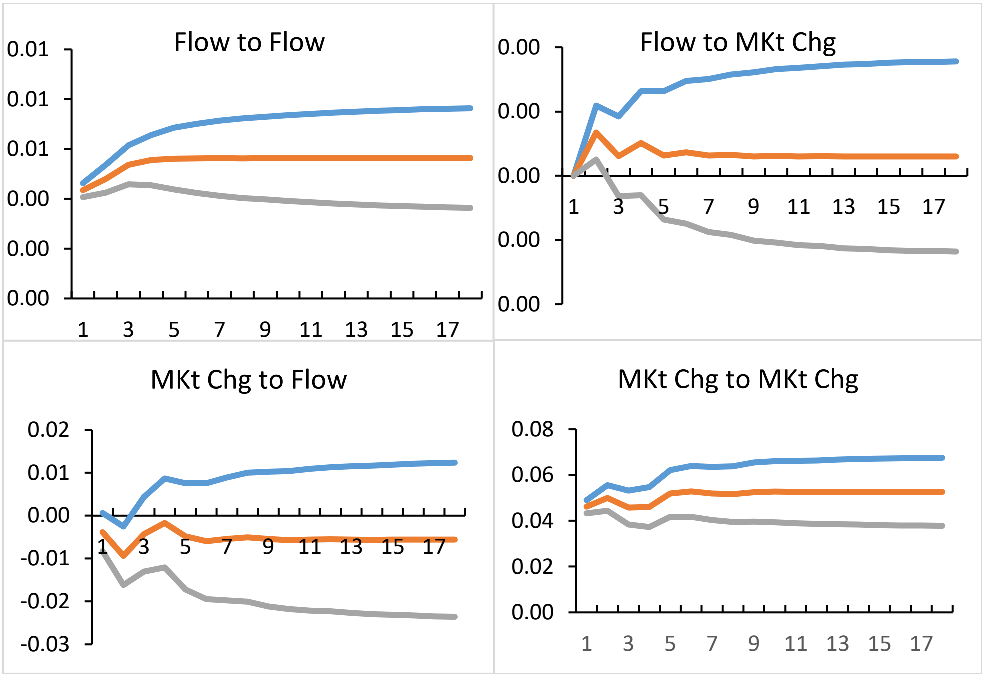


Figure 13: Other Equity

Appendix D: Summary statistics coefficient and standard error from Bivariate VAR results

	FL(-1)	St.errors	FL(-2)	St.errors	FL(-3)	St.errors	FL(-4)	St.errors	MK(-1)	St.errors	MK(-2)	St.errors	MK(-3)	St.errors		MK(-4)	St.errors	C	St.errors	@MSUM(LFL1(-1),12)/FN1(-13)	St.errors	R-squared	Adj. R-squared
FL1	0.37	-0.10	0.00	-0.10	0.08	-0.10	-0.13	-0.09	0.05	-0.01	0.00	-0.01	-0.01	-0.01		0.00	-0.01	0.00	0.00	0.03	-0.02	0.41	0.36
MK1	1.10	-0.91	0.52	-0.97	-0.66	-0.97	0.33	-0.86	-0.04	-0.10	-0.08	-0.11	0.03	-0.11		0.17	-0.11	0.01	-0.01	-0.15	-0.15	0.05	-0.03
FL2	0.27	-0.10	-0.03	-0.10	0.06	-0.10	-0.06	-0.09	0.11	-0.02	-0.01	-0.02	0.01	-0.02		0.02	-0.02	0.00	0.00	0.03	-0.02	0.29	0.23
MK2	0.25	-0.42	-0.51	-0.44	0.64	-0.44	-0.26	-0.40	0.11	-0.10	-0.23	-0.10	0.22	-0.11		-0.02	-0.10	0.00	-0.01	-0.04	-0.08	0.10	0.02
FL3	0.32	-0.10	0.16	-0.10	0.09	-0.10	0.07	-0.10	0.04	-0.01	-0.01	-0.01	0.01	-0.01		-0.02	-0.01	0.00	0.00	0.01	-0.02	0.44	0.40
MK3	0.40	-1.00	-0.25	-1.03	0.98	-1.05	-1.21	-0.99	0.06	-0.10	-0.22	-0.10	0.06	-0.10		0.12	-0.10	0.01	-0.01	-0.03	-0.18	0.11	0.04
FL4	0.29	-0.10	0.08	-0.11	0.14	-0.10	-0.03	-0.10	0.14	-0.03	-0.02	-0.04	0.04	-0.04		0.03	-0.04	0.00	0.00	-0.01	-0.02	0.23	0.16
MK4	-0.04	-0.31	-0.14	-0.32	-0.34	-0.32	0.55	-0.31	-0.19	-0.10	-0.15	-0.11	0.03	-0.11		0.14	-0.11	0.01	-0.01	0.03	-0.07	0.10	0.02
FL5	0.35	-0.10	-0.09	-0.10	-0.09	-0.10	0.16	-0.08	0.19	-0.02	0.01	-0.03	0.06	-0.03		0.03	-0.03	0.00	0.00	0.00	-0.01	0.54	0.50
MK5	0.89	-0.41	0.16	-0.43	-0.52	-0.44	0.32	-0.36	0.07	-0.10	-0.22	-0.12	-0.02	-0.12		0.04	-0.12	0.01	-0.01	-0.04	-0.06	0.08	0.00
FL6	0.36	-0.10	-0.09	-0.10	0.09	-0.09	-0.07	-0.09	0.03	-0.01	-0.02	-0.01	0.03	-0.01		-0.01	-0.01	0.00	0.00	0.03	-0.02	0.24	0.18
MK6	0.18	-0.68	0.03	-0.65	0.41	-0.63	-0.47	-0.62	0.02	-0.10	0.04	-0.10	0.06	-0.10		0.07	-0.10	0.00	-0.01	0.01	-0.12	0.02	-0.06
FL7	0.21	-0.10	0.11	-0.10	0.12	-0.11	-0.02	-0.10	0.08	-0.02	0.04	-0.02	0.02	-0.02		-0.02	-0.02	0.00	0.00	0.02	-0.02	0.29	0.23
MK7	0.18	-0.42	0.52	-0.43	-0.28	-0.44	-0.60	-0.42	0.14	-0.10	-0.23	-0.10	-0.08	-0.10		0.03	-0.10	0.00	0.00	-0.05	-0.08	0.13	0.06
FL8	0.30	-0.10	0.11	-0.11	-0.07	-0.11	-0.01	-0.10	0.20	-0.03	0.07	-0.04	0.03	-0.04		0.04	-0.04	0.00	0.00	0.02	-0.02	0.32	0.26
MK8	-0.11	-0.29	-0.29	-0.31	-0.26	-0.31	-0.22	-0.29	-0.29	-0.10	-0.18	-0.11	-0.24	-0.11		-0.05	-0.11	0.01	-0.01	0.07	-0.06	0.14	0.06
FL9	0.31	-0.10	0.10	-0.10	0.15	-0.10	-0.08	-0.10	0.05	-0.02	0.01	-0.02	0.01	-0.02		-0.01	-0.02	0.00	0.00	0.00	-0.02	0.19	0.13

MK9	-0.46	-0.55	-0.10	-0.56	-0.72	-0.57	0.69	-0.55	-0.12	-0.10	-0.16	-0.10	-0.06	-0.10		0.17	-0.10	0.00	0.00	0.14	-0.10	0.11	0.03
FL10	0.38	-0.09	0.18	-0.10	-0.09	-0.10	0.27	-0.09	0.12	-0.02	0.05	-0.02	0.03	-0.02		0.01	-0.02	0.00	0.00	-0.02	-0.01	0.47	0.43
MK10	-0.89	-0.50	0.47	-0.53	-0.41	-0.52	-0.36	-0.50	-0.15	-0.10	-0.06	-0.11	-0.02	-0.11		0.15	-0.11	0.01	-0.01	0.03	-0.08	0.10	0.03
FL11	0.59	-0.10	-0.22	-0.11	0.23	-0.10	-0.06	-0.08	0.08	-0.01	0.02	-0.02	0.02	-0.02		-0.03	-0.02	0.00	0.00	0.02	-0.01	0.69	0.67
MK11	0.18	-0.64	0.10	-0.69	0.33	-0.68	-0.48	-0.51	0.22	-0.10	-0.10	-0.11	0.07	-0.11		0.03	-0.11	0.00	-0.01	-0.01	-0.05	0.07	0.00
FL12	0.29	-0.10	0.01	-0.10	0.20	-0.10	-0.05	-0.09	0.13	-0.02	0.06	-0.02	0.09	-0.02		-0.01	-0.03	0.00	0.00	0.01	-0.02	0.48	0.43
MK12	0.29	-0.47	-0.25	-0.47	-0.29	-0.48	-0.06	-0.44	-0.12	-0.10	-0.13	-0.12	-0.10	-0.12		-0.08	-0.12	0.01	-0.01	0.11	-0.07	0.05	-0.03
FL13	0.18	-0.10	0.08	-0.10	0.12	-0.10	0.03	-0.09	0.01	-0.01	-0.02	-0.01	0.00	-0.01		0.01	-0.01	0.00	0.00	-0.02	-0.03	0.09	0.02
MK13	1.59	-0.93	0.31	-0.96	0.00	-0.96	1.57	-0.89	-0.17	-0.09	-0.04	-0.09	0.08	-0.10		0.20	-0.09	0.01	-0.01	-0.26	-0.24	0.11	0.03
FL14	0.36	-0.10	0.22	-0.11	0.05	-0.11	-0.05	-0.10	0.02	-0.01	0.00	-0.01	-0.01	-0.01		0.00	-0.01	0.00	0.00	0.02	-0.01	0.42	0.37
MK14	-0.09	-0.99	1.23	-1.06	-0.78	-1.07	2.91	-1.03	0.02	-0.09	-0.15	-0.10	-0.02	-0.09		0.16	-0.09	0.00	-0.01	-0.33	-0.14	0.13	0.05
FL15	0.43	-0.10	0.27	-0.11	-0.01	-0.11	-0.09	-0.10	0.08	-0.01	0.00	-0.02	0.00	-0.02		0.00	-0.02	0.00	0.00	0.01	-0.01	0.56	0.52
MK15	1.37	-0.66	-0.93	-0.74	-0.35	-0.76	0.73	-0.66	0.16	-0.10	-0.10	-0.11	0.16	-0.11		0.06	-0.11	0.01	-0.01	-0.07	-0.09	0.09	0.02
FL16	0.12	-0.10	0.13	-0.10	-0.01	-0.10	0.00	-0.09	0.01	-0.01	-0.01	-0.01	0.01	-0.01		-0.01	-0.01	0.00	0.00	0.03	-0.02	0.16	0.08
MK16	-1.20	-1.09	1.32	-1.07	0.41	-1.06	-0.72	-0.95	0.08	-0.10	-0.08	-0.10	-0.01	-0.10		0.13	-0.10	0.01	-0.01	0.04	-0.17	0.06	-0.01
FL17	0.26	-0.10	0.06	-0.10	0.05	-0.10	0.14	-0.09	0.02	-0.01	0.00	-0.01	0.01	-0.01		-0.01	-0.01	0.00	0.00	0.00	-0.02	0.24	0.18
MK17	1.33	-1.37	0.94	-1.42	0.42	-1.42	2.01	-1.30	-0.03	-0.09	-0.13	-0.10	0.00	-0.10		0.19	-0.10	0.00	0.00	-0.17	-0.26	0.09	0.02
FL18	0.52	-0.10	0.31	-0.11	-0.13	-0.11	-0.09	-0.10	0.18	-0.03	-0.05	-0.04	-0.03	-0.04		-0.05	-0.04	0.00	0.00	0.01	-0.01	0.54	0.50
MK18	-0.34	-0.32	-0.14	-0.35	0.69	-0.35	0.06	-0.33	-0.11	-0.10	0.07	-0.11	0.07	-0.11		-0.08	-0.11	0.00	0.00	0.01	-0.04	0.06	-0.01
FL19	0.54	-0.10	-0.09	-0.11	0.13	-0.10	0.08	-0.10	0.17	-0.04	0.00	-0.04	0.09	-0.04		-0.03	-0.04	0.00	0.00	0.00	-0.01	0.40	0.35
MK19	-0.09	-0.25	-0.29	-0.27	-0.50	-0.27	-0.06	-0.26	-0.28	-0.10	-0.26	-0.11	-0.21	-0.10		-0.02	-0.10	0.01	0.00	0.07	-0.04	0.15	0.08
FL20	0.13	-0.10	-0.01	-0.10	0.13	-0.10	-0.09	-0.10	0.10	-0.03	0.04	-0.03	0.04	-0.03		0.06	-0.03	0.00	0.00	0.03	-0.02	0.20	0.14
MK20	-0.54	-0.33	-0.30	-0.33	-0.30	-0.33	-0.19	-0.33	-0.64	-0.10	-0.29	-0.11	-0.18	-0.11		-0.17	-0.10	0.00	0.00	0.07	-0.07	0.31	0.25
FL21	0.12	-0.10	0.05	-0.11	0.07	-0.11	-0.01	-0.09	0.27	-0.04	0.09	-0.05	0.02	-0.05		0.00	-0.05	0.00	0.00	0.02	-0.02	0.32	0.27
MK21	-0.46	-0.27	0.09	-0.27	0.03	-0.27	-0.20	-0.24	-0.30	-0.10	-0.08	-0.12	-0.15	-0.12		-0.01	-0.12	0.01	0.00	-0.02	-0.06	0.13	0.05

FL22	0.33	-0.10	0.07	-0.10	0.00	-0.10	-0.17	-0.09	0.12	-0.02	0.06	-0.02	-0.03	-0.02		-0.01	-0.02	0.00	0.00	0.05	-0.02	0.49	0.45
MK22	-0.50	-0.49	0.06	-0.51	1.03	-0.49	-0.10	-0.46	-0.07	-0.10	0.07	-0.11	0.08	-0.11		-0.06	-0.11	0.01	-0.01	-0.09	-0.08	0.06	-0.02
FL23	0.38	-0.10	0.28	-0.11	-0.02	-0.11	-0.22	-0.10	0.15	-0.03	0.04	-0.03	-0.03	-0.03		-0.09	-0.03	0.00	0.00	0.03	-0.01	0.47	0.43
MK23	0.14	-0.36	0.41	-0.39	-0.03	-0.40	0.14	-0.37	-0.02	-0.10	-0.02	-0.12	-0.09	-0.12		0.10	-0.12	0.00	0.00	0.00	-0.05	0.05	-0.03

Equity Market: FL1 & MK1: Asia Pacific Excluding Japan, LF2&MK1 Asia Pacific Including Japan, FL3&MK3 Europe Excluding UK, FL4 &MK4 Europe Including UK, FL5&MK5 European Smaller Companies FL6&Mk6 Global Emerging Markets, FL7&Mk7 Japan, FL8&MK8 Japanese Smaller Companies, FL9&Mk9 North America, FL10&MK10 North American Smaller Companies FL11&MK11 Specialist, FL12&MK12 Technology and Telecommunications, FL13&MK13 UK All Companies, FL14&Mk14 UK Equity Income, FL15&MK14 UK Smaller Companies, FL16&MK16 Other ,FL17&MK17 Total equity

Bond Market: FL18&MK18 £ Corporate Bond, FL19&MK19 Global Bonds, FL20&MK20 UK Gilts, FL21&Mk21 UK Index Linked Gilts, Fl22&MK22Other Fixed Income LF23Total Bond

Appendix E: Wright methodology measure of monetary surprise

Measuring the monetary policy stance using Wright methodology could be as follows: It is based on the heteroskedasticity estimation of Roberto Rigobon (2003). We are going to use daily frequency data and will estimate VAR as follows to create monetary policy surprise.

We estimate the following reduced VAR:

$$y_t = FX_{t-1} + u_t$$

Because we know that it is reduced from the forecast error which can be related to a set of underlying shocks such as:

u_t is the reduced form forecast error that can be related to a set of underlying shocks as:

$$u_t = \sum_{i=1}^{p} R_i \, \eta_{it}$$

Where η_{it} is the *i*th structural shock, R_i is a px1 vector, and the structural shocks are independent of each other over time. We are ordering monetary policy first, however, it is not necessary as we are not going to use the Cholesky decomposition for identification.

Variance and covariance of the reduced form of all shocks on announcement day and non- announcement days are presented in the following matrices. As the monetary policy shock is located in the first column of the below matrices, the variance of monetary policy shock will be σ_1^2 ; otherwise variance will be σ_0^2 , the mean will be zero in both situations.

$$variance\ of\ \text{announcement day} \quad \Sigma_1 = \begin{bmatrix} \sigma_1^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$mean = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$variance\ of\ non\ \text{announcement day} \ \Sigma_0 = \begin{bmatrix} \sigma_0^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$mean = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

As can be seen, all other structural shocks except monetary shock are identically distributed with mean zero and variance one. The identifying assumption is that

$\sigma_1^2 \neq \sigma_0^2$ This strategy for identification was proposed by Rigobon (2003) and applied to asset price data by Rigobon and Sack (2003, 2004 and 2005).

We will have the following condition:

$$\Sigma_1 \text{-} \Sigma_0 = R_1 R_1^{'} \sigma_1^2 \text{-} R_1 R_1^{'} \sigma_0^2 = R_1 R_1^{'} (\sigma_1^2 \text{-} \sigma_0^2)$$

This allows R_1 to be identified. As $R_1 R_1'$ and $\sigma_1^2 - \sigma_0^2$ are not separately identified, we assume that $\sigma_1^2 - \sigma_0^2$ =1. Also, as we are looking to find the monetary policy shock, there is no need for further restriction on the VAR system.

We estimate reduced form VAR coefficient matrices F and also residualu_t. Then based on the announcement and non-announcement, we split the residual into two groups and construct sample variance and covariance of each group. We will denote the estimate-sample variance and covariance as $\widehat{\sum}_1$ and $\widehat{\sum}_0$. We can estimate parameter R_1 by solving the minimum distance problem.

$$\hat{R}_1 = \arg\min_{R_1}[vech\left(\hat{\Sigma}_1\text{-}\hat{\Sigma}_0\right)\text{-}vech(R_1R_1^{'}]^{'}[\hat{V}_0+\hat{V}_1]^{-1}[vech\left(\hat{\Sigma}_1\text{-}\hat{\Sigma}_0\right)\text{-}vech\left(R_1R_1^{'}\right)]$$

Where $\hat{V}_0$ and $\hat{V}_1$ are estimates of the variance and covariance matrices of

$vech(\widehat{\sum}_1)$ and $vech(\widehat{\sum}_0)$

After identifying $\widehat{R}_1$, we can measure monetary surprise as follows:

We can rewrite the reduced form of the VAR to the structural form as follows A $Y_t = BX_{t\text{-}1} + e_t$ then we know that $u_t = A^{-1}e_t$, and then we can estimate $e_t = Au_t$ In this equation we just need the first column of A which is R_1 . Therefore, we can measure the structural shock for monetary policy for each point in the time series.

Appendix F: Bivariate VAR impulse Figure daily data

Bivariate VAR impulse response from daily data, equity and bond markets Cholesky identification

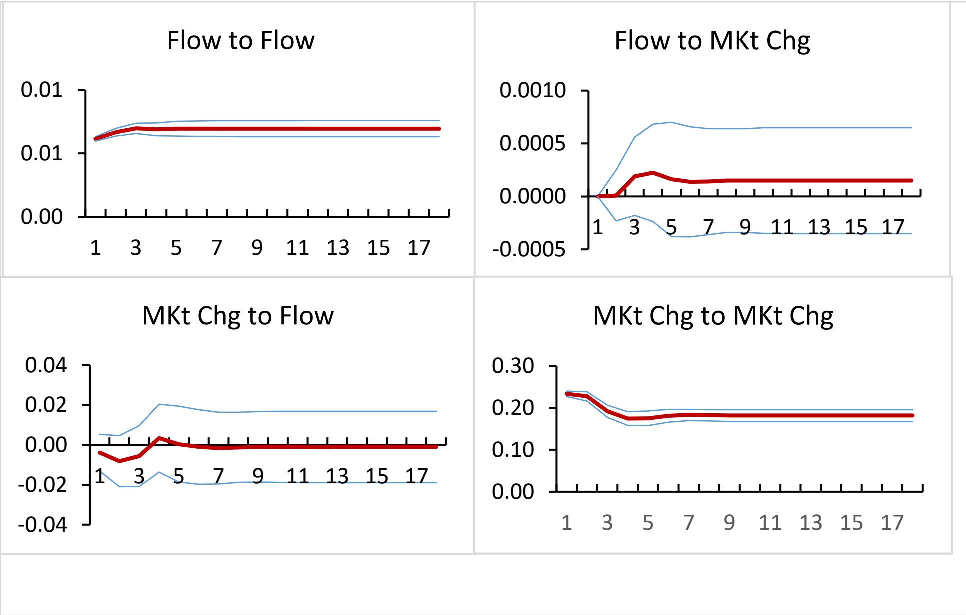


Figure 1: Emerging Markets Global HC

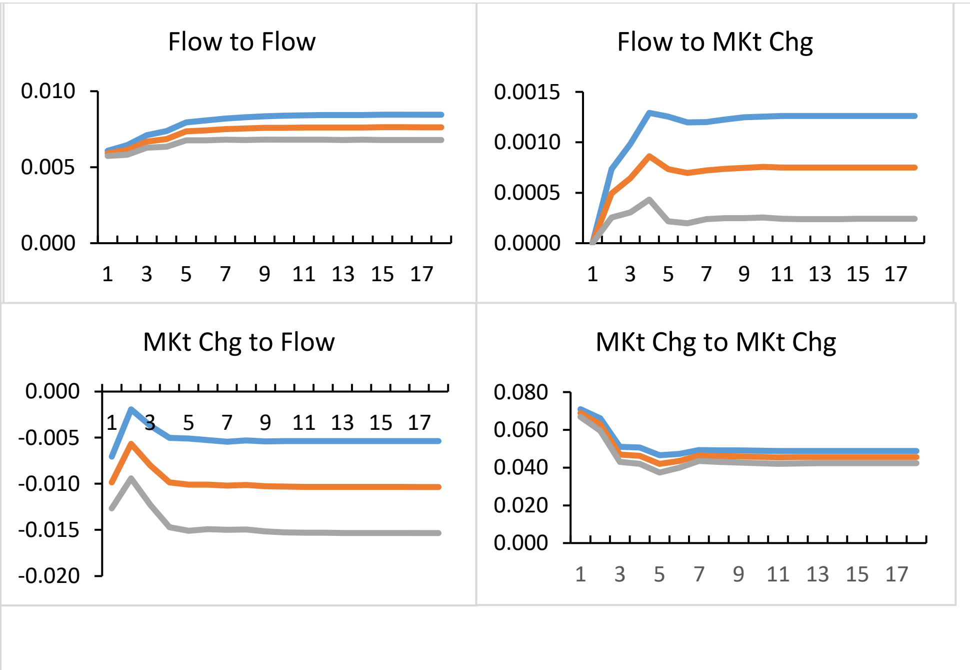


Figure 2 Emerging Markets Global LC

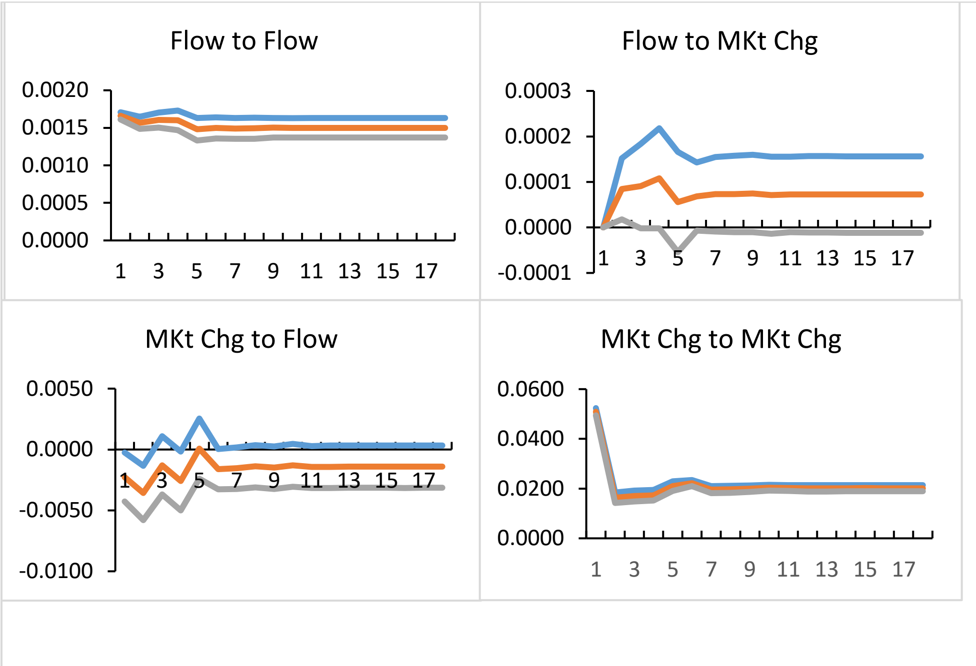


Figure 3 GBP

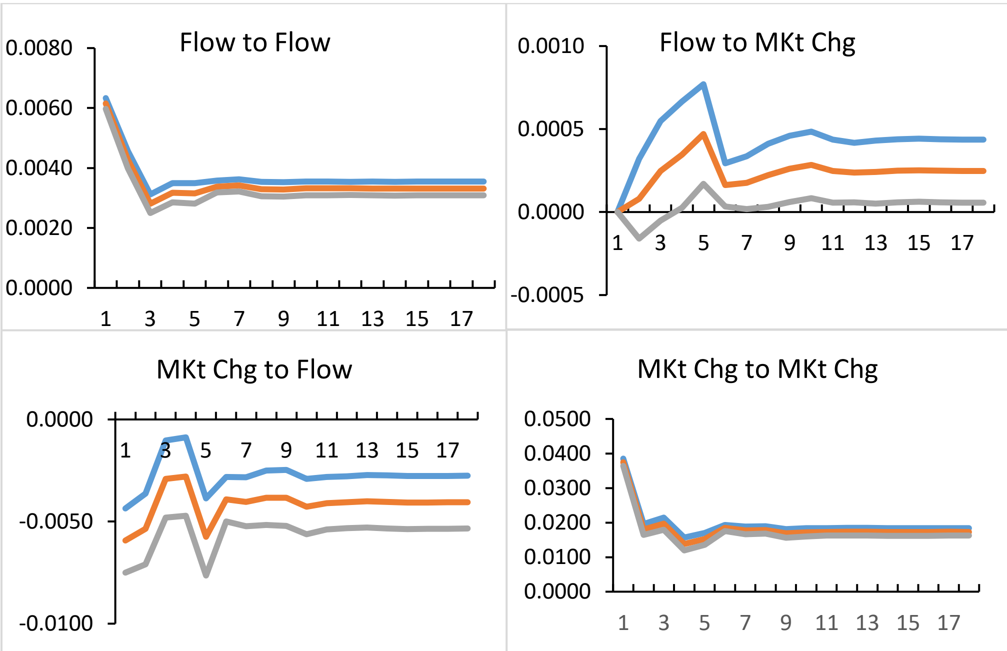


Figure 4. GBP Government

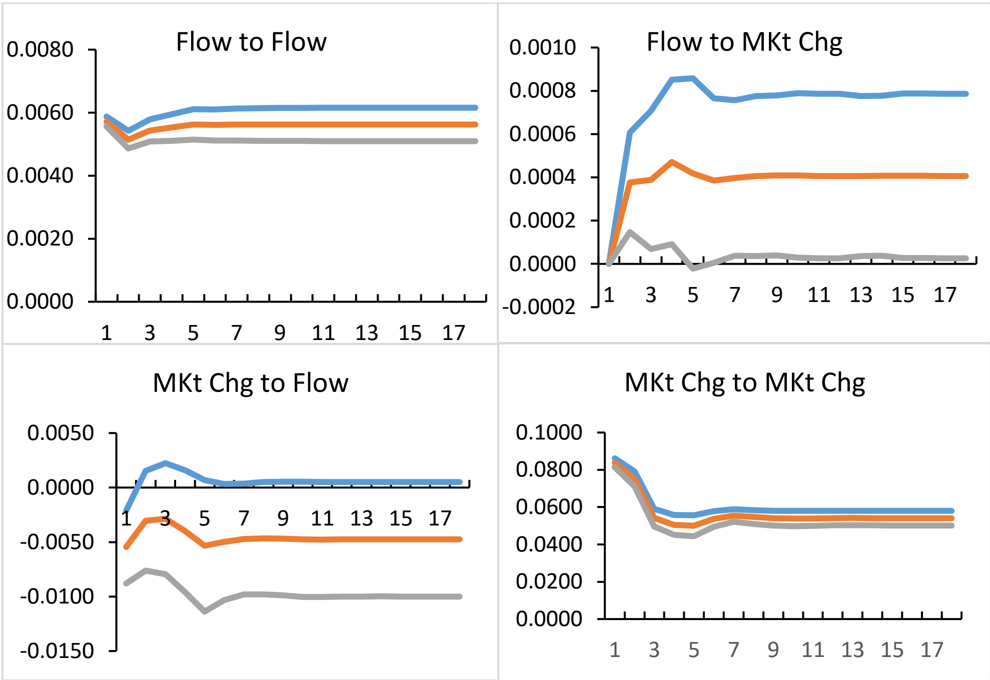


Figure 5. GBP High Yield

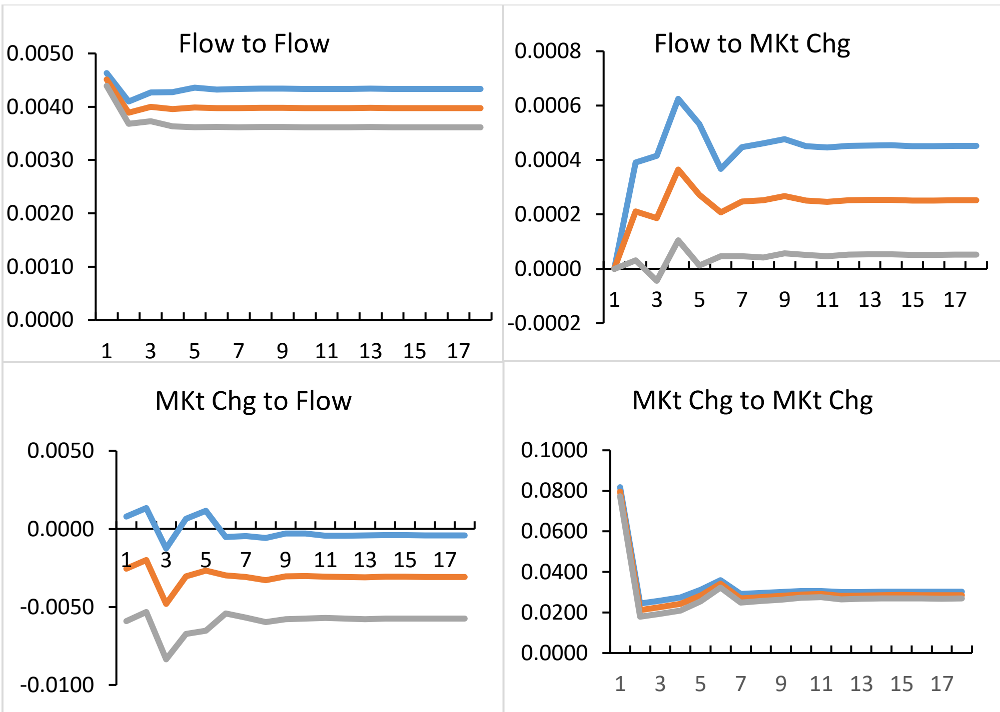


Figure 6 GBP Inflation Linked

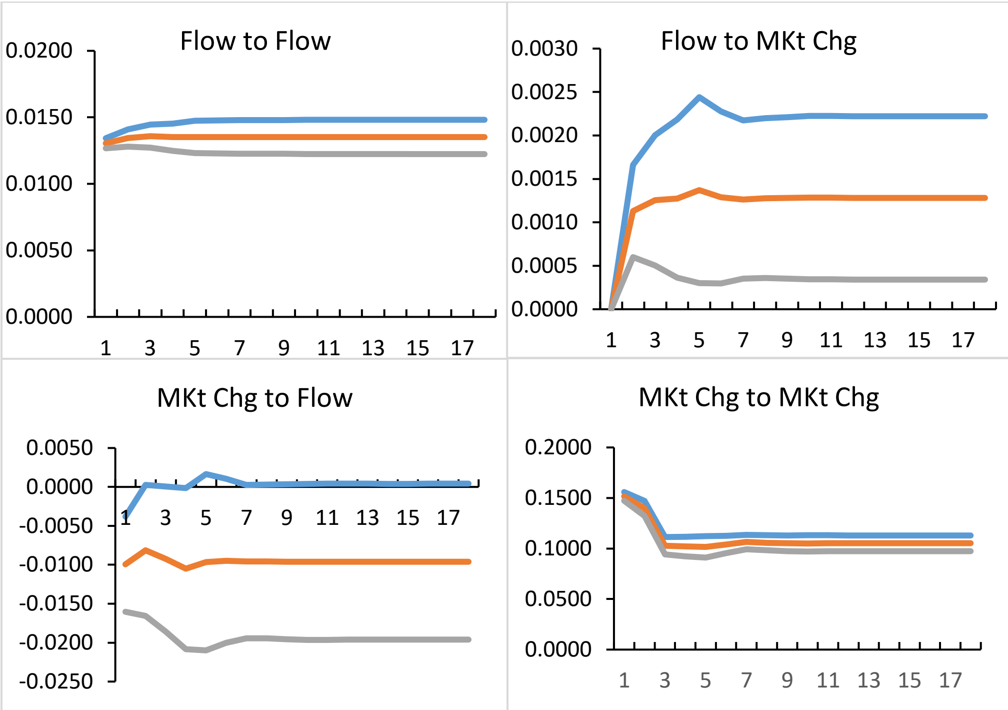


Figure 7.GBP Short Term

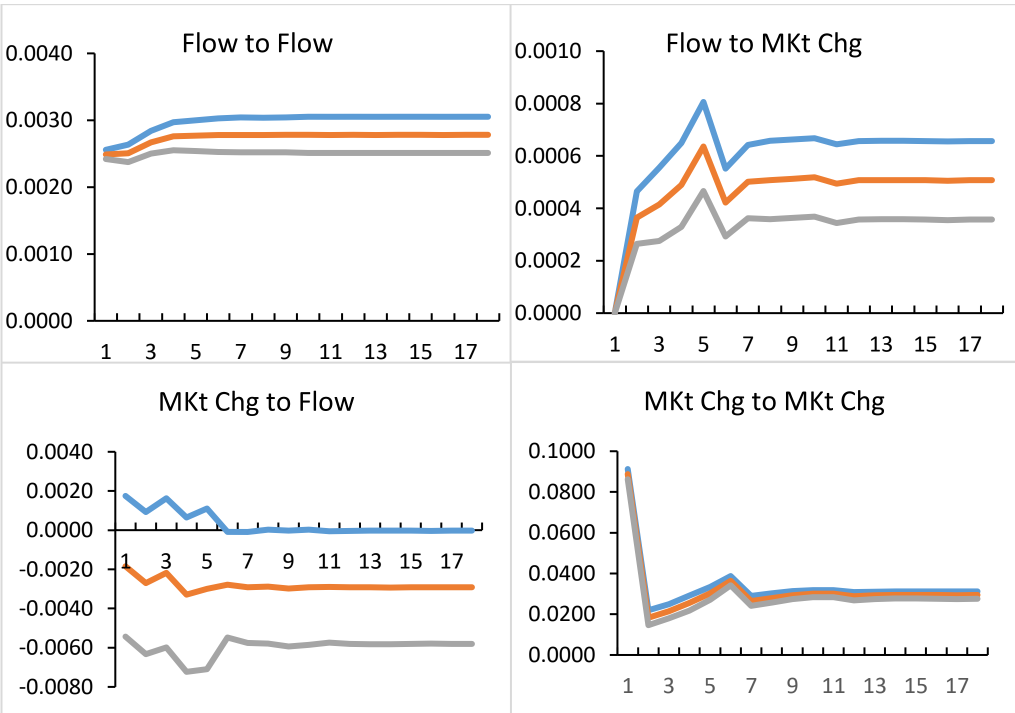


Figure 8. Global High Yield

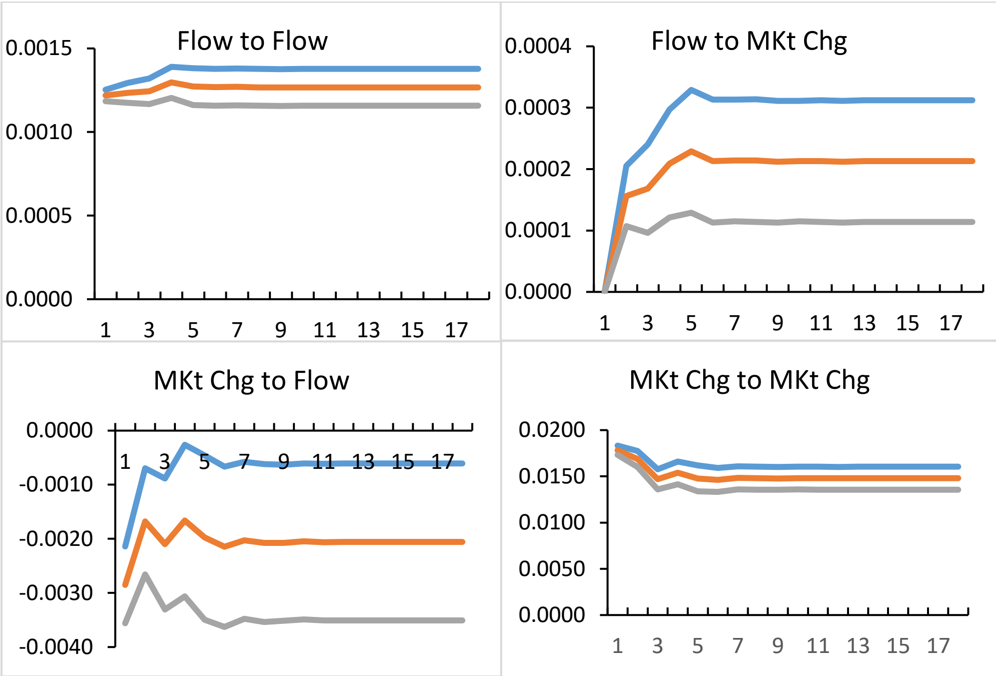


Figure 9. Equity Emerging Mkts Global

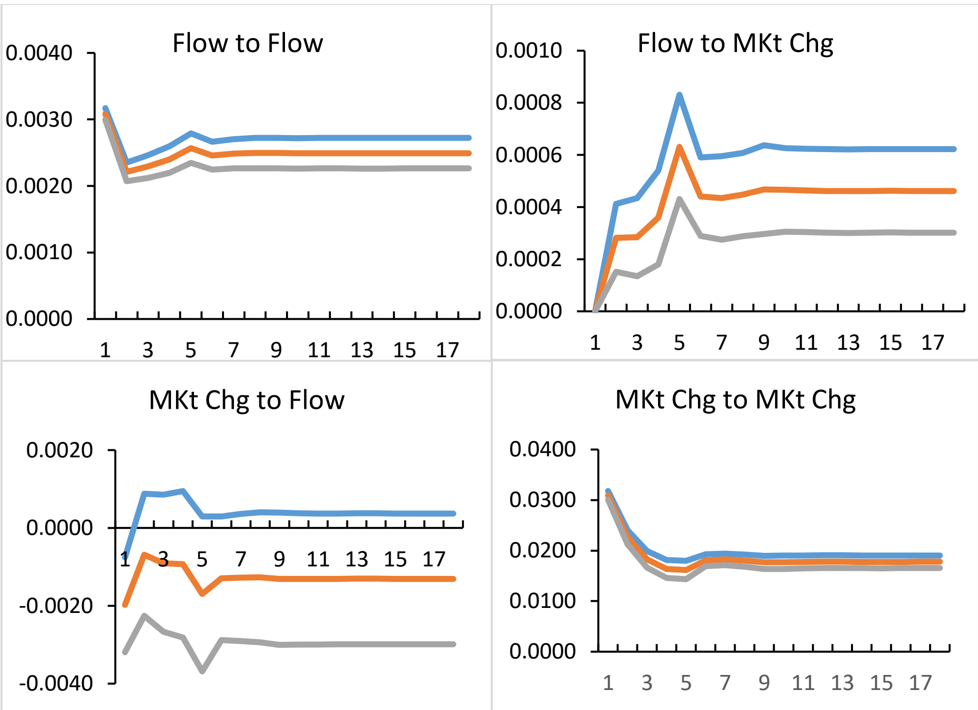


Figure 10. Equity Europe ex UK

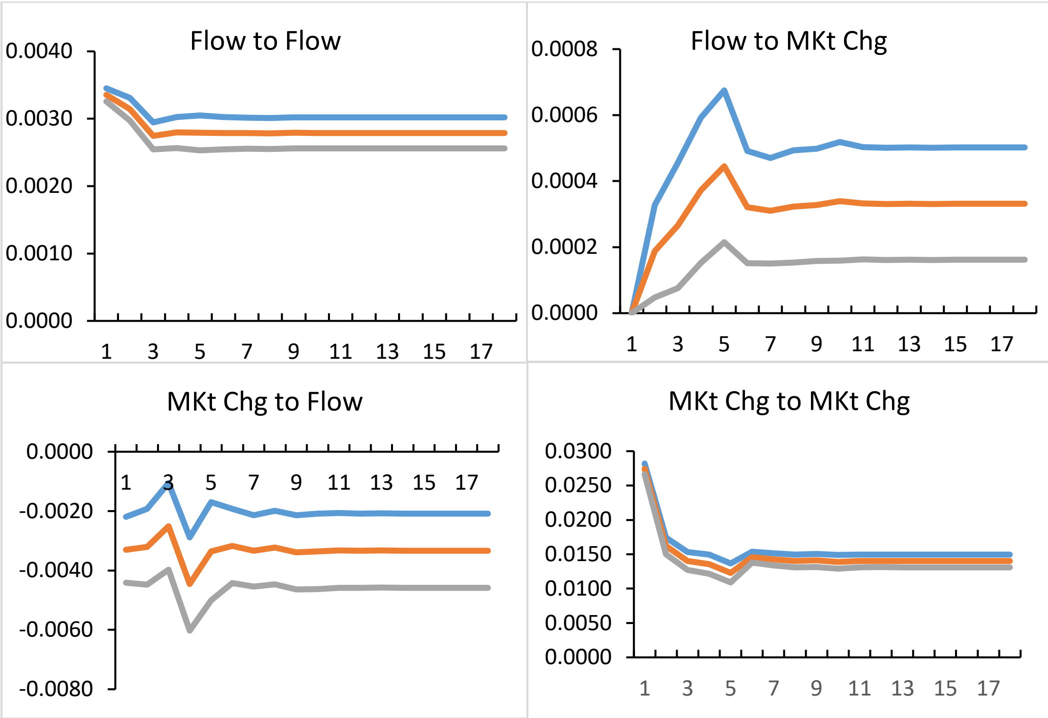


Figure 11. Equity Global ex UK

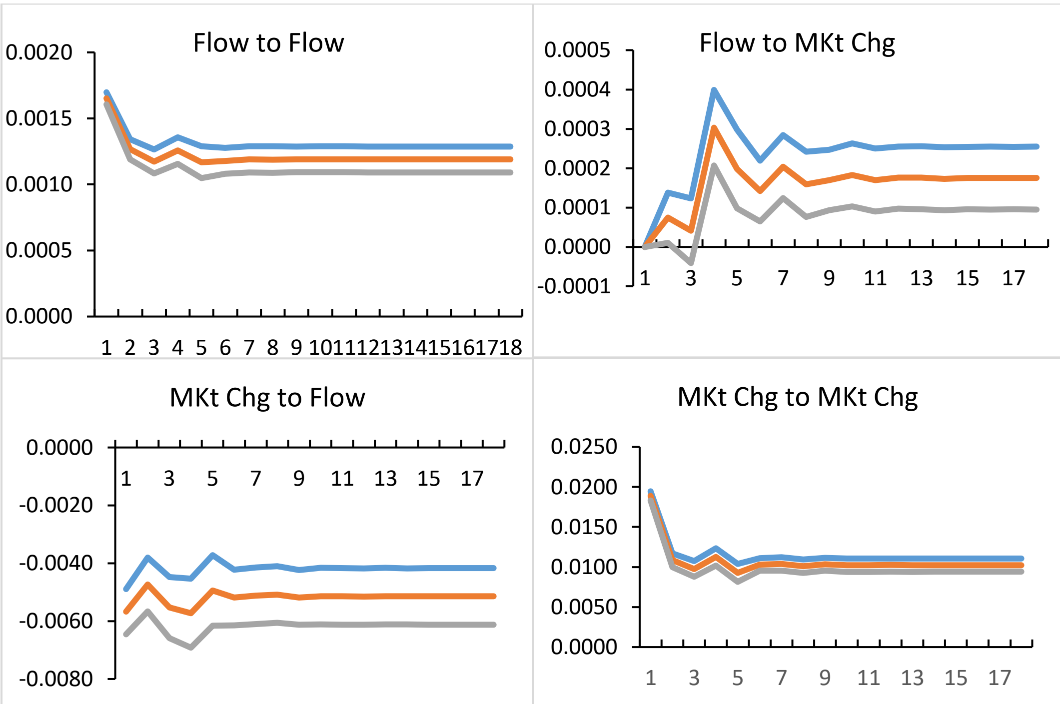


Figure 12. Equity UK

Chapter 3

The impact of external economic shocks to the UK economy

3.1 Introduction

The UK economy is closely integrated into the world economy through trade and financial services. Understanding the transmission of international shocks to the UK and the magnitude of those shocks informs the domestic policy response. Building on the growing literature on the importance of large data sets for empirical macroeconomic modelling, we use a large data set to analyse the impact of global developments on the UK economy. We evaluate the impact of shocks originating from advanced economies (G7) and emerging markets (EM) on UK macroeconomic variables. These two groups of countries produce 70 per cent of world output. We distinguish between a supply shock and oil price shocks, and the analysis will be based on reduced form VAR (FAVAR). The outcome of this simple and transparent model will be compared to the multi country large scale model NiGEM.

The impact of changes in advanced economies on the UK may be different compared to that of emerging economies as they have different links to the UK and different economic structures. As we can see from Figures 3-1 and 3-2, while UK trade in merchandise goods with advanced economies is steadily declining, with emerging markets it is growing.

Furthermore, the FDI as proxy for financial connections has the same trend as shown in Figures 3-3 and 3-4. The trend for outward FDI for both of these groups of countries reached the same level after the recent financial crisis. This could be due to excessive risks, low returns and severe economic recession in advanced economies.

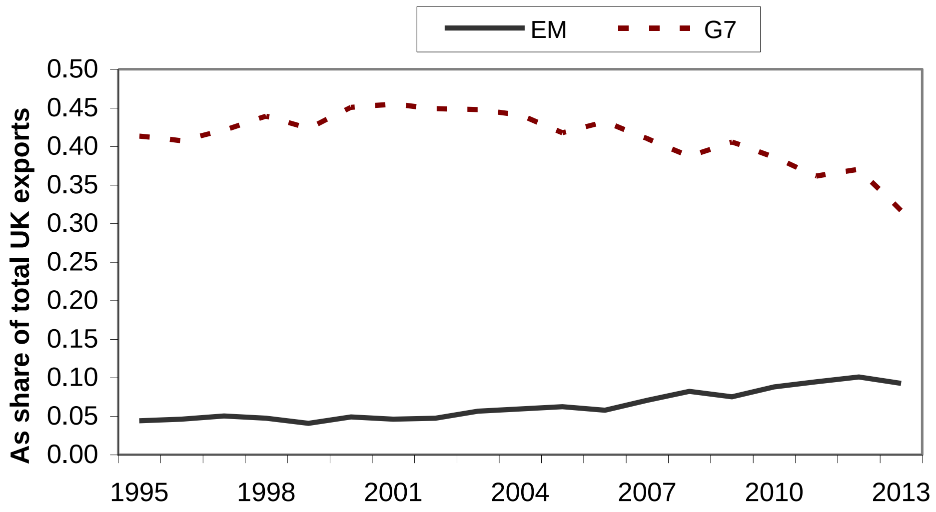


Figure 3-1:UK merchandise exports to advanced economies and emerging economies as a share of world UK exports, annual 1995-2013

Source: http://unctadstat.unctad.org/EN/

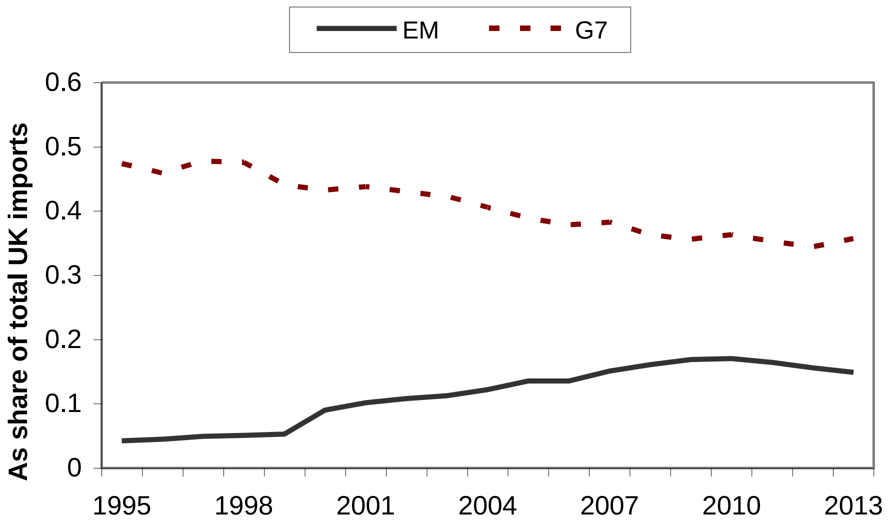


Figure 3-2:UK merchandise imports from advanced economies and emerging economies as a share of world UK exports, annual 1995-2013

Source: http://unctadstat.unctad.org/EN/

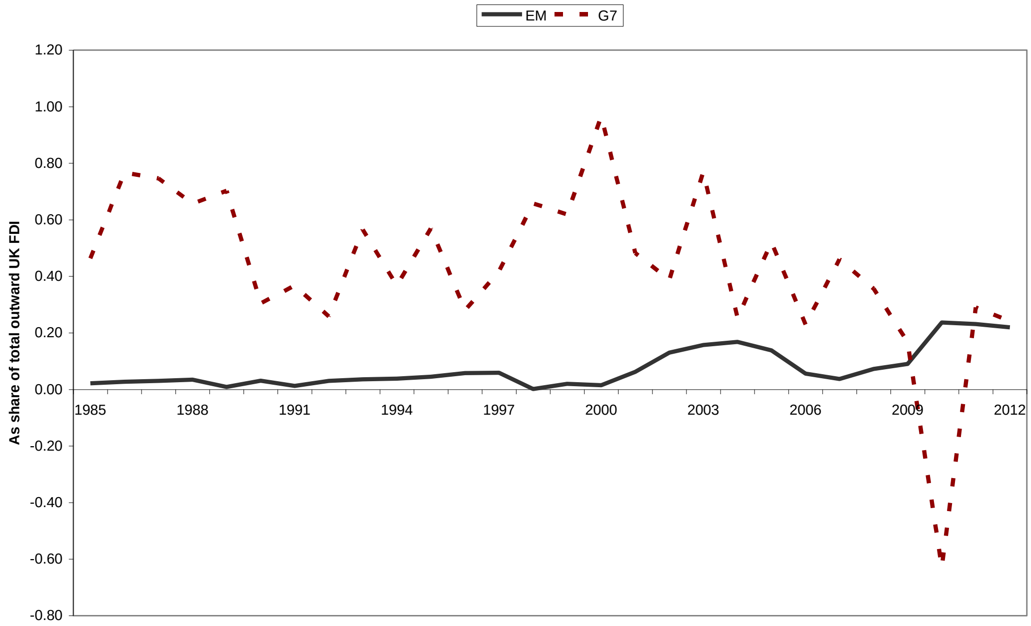


Figure 3-3: Outward FDI in advanced and emerging economies as a share of total outward FDI UK

Source: http://stats.oecd.org/

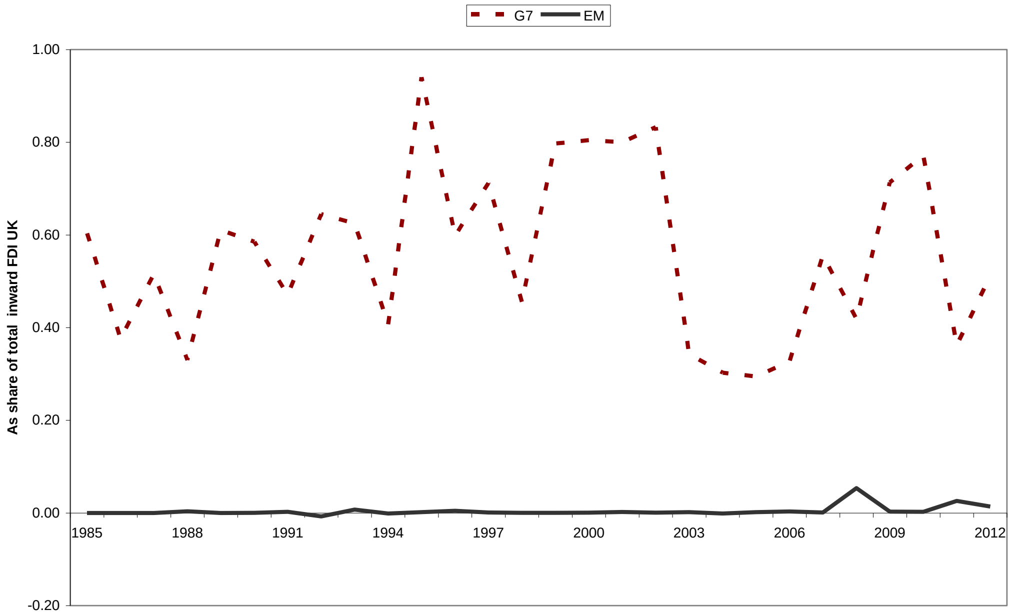


Figure 3-4: Inward FDI from advanced and emerging economies as a share of total

Inward FDI UK. Source: http://stats.oecd.org/

The UK received nearly 50 per cent of its FDI from its partners in the G7 while its outward FDI to the G7 and the EM has recently converged to the same level. These pictures confirm the role of emerging economies, and the necessity of understanding the potential for emerging economies to affect the domestic economy alongside traditional trading partners.

Furthermore, the potential impact of oil price shocks has increased for the UK, as it became a major oil producer in 1975 and a net oil exporter from 1981 to 2005. International supply and oil price shocks could have different impacts on the UK due to oil revenue. Also, separation between supply and oil price shocks may prevent misspecification of the model. The figures below show the oil price and the UK profile of oil production and consumption since 1975. UK oil production has increased since 1975 while the oil consumption has stayed the same; therefore the oil intensity[10] of the UK economy has fallen, as it has for other advanced economies.

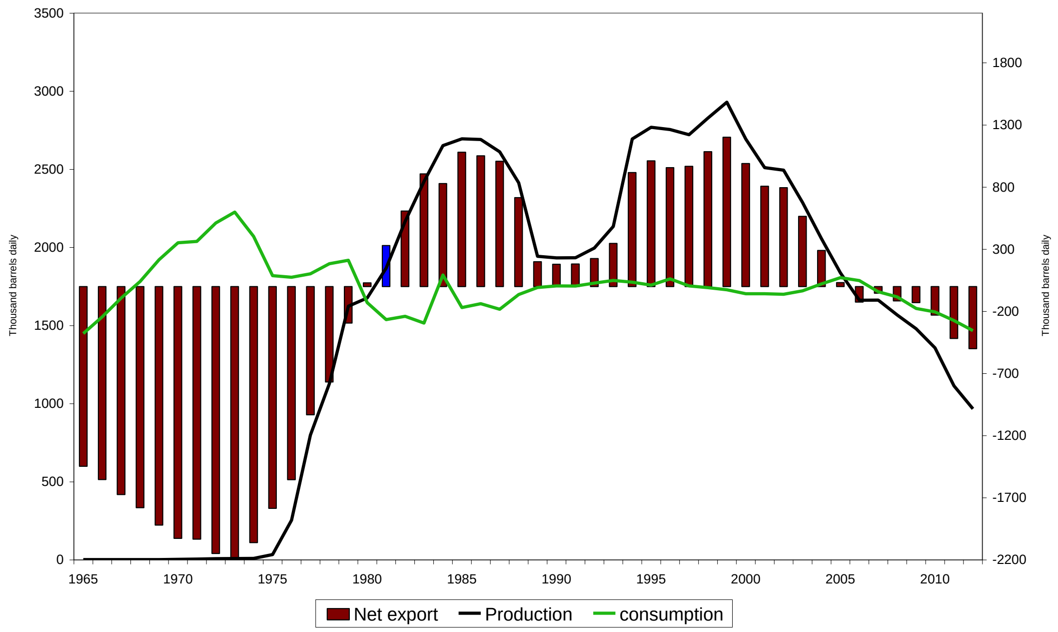


Figure 3-5: Oil production, consumption and exports in the UK

Source: BP statistics

[10] We define oil intensity as the share of consumption of oil, gas and coal as a share of GDP in 2009.

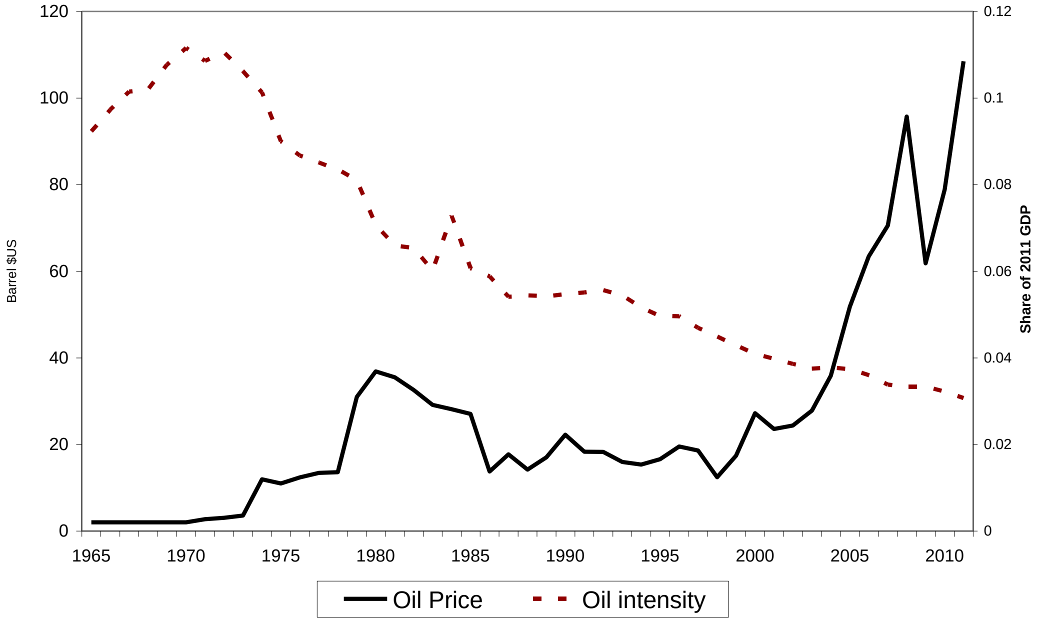


Figure 3-6: Oil intensity of UK and oil price

3.2 Literature review.

An open economy like the UK is subject to external shocks, causing fluctuation in domestic variables. The impact depends on how and in what sectors the local economy is exposed to world events. In the applied macroeconomic literature VAR models, pioneered by Sims (1980), have become the workhorse of the investigation of shocks (e.g monetary policy, fiscal policy, supply shock, demand shock etc.). The model is popular for its simplicity and transparency. It has been significantly extended and is used widely among economic researchers and policymakers. For this thesis Bernanke and et al.'s (2005) Factor Augmented VAR approach can be used to analyse a large array of variables.

As an alternative to VAR approaches, policy makers (central bankers and policy institutions such as the European Commission and the IMF) also use large scale models to investigate the impact of shock or policy changes in one country on other countries. These models are quite complicated and most of them are multi-country models. Examples include NiGEM of the National Institute of Economic and Social Research, the IMF's Multimod and QUEST from the European Commission.

It is therefore interesting to compare these two very different modelling approaches. There is a large body of literature that has used VAR (vector autoregression model) to investigate the transmission of international shocks – mostly monetary shocks – in an open economy. This literature is mostly based on a small scale VAR: see, for example, Sims (1980, 1992), Bernanke and Blinder (1992), Clardia and Gali (1994), Canova and de Nicole (2002), Uhlig (2005) and many others. The model has also been applied to study the impact of fiscal policy: see, among many, Blanchard and Perotti (2002), Kim and Roubini (2008), and Mountford and Uhlig (2009). The VAR model has been used to study oil price shocks, capital controls and exchange rates: Kim (2003, 2014), Millard and Shakir (2013).

By using a small scale VAR we are losing information. For example, central bankers monitor a large number of variables and if they do not incorporate all available information in their decision process, they may mis-specify the model.

Furthermore, if we use a small scale VAR, the impact of the impulse response will be limited to a set of variables.

To overcome the limitation of small scale VAR, the factor model was introduced by Bernanke, Boivin and Eliasz (2005). This model has been widely used to investigate various shocks to the economy. For example, Lagana and Mountford (2005) applied the same methodology to investigate the impact of monetary policy shocks on the UK economy. Mumtaz and Surico (2009) extended the Bernanke, Boivin and Eliasz (2005) models to look at the impact of external shocks on the open economy (2009).

This work is closely linked to Mumtaz and Surico (2009). They used their framework to examine the impact of foreign shocks on the UK economy. They found that shocks to foreign economic activity have little impact on the UK economy, although they have not distinguished the source of the foreign shocks. The shocks they studied mostly originated in advanced economies. We are extending their analysis to include emerging economies.

We separate supply shocks and oil price shocks. The UK was a net oil exporter from 1982 to 2005. Oil price and foreign supply shocks were expected to have different impacts on the UK. Increases in the oil price boost oil revenue but they also drive inflation up. We are extending Mumtaz and Surico's (2009) UK data from 2005 to 2012 and using a new data set for advanced and emerging economies we are using a new data set. This list is available in appendix B.

Our contribution is to differentiate sources of shock between advanced and emerging economies and also separate oil price and supply shocks using a rich data set up to 2012. We compare the outcome to a large scale model. We investigate the following shocks: demand shocks in advanced and emerging economies, supply shock, and oil price shock.

We use these shocks with sign restriction. Following the contribution of Mumtaz and Surico (2009), we ask whether shocks originating from these two groups of countries will differ. What would be the impact of oil price shocks on the UK price and what would be the impact of a supply shock from these groups of countries over a disaggregated consumer price deflator? The result of these shocks will be checked against the large scale quarterly model NiGEM.

3.3 Methodology

The model is based on Bernanke et al. (2005), expanded by Mumtaz and Surico (2009) to include international factors. Following Mumtaz and Surico, the model has two blocks, one for foreign (advanced economies, emerging economies and oil prices) and the other for the domestic UK economy. The state of the economy cannot be observed but we can summarise in the K factor of unobservable factors.

$$F_t = \left[F_t^{G7}\ F_t^{EM}\ F_t^{oil}\ F_t^{UK}\right]' \qquad (3\text{-}1)$$

Advanced economies, emerging economies and oil prices are part of a foreign block; the central bank policy rate will be Rt and directly observable. The joint dynamic Ft and Rt will be determined by the following equation:

$$\begin{bmatrix} F_t \\ R_t \end{bmatrix} = B(L) \begin{bmatrix} F_{t-1} \\ R_{t-1} \end{bmatrix} + u_t \qquad (3\text{-}2)$$

In this equation B(L), there is a conformable lag polynomial of finite order p, and $u_t = \Omega^{1/2} e_t$is an error term with mean zero $e_t \sim N(0, I)$ and $\Omega = A_0(A_0)'$

Equation (3-2) is a standard VAR model, the only difference being F as unobserved factors which are extracted by a large panel of the N indicator which contains important information about the economy. Let X_t be a vector of information variables: the factors and the variables in the panel are related by an observation equation of form:

$$X_t = \lambda^f F_t + \lambda^R R_t + v_t \qquad (3\text{-}3)$$

Where λ^f and λ^R are N by K and N X 1 matrices of factor loading, and v_t is a vector of N by 1 zero mean disturbance.

Equation 3-2 and 3-3 is the FAVAR model from Bernanke, Boivin and Eliasz (2005) extended to include foreign blocks (Boivin, Giannoni and Mihov, 2009 and Mumtaz and Surico, 2009). X_t Will be driven by the joint dynamic of Ft and Rt. The factor can be estimated by principal components (Stock and Watson (2002, 2005)). Principal components analysis is a mathematical tool that reduces a complex data set, possibly correlated, to a lower dimension and uncorrelated data. In other words, we try to find or construct a small data set that can describe and represent characteristics of a large data set.

To estimate FAVAR given by equation (3-2), we need the unobserved factors. We follow closely Mumtaz and Surico (2009) and assume that the foreign block contains five factors, where $y^{g7}$and π^{g7} represents the real activity factor and inflation factors of advanced economies, y^{em} and π^{em} represents emerging economies' real activity and inflation, and Oil represents real oil price factors. These factors are identified through the upper N by 6 block of matrices that was assumed to be a block diagonal. Forexample, advanced economy real activity factors come from the real activity of the G7 in our panels. All factors are identified accordingly.

The UK dynamics of UK variables are captured by K domestic factors. The domestic factors are extracted from the full panel of the UK series, in other words, the bottom N by K block of a full matrix. This will ensure that the dynamic of the variable in X_t depends on the structure imposed on by the factor loading parameters.

3.4 Data

We use quarterly data from 1975 to 2012 Q4. The data contains 615 foreign and domestic variables. The advanced economies are the G7 (USA, Canada, Germany, Italy, France and Japan) and the emerging economies are Brazil, India, China, Russia, South Africa, Turkey and Mexico. The following data was collected for these countries.

Real economic activity: Real output, industrial production, exports and imports of goods and services, the oil intensity of the economy as a share of output.

Prices: Consumer price deflator, GDP deflators, import prices, imports of commodity and non-commodity prices.

Interest rate: We assume that the G7 financial market has relevance worldwide, and therefore collected a 3-month interbank rate and 10 years of government bond yields.

Oil price: We included the oil price for the Brent and Dubai markets and deflated it by the US consumer price to create a real oil price.

All of this data is seasonally adjusted, and we take log first differences of these series and in some cases log the second difference to ensure the data is stationary, apart from the interest rate and oil intensity of the economy which we will use as the level.

The UK data includes real activity and expenditure, deflator prices, government accounts, the household sector, the labour market, and the financial sector. All of this data is transformed to be stationary and standardised prior to estimation. The source for UK data is mostly the ONS, the Bank of England and DataStream; the international data is mostly taken from their national and international sources, the IMF, DataStream and other sources such as NiGEM (NIESR) (most data in NiGEM is also taken from these sources and then transformed or extended). Overall, we collected 406 domestic series and 209 foreign series; the full list is in Appendix B.

3.5 Estimation

We follow Mumtaz and Surico (2009) and Bernanke et al. (2005) in using two-step procedures. In the first step, the unobserved factor and the loading factor will be estimated via principal components. In the second step, we use these factors and a 3-month Treasury bill to estimate VAR via Bayesian methods. Our UK model has five factors. This implies that our estimation of VAR will have 12 endogenous variables. We include two lags in our estimation.

3.5.1 Identification of structural shocks

We look at the impact of the following shocks originating from advanced and emerging economies and oil markets.

Demand shocks in advanced and emerging economies: These shocks are associated with the rise and fall in confidence in these economies. They could be the fiscal policy in these economies or events that reduce or increase spending confidence in households and firms. As a result, the aggregate demand will shift in these economies in our scenario.

Supply shock: These shocks come from the production sector which will in turn impact the supply and prices of goods and services. This could be an increase in productivity and a reduction in the price which would shift the aggregate supply curve.

Oil price shock: shocks originating in the supply or production of oil, or instability in an oil exporting region (Kilian 2014).

In all our shocks, we look at the impact of a 1 per cent increase in aggregate demand, aggregate supply and real oil prices. As in chapter one we need to impose additional restrictions on the model. One possibility would be to add zero restriction following Arias et al. (2018), however, this is quite computationally intensive, especially in a

VAR of high dimension with several shocks. Thus we leave this for future work and we choose a simpler option of imposing extra sign restrictions on the identified shocks to ensure each shock has a unique pattern. A drawback of this approach is that some of these restrictions involve quite strong assumptions, as we detail below. Then we analyse the impact of these shocks on selected domestic variables in the UK.

$$\begin{matrix} & & [AD^{g7} & AS^{g7} & R^{g7} & AD^{em} & AS^{em} & O & F^{uk} & R^{uk}] & \end{matrix}$$

$$\begin{bmatrix} y^{g7} \\ \pi^{g7} \\ r^{g7} \\ y^{em} \\ \pi^{em} \\ Oil \\ F^{uk} \\ r^{uk} \end{bmatrix} = \begin{bmatrix} + & + & - & \times & - & - & 0 & 0 \\ + & - & - & \times & \times & + & 0 & 0 \\ + & - & + & - & - & + & 0 & 0 \\ + & - & - & + & + & - & 0 & 0 \\ + & \times & + & + & - & + & 0 & 0 \\ + & - & - & + & - & + & 0 & 0 \\ \times & \times & \times & \times & \times & \times & \times & 0 \\ \times & \times & \times & \times & \times & \times & \times & \times \end{bmatrix} \begin{bmatrix} e_{AD^{g7}} \\ e_{AS^{g7}} \\ e_{R^{g7}} \\ e_{AD^{em}} \\ e_{AS^{em}} \\ e_{O^{p}} \\ e_{F^{uk}} \\ e^{r} \end{bmatrix}$$

Identification Scheme.

As we can see from the sign identification restrictions above, we order the international factors first, then UK factors and finally observe the factor interest rate. (+) indicates a positive, (-) shows a negative impact and (x) is a free estimate in the foreign block.

- We assume that a supply shock in advanced economies has a negative impact on emerging market demand due to lower demand for emerging market products and vice versa. In addition, we assume that advanced economies' central banks actively monitor global development. Thus, as emerging markets grow due to demand shock or supply shock, the central banks in advanced economies reduce the rate to support the economy or prevent deflation. Supply shock and falling prices in emerging economies creating deflationary pressure in advanced economies (Hirakata et al. 2014) A demand shock in advanced economies will increase output, price, rate, oil price and also output and price in emerging economies.

- A supply shock in advanced economies will increase output and reduce prices and rates in advanced economies. This is the same as Peersman (2005) and Fry and Pagan (2011), however, the impact on emerging market output is negative while the price is unrestricted. Furthermore, the impact on the oil price is negative following Kilian and Murphy (2014).

- Policy rate shocks in advanced economies reduce output and prices. As the rate increases, the capital flow will reverse and the cost of foreign denominated debt will increase. The impact on output in emerging economies will be negative and will increase prices. The impact on the price of oil is negative, consistent with the response of the price level (Peersman (2005)).

- A demand shock in emerging markets increases output prices and the oil price. The impact on advanced economies' supply and demand is unrestricted and on rates will be negative, consistent with the assumption described above.

- An emerging market supply shock increases output in emerging economies and reduces prices. It has a negative impact on output in advanced economies and the price will be unrestricted. The impact on oil price is also negative.

- An oil price shock could be due to disruptions to supply caused by natural disaster or changes in production quotas. Following Kilian and Murphy (2014), this leads to price increases and reduces output in both advanced and emerging economies. The central bank could react and increase the rate to reduce the price increases.

As we can see from these assumptions the impact on all UK variables will be determined endogenously in the model and we restrict the foreign block.

3.6 Results

3.6.1 International movement

We extracted six factors from foreign blocks in which three are factors from advanced economies, two are factors from emerging economies, and one will be real oil prices. These factors are extracted by the principal component analysis and presented below.

Figures 3-7 and 3-8 plot real economic activity and inflation in advanced economies. The grey bars are the recession in the US or recession in any two advanced economies. The pattern of real economic activity in advanced economies matched that reported in literature such as Kose et al. (2003), Bagliano and Claudio (2009) and Perri (2014). From the chart we can see the recession profiles in 1980, 1990, 2000 and the most recent one in 2007-9. The latest recession has the deepest contraction, followed by the recession in the early 1980s.

The profile of inflation factors in advanced economies is also matched to those reported in earlier literature such as Cicarelli and Mojon (2010). In the late 1970s and the early 1980s, advanced economies were associated with high inflation but since the mid-1980s and especially since the early 1990s, inflation has been persistently positive, low and stable. This is in line with the common disinflation around the world that Rogoff (2003) reported. Furthermore, the commodity price shock is considered to be one of the main drivers for the global inflation dynamic, although this factor cannot be explained by the comovement alone (Gerard, 2012).

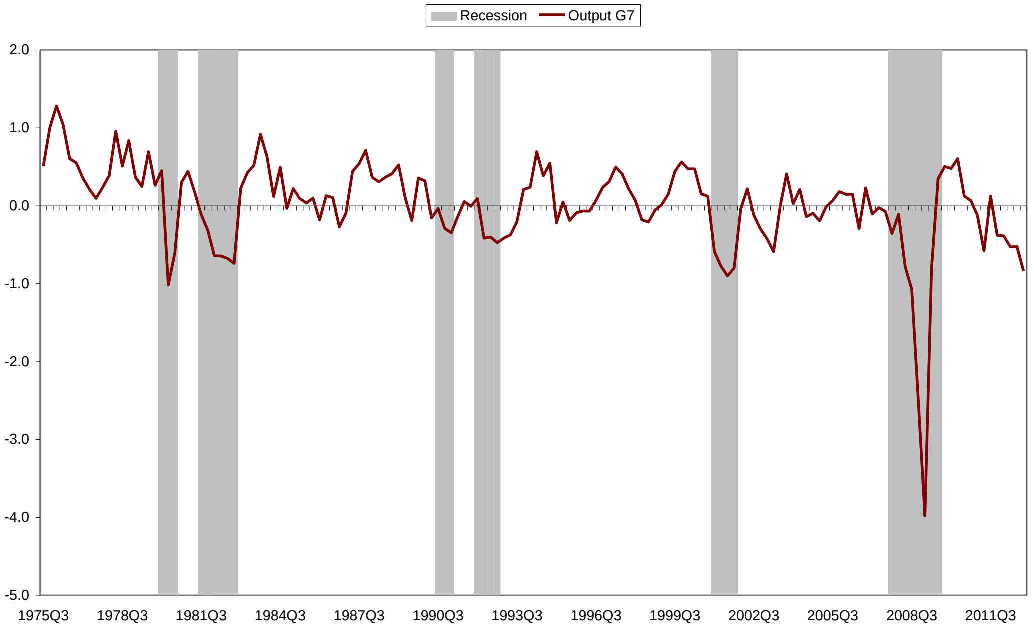


Figure 3-7: Real economic activity factors in advanced economies

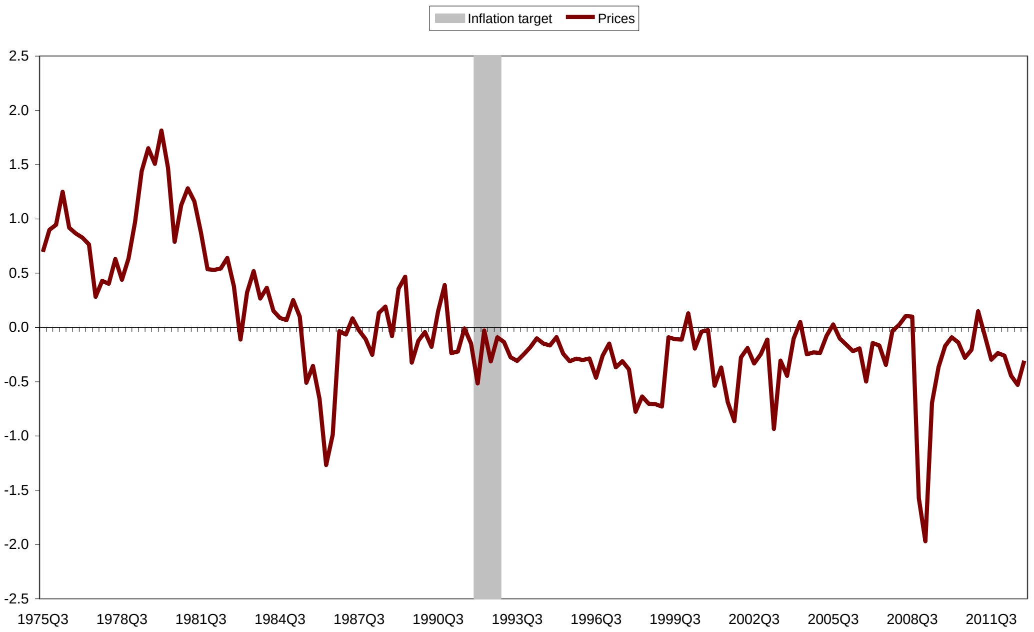


Figure 3-8: Inflation factors in advanced economies

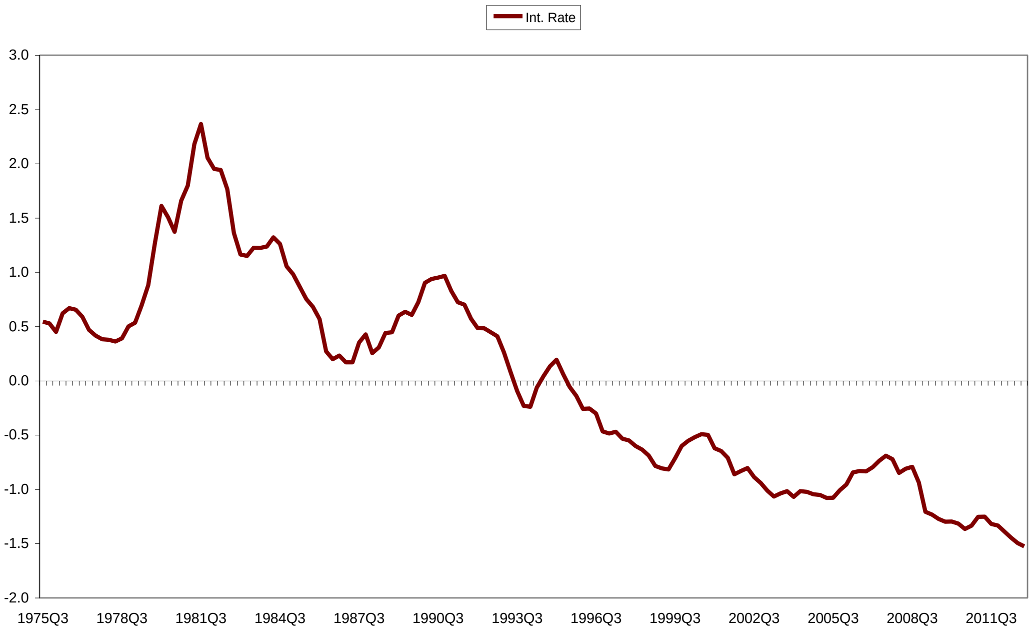


Figure 3-9: Interest rate factors in advanced economies

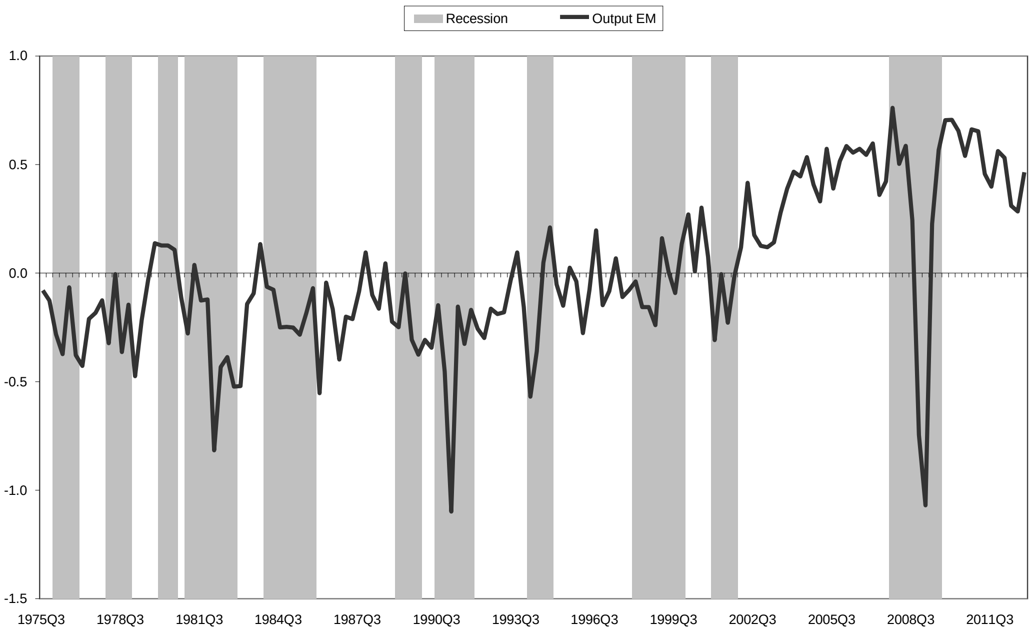


Figure 3-10: Real economic activity factors in emerging economies

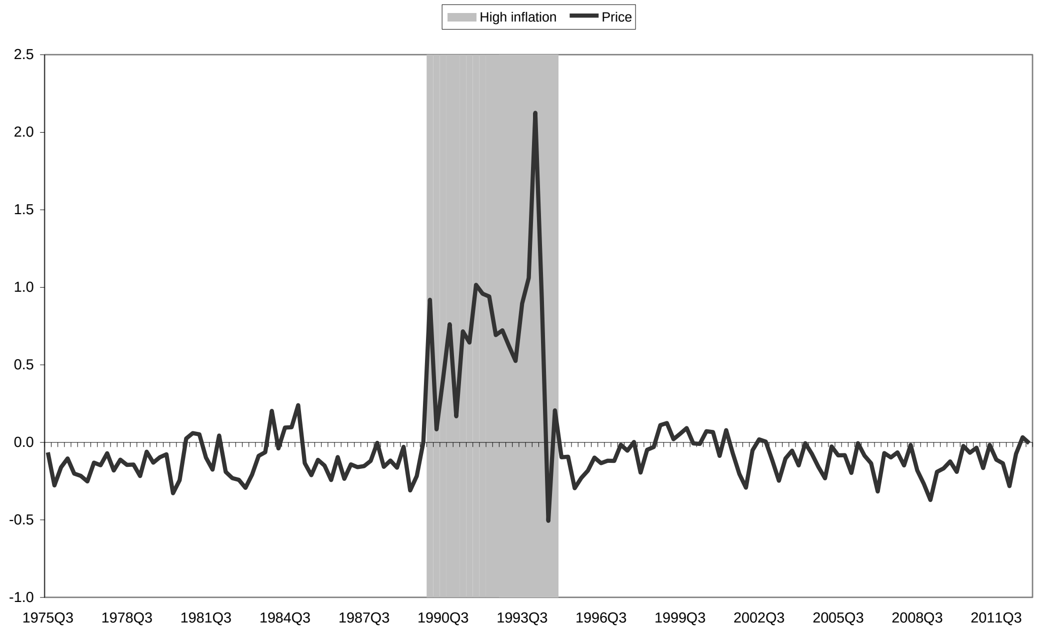


Figure 3-11: Inflation factors in emerging economies

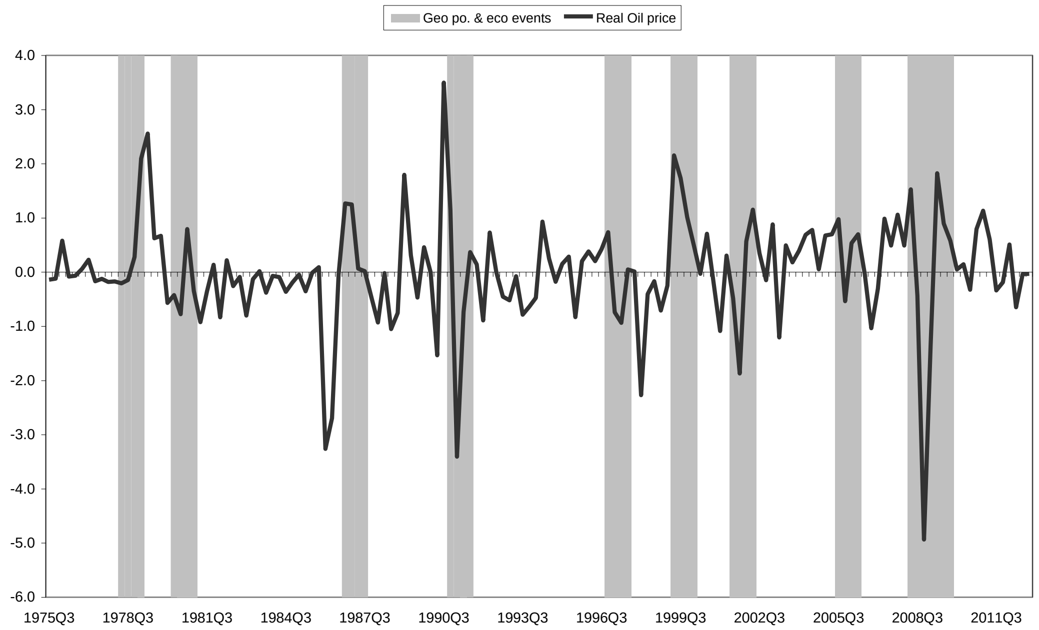


Figure 3-12: Real oil price factors

The comovements in real activity and inflation for emerging economies are presented in Figures 3-10 and 3-11. The grey bars show an economic crisis in at least two of these countries. The dates for the economic crises come from Gourinchas and Obstfeld (2011). The crisis could be a debt-crisis default, banking crisis or currency crisis. As we can see from the chart, crises show a comovement among these countries and lead to a decline in economic activity. The real activity in emerging economies also has comovement with the advanced economies. For example recessions in the early 1980s, the 1990s, 2000 and 2007 in advanced economies also coincides with a decline in economic activity in emerging economies.

The inflation profile in these countries is shown in Graph 9. From the mid-1980s to mid-1990s some of these emerging economies experienced very high inflation or even hyperinflation. Brazil had high inflation from 1986 to 1994, but from July 1994 to 1997 inflation reduced to international levels as a result of reforms such as revaluing the currency, making it illegal for the central bank to finance government debt and freezing wages. Mexico also experienced high inflation following a default in the 1980s, the peso crisis and currency devolution in 1994. The collapse of the Soviet Union was followed by reforms in Russia in the early 1990s that also brought on high inflation. In Turkey inflation was attributed to the high public sector budget deficit and massive infrastructure investment, among other factors Aykut (2005).

The oil price factor is in figure 3-12. The grey bars show geopolitical events in the oil exporting countries. These events in the oil market could be the Arab Oil Embargo, the Iran–Iraq war, the Iraqi invasion of Kuwait and the Asian financial crisis when demand plummeted from these energy-hungry countries, the 9/11 attack, and the global financial crisis in 2007-9.

Overall, these international comovements in emerging and advanced economies are mostly attributed to common components. The potential drivers for these comovement points in the literature (see Canova et al. (2007), Crucini, Kose and Otrok (2011), Wen (2007)) are international trade, financial conditions, monetary policy, and movement in productivity and consumption demand.

3.6.2 Aggregate demand shock in advanced economies

We consider the increase in aggregate demand by 1 per cent on average in advanced economies. This increase could be a result of fiscal expansion or increases in confidence which boost private consumption and investment. The governments in these economies boost demand through various stimuli. The impact of this demand will spill over to their trading partners such as the UK.

The impulse response of the shock is presented in Figures 3-13 and 3-14. The shock is identified by sign restriction. The magnitude of the impact of the shock depends on the exposure of the economy under investigation to the country that originated the shock, as well as the different price and demand elasticities of trade: Orazgani and Fic (2013). As can be observed, the increases in aggregate demand in advanced economies will push inflation factors in the advanced economy, while the impact on the emerging market inflation factor is lower. However, the impact on the interest rate factor in advanced economies is prolonged while the impact on the oil price is quite short lived.

The dynamic impact of this shock on the UK economy in Figure 3-13 demonstrates that prices, the GDP deflator and wages will increase in line with the advanced economies. The GDP deflator will grow by around 0.15 PP over three periods while the consumer price indices and wages will grow by around 0.2 PP over the same periods. This is consistent with the expansion in global demand that puts upward pressure on the price of manufacturing inputs and intermediate goods.

The trade balance will improve as a result of depreciation in the nominal effective exchange rate. This improvement is in line with the recent study by the Bank of England: see Kamath and Varun (2011). As a result of depreciation in the effective exchange rate by around 25 per cent from mid-2007 to 2009, there were significant improvements in the current account balance.

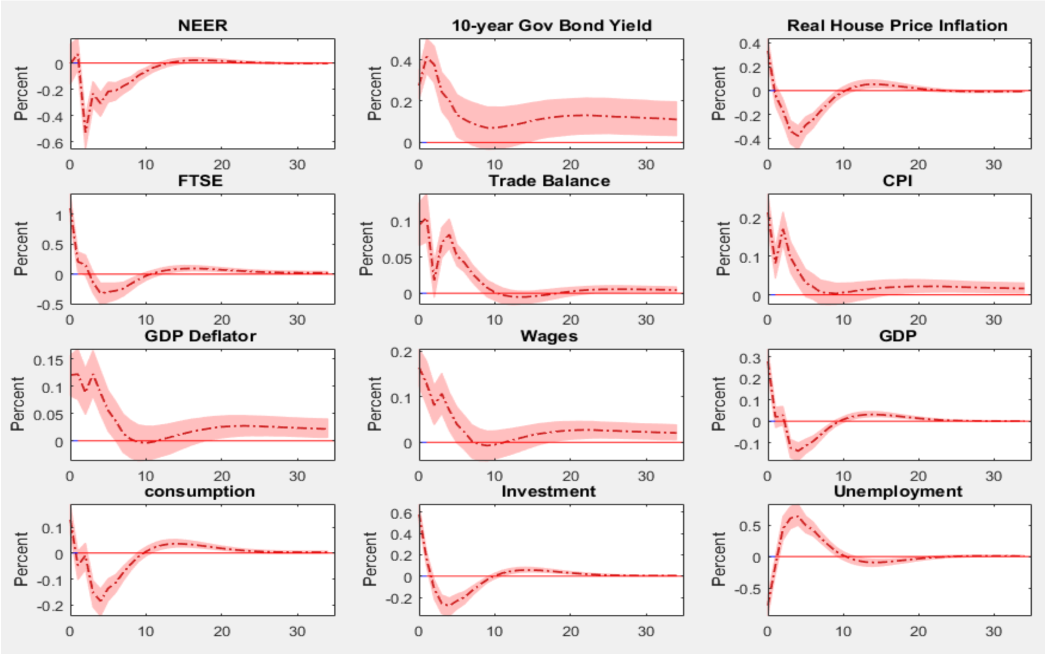


Figure 3-13: Aggregate demand shock in advanced economies and the impact on UK variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

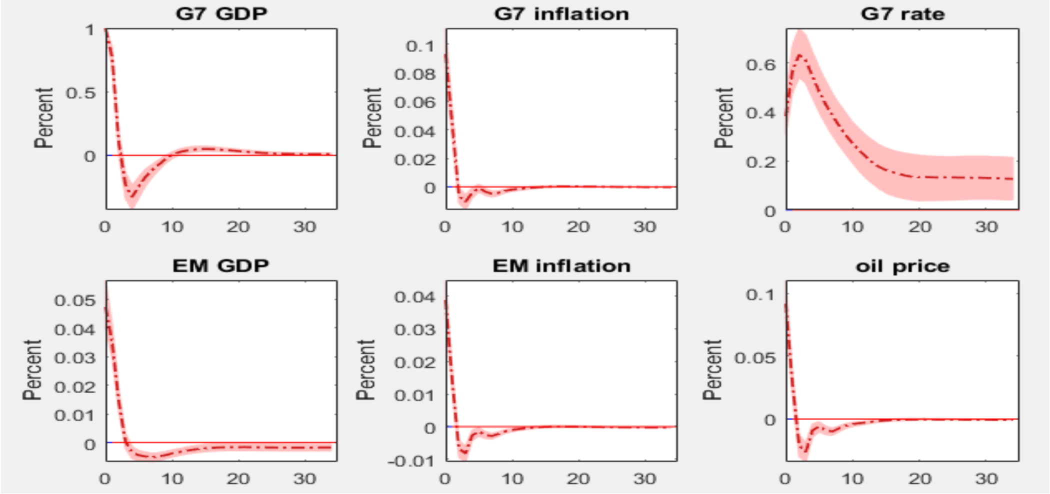


Figure 3-14: Aggregate demand shock in advanced economies and the impact on foreign variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

For the first two quarters, as a result of strong demand from advanced economies, real output will rise. This, combined with a rise in prices, will create prolonged inflationary pressure. Consequently the UK central bank will contract monetary policy to combat inflationary pressure stemming from foreign demand. The impact is shown on the 10-year government bond yield. The government bond yields will increase by 0.4 per cent on average. This increase will have an adverse impact on the real economy in the medium to long term. Consequently, real output, consumption and investment will fall for the first 10 months before reverting.

The impacts on financial instruments such as house and equity prices are pro-cyclical, meaning moving with economic development. These variables respond immediately to shocks and rise with the initial jump in output. However, after the central bank raises interest rates, these variables will fall back. One explanation could be the result of a hike in interest rates and falling output due to economic adjustments. The cost of mortgages will be unaffordable and demand for houses will drop. In addition, people may switch from equity to bonds due to the rate increase.

3.6.3 Aggregate demand shock in emerging economies

The impacts of emerging economy demand shocks for the same variables are presented in Figures 3-15 and 3-16. The impulse responses of all variables in emerging economies are comparable to those in advanced economies. Notwithstanding, the magnitude is different compared to the advanced economies: most variable response is one third of that seen in advanced economies. Despite having different ties with the UK and economic structures, the similarity of the impact shows the sensitivity of the UK economy to international shock. In addition, this confirms the importance of emerging market shocks for the UK economy.

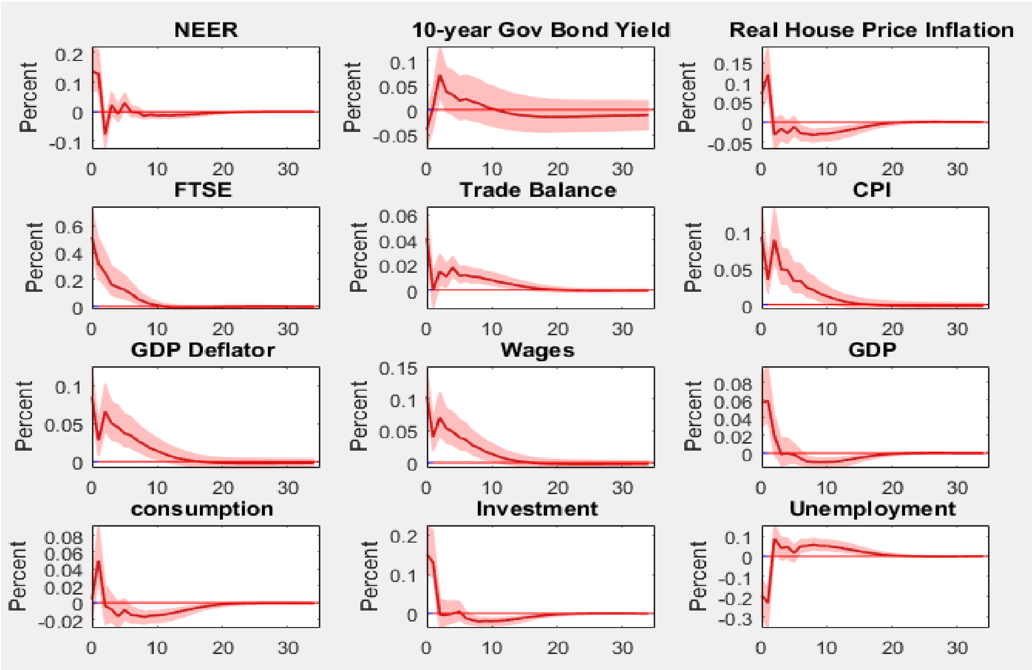


Figure 3-15: Aggregate demand shock in emerging economies and its impact on UK variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

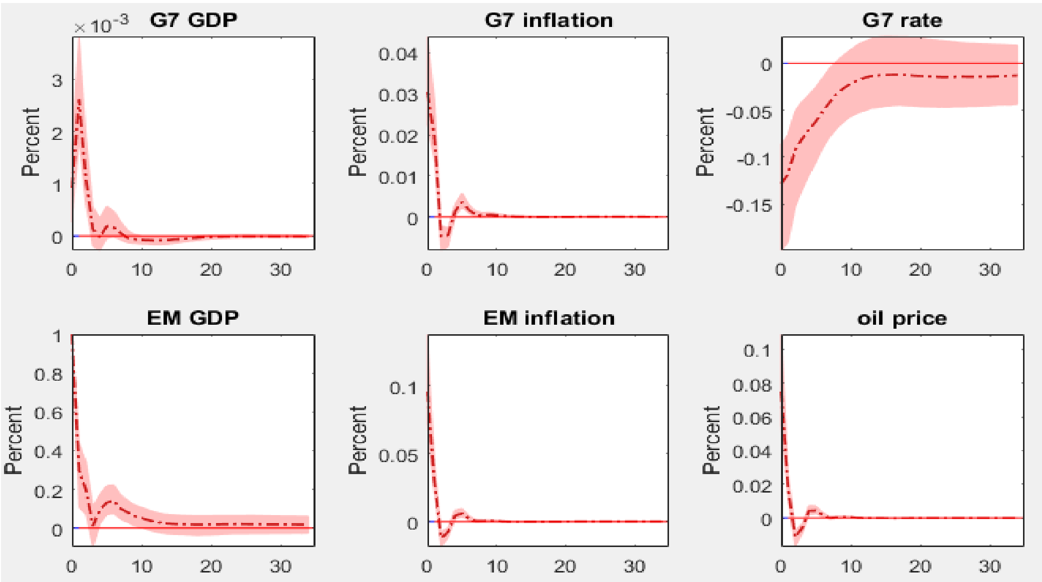


Figure 3-16: Aggregate demand shock in emerging economies on foreign variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

3.6.4 Oil price shock

The impact of oil price shocks on the macroeconomy has been the subject of many studies. The magnitudes of the impact are dependent on the oil intensity of the economy, oil exporter status and the methodology of estimation (WB 2015); for example, a 10 per cent increase in oil price will reduce US real activity by 0.3-0.6 per cent and that of the Euro Zone by 0.1-0.3 per cent (Jimenez-Rodriguez et al., 2005). Additionally, the literature broadly confirms that the impact of the oil price on the economy has decreased since the mid-1980s — see, for example, Bernanke et al. (1997), Hooker (2002) and Hamilton (2009). This could be a result of the reduction in the oil intensity of these economies (appendix A shows the oil intensity of the countries studied).

The literature in this area also suggests that the impact of oil price shocks on advanced economies depends on the underlying shocks: see Baumeister et al. (2010) and Peersman et al. (2012). These studies are mostly focused on the impact of oil price shocks on US or major oil exporting countries such as the OPEC members, and a few studies focus on the cross-country impacts.

Nevertheless, the UK economy moved from being a traditional oil importer to an oil exporter in the early 1980s. Empirical studies suggest that a 10 per cent fall in oil price will reduce output by 0.8 to 2.5 per cent in oil exporting countries (WB, 2012). Therefore the impact of the shock on the UK economy could vary due to its oil exporter status. The asymmetric impact of oil price also has been widely studied. If we assume that the impact on the oil price is symmetric, then a positive/negative price shock will increase/decrease government revenue, and it may help output or it may reduce real economic activity.

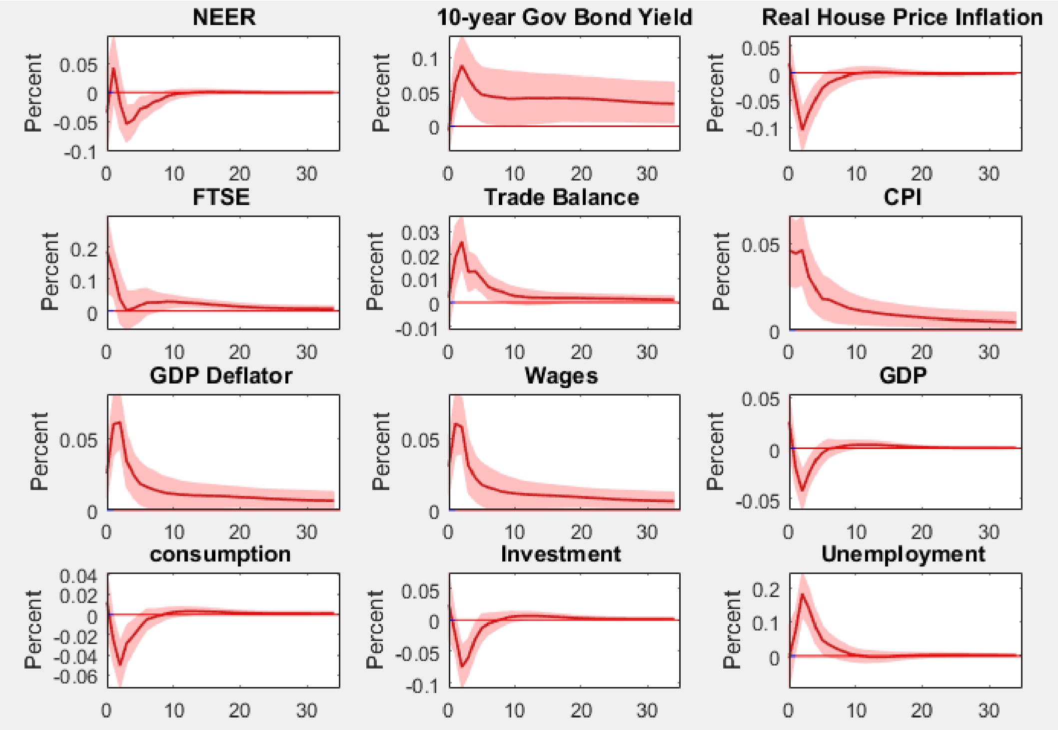


Figure 3-17: oil price shock and its impact on UK variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

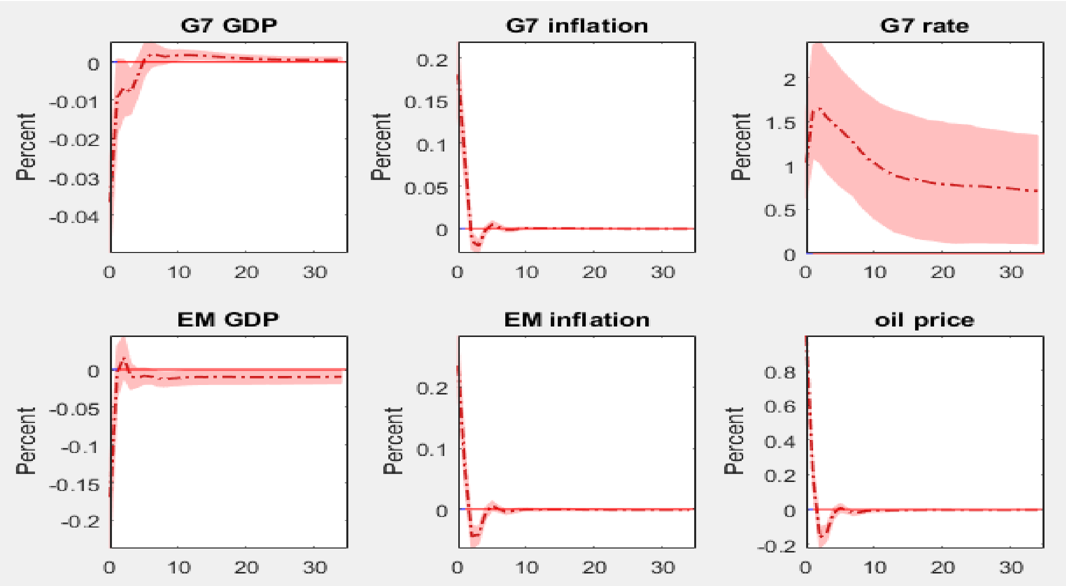


Figure 3-18: oil price shock and its impact on foreign variables

This figure shows the median response together with 68 per cent confidence band. The shock scale to unit of QE shock and 25000 simulation, with the first 20000 as burn in, were used to generate impulse response.

Figure 3-17 and 3-18 plots the impact of a 1 per cent increase in real oil prices on the advanced and emerging economies and selected variables in the UK. As we can see from the graph, when the oil price increases the real activity factor in advanced and emerging economies falls and prices increase. The magnitude of the impact on inflation for both advanced and emerging economies is the same while the impact on output in advanced economies is lower. This could reflect reduction in oil intensity of these economies and high dependency on oil in emerging economies.

The effect of oil price shocks in the UK economy is in line with advanced and emerging economies at least for output and inflation. We see a reduction in output and a rise in prices. This may reflect that the UK was an oil exporter for the majority of the sample and it’s possible the UK was shielded from external oil shocks. The price will increase in the UK as the oil price feeds into the consumer price deflator. It shows that impacts on wages and inflation are quite long lasting. As a result of the increase in price and wages, monetary policy reacts and the interest rate will increase. Mortgages become more expensive, reducing the demand for houses and thus house prices.

3.6.5 International supply shock and distribution of domestic prices

The literature has investigated how the sectorial prices respond to shocks. For example, Boivin et al. (2009) and Balke and Wynne (2007) investigate the impact of monetary policy shocks on prices while Mumtaz et al. (2009) look at the impact of supply shocks on price deflators. However, in this study, following Mumtaz et al. (2009), we look at the impact of supply shock from emerging economies, advanced economies and oil price shocks on the consumer price deflator and associate quantity. This will help us to quantify and distinguish the relative importance of the supply shocks originating from advanced economies versus emerging economies, and to compare them to oil price shocks. Figures 3-18 and 3-19 plot the outcome of these shocks on the consumer price deflator left panel and the associated quantity on the right panel.

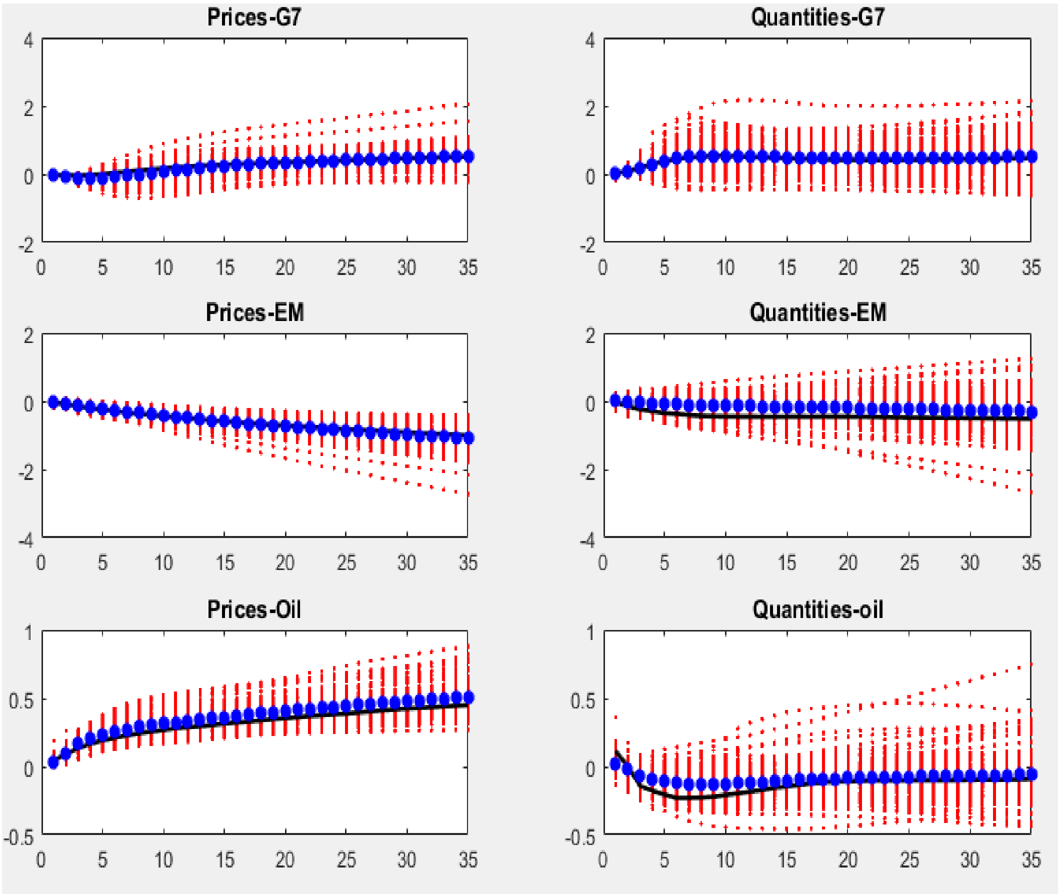


Figure 3-19: Impact of supply on disaggregated consumer price deflator (blue is median and the black line is the aggregate response)

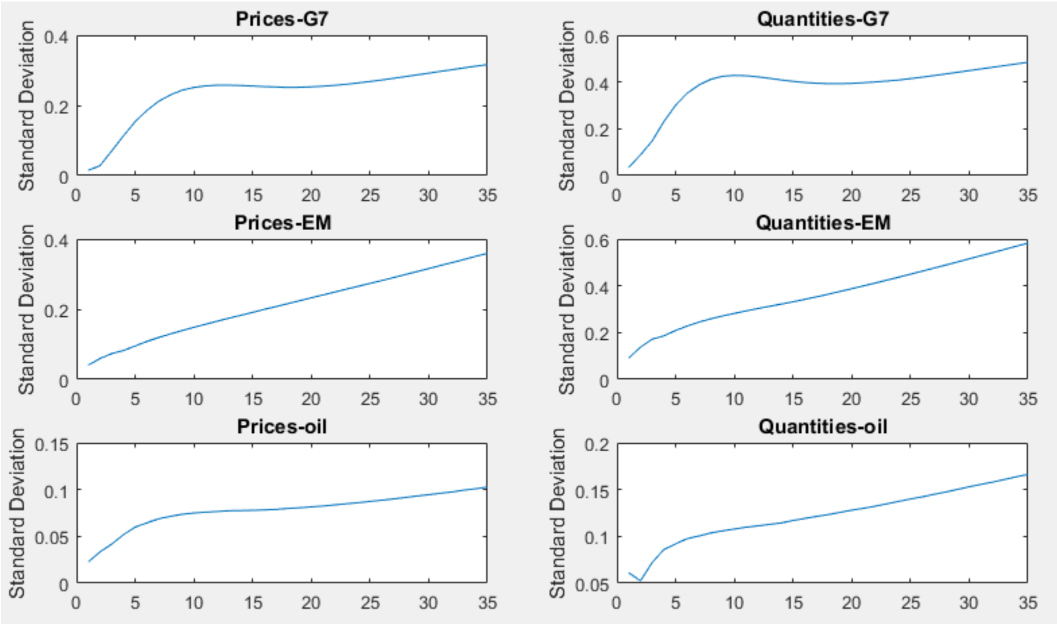


Figure 3-20: Standard deviation at each point for the consumer price deflator and its quantity due to shock to an advanced economy, emerging economies and oil price shock.

As we can see from the graph, a positive supply shock to both emerging markets and advanced economies reduces prices in the UK. However, the quantity response for the advanced economy shows an increase (a wide dispersion) while quantity is less responsive to emerging market supply shocks. This may confirm that a supply shock in advanced economies has more impact on UK price than for emerging economies. Furthermore, the panels in Figure 3-20 show the increases in standard deviation response at each forecast horizon point. This will confirm increases in dispersions of price and quality at each forecast horizon. This suggests that both supply shocks have a permanent impact on some components.

In the final row we present the impact of the oil price shocks on the consumer price deflator. The increase in oil price shocks will lead to increases in prices and reduce the quantity. The standard deviation of response of oil price shocks for each forecast horizon also shows a major discrepancy between prices and quantity: some products may become permanently expensive. We also check if this is happening under falling oil prices, and the result suggests that oil price increases have a permanent impact.

3.6.6 Forecast error variance decomposition

To evaluate the relative importance of each shock, we compute the forecast error decomposition. The median of this computation for selected variables in the UK is in Figure 3-21. Overall the advanced economies shock has a substantial impact on the UK variables. The demand and supply shock in advanced economies contributes to most of the forecast error variance of these selected variables. For example, each of these two shocks explain 5 to 10 per cent of the forecast variance of these variables. Interestingly, we don't see a huge contribution to forecast variance from an oil price shock. This could be due to reduction in oil intensity of production in the advanced economies and in particular in the UK.

In addition to these shocks, we can see a large contribution from emerging market demand and supply shocks, notably on inflation and asset prices such as the FTSE and government bond yield. For example, we expected that interest rate shock in G7 could have explained more of the forecast error variance of asset prices such as nominal effective exchange rate (NEER) and government bonds.

However, the forecast variance of government bonds due to supply shocks in emerging economies and demand shock in advanced economies is significant compared to the interest rate. Also, it's hard to justify the forecast variance of the nominal effective exchange rate due to demand from both emerging market and advanced economies being the same. Given our strong assumption for identification some of these results need further investigation.

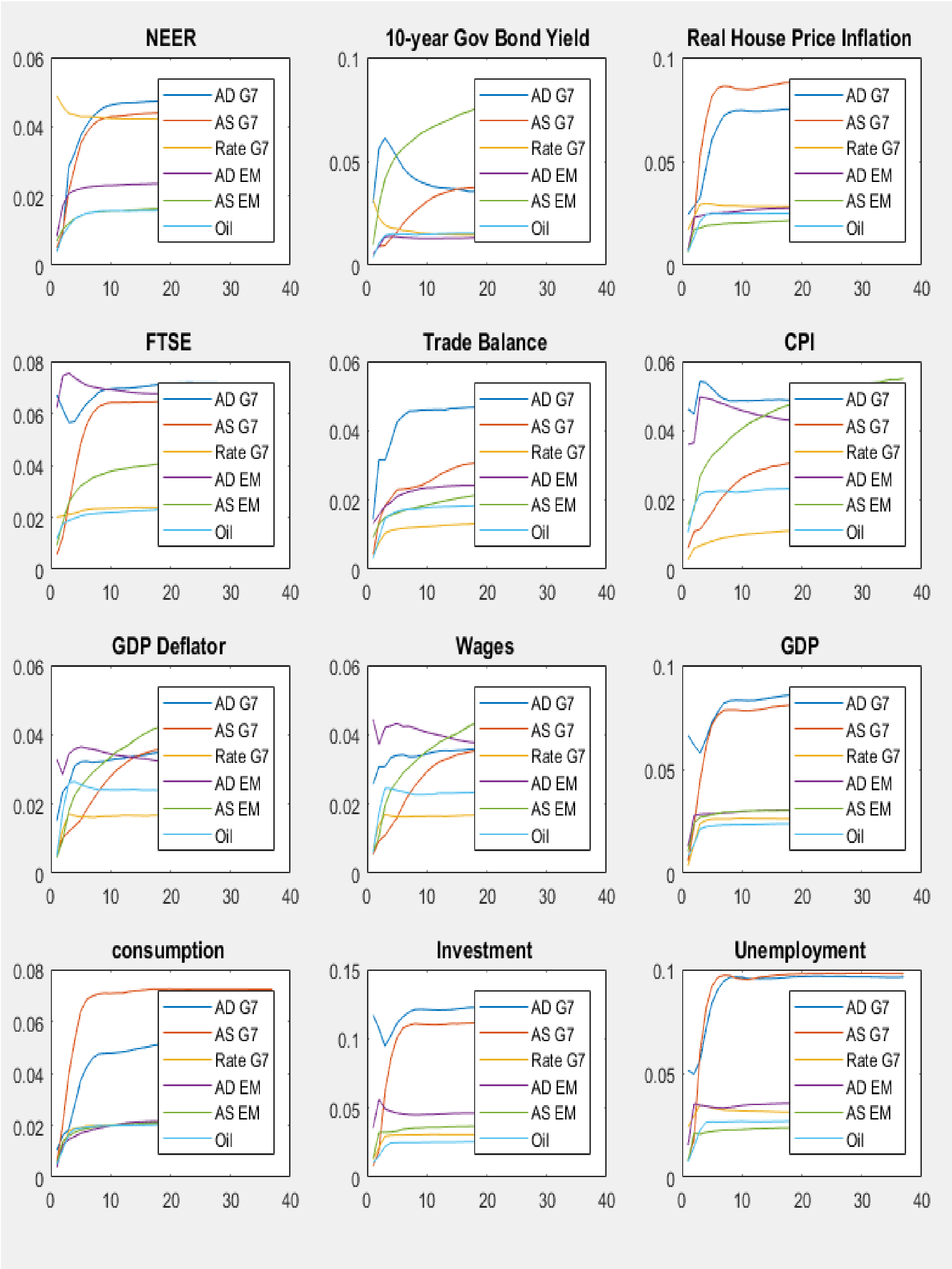


Figure 3-21: Forecast error variance decomposition for selected UK variables

3.7 Sensitivity analysis

We perform two sets of analysis to check our demand shock and oil price shock. First, we perform a subsample analysis and compare the full set of data. Then we compare the FAVAR result to a large scale model NiGEM.

3.7.1 Subsample analysis

To check the credibility of our results we perform a subsample analysis on data since 1997. Figures 3-21 and 3-22 present the outcome of the subsample (solid line) compared to the full sample (dotted line) for selected variables. The results are similar to the full sample periods but the adjustment process for prices is faster, around 2-4 quarters compared to nearly 3 years in full sample sizes.

However, the impact of the shock for the real economy such as real output, consumption and investment arise nearly the same, with a slightly larger impact in initial periods. The quick adjustment in prices could be the outcome of low and stable inflation and monetary policy in these periods. The picture is the same for emerging markets. Overall, this exercise confirms the validity of the importance of the shock originating from these economies, and most importantly emerging economies.

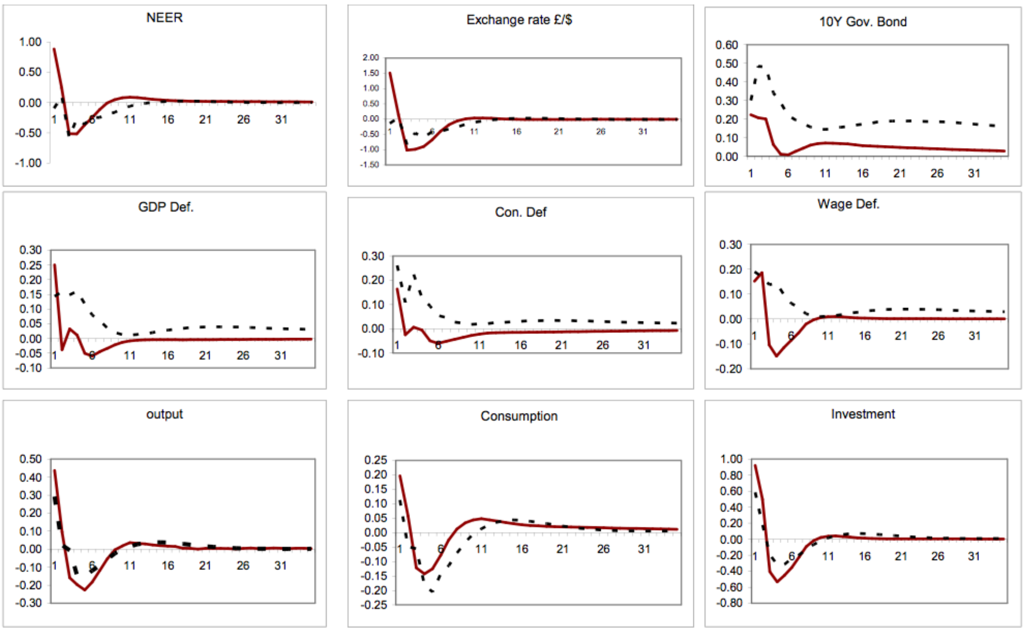


Figure 3-22: advanced economies full sample (solid line) and subsample (dotted line)

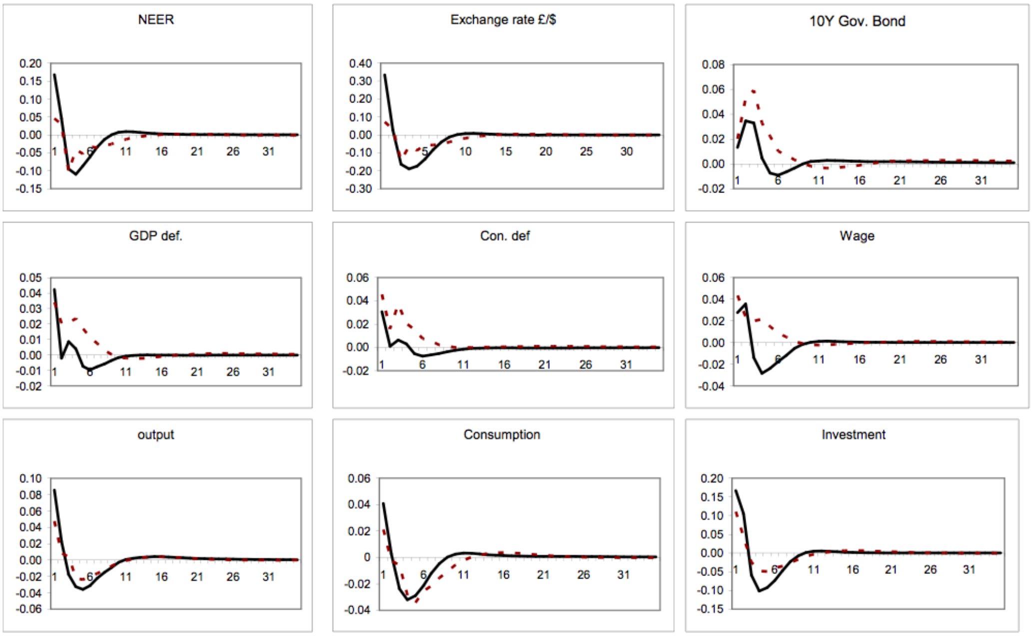


Figure 3-23: emerging economies full sample (solid line) and subsample (dotted line)

3.7.2 Model comparison

To evaluate our results in FAVAR, we compare the demand shock from advanced and emerging economies and oil price shocks to the National Institute Global Macroeconomic Model (NiGEM).

NiGEM is a large-scale quarterly macroeconomic model of the world economy. Most OECD countries are modelled separately, and the rest of the world is modelled through regional blocks. Economies are linked through trade, competitiveness and financial markets. All country models contain the determinants of domestic demand, export and import volumes, prices, current accounts and net assets. The comprehensive list of individual countries and regions for NiGEM version 2013 is presented in Table 3-1.

		World model NiGEM	
Individual countries model			
EU27	EU27		
Euro Area	non EMU	**Individual countries**	**Region**
Austria	Bulgaria	Australia	Africa
Belgium	Czech Republic	Canada	Asia Far East
Estonia	Denmark	China	commonwealth and independent states
Finland	Hungary	Hong Kong	Developing Europe
France	Latvia	India	Latin America
Germany	Lithuania	Japan	Middle East
Greece	Poland	Mexico	
Ireland	Romania	New Zealand	
Italy	Slovenia	Norway	
Netherlands	Sweden	Russia	
Portugal	UK	South Africa	
Slovak Republic		South Korea	
Spain		Switzerland	
		Taiwan	
		US	

Table 3-1: The list of countries and regions for NiGEM version 2013

NiGEM is structured around the national income identity, can accommodate forward looking consumer behaviour and has many of the characteristics of a Dynamic Stochastic General Equilibrium (DSGE) model. Unlike a pure DSGE model, NiGEM is based on estimation using historical data. The model is designed for policy analysis and forecasting. It uses quarterly data starting from 1961 and contains 6000 equations. Therefore, describing the model of each country and giving a detailed explanation is outside the scope of this overview. A reader seeking details of the model is encouraged to visit the National Institute web site and in particular Barrel et al. (2004a).

As part of our exercise in FAVAR, we look at supply and demand shocks in advanced and emerging economies and oil price shocks and we compare the results to those in NiGEM. I review key equations in NiGEM and the way in which it interacts with the price system. Supply and demand is the core of the NiGEM model, as is shown in the figure below:

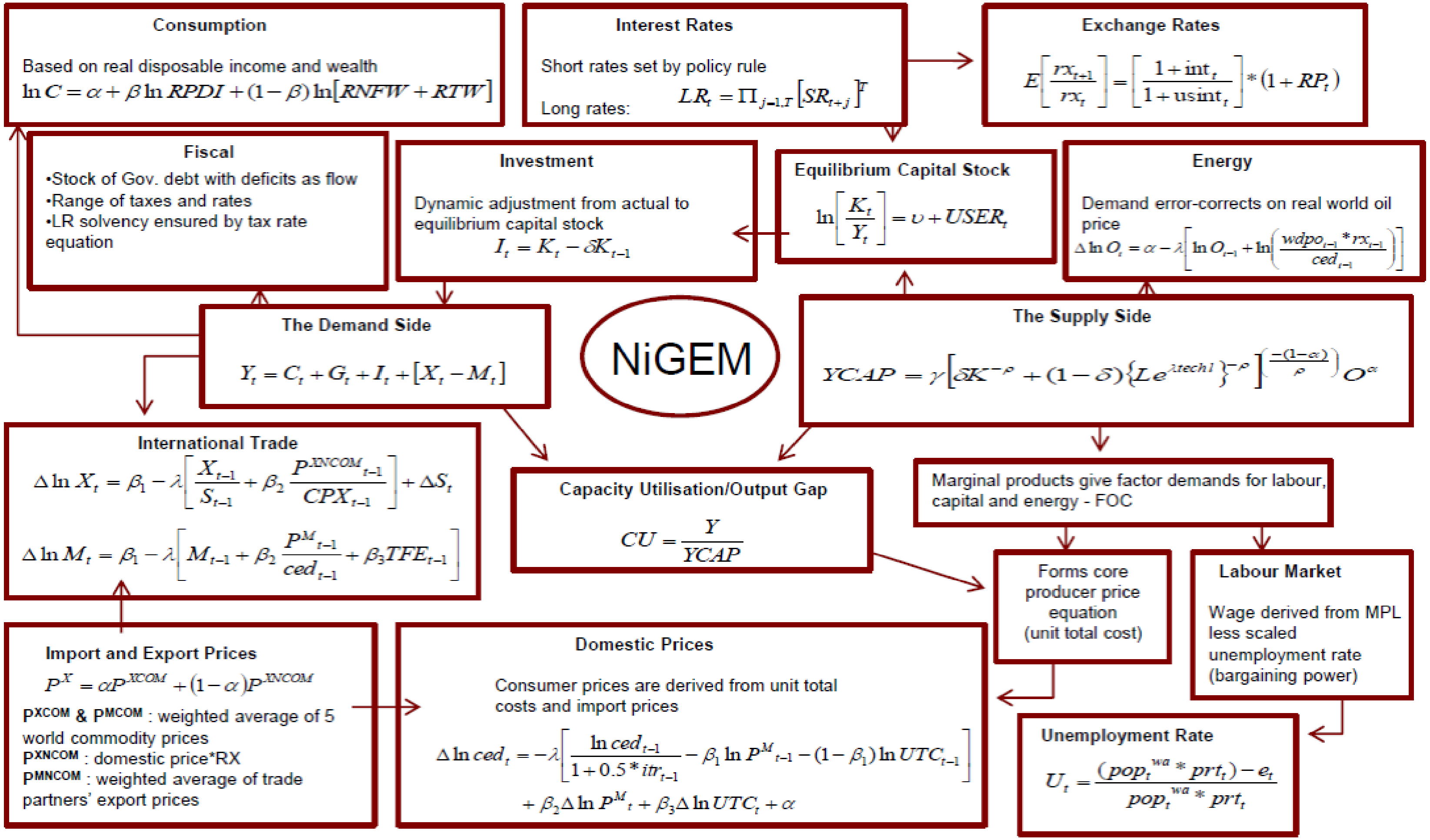


Figure 3-24: The schematic overview of the NiGEM model

(Source: NIESR)

3.7.2 .1 Overview of the key equations

The economic output in the short to medium run is driven by the demand side of the economy and the following national account identity holds (equation 1). However, the output in the long run is driven by underlying production function that constitutes the supply side of the economy (equation 3).

$$Y = C + PSI + GC + GI + DS + XVOL - MVOL + RES \qquad (3\text{-}4)$$

In this equation (3-4), (Y) is real output, (C) household consumption, (PSI) private sector investment and (GC) government consumption, (GI) government investment, (DS) stock building, XVOL is exports and MVOL is imports, and finally RES is residual. For each component of demand, there is an estimated equation, for example for household consumption (C) modelled in the following error correction (ECM) form:

$$\ln(c) = \alpha + \beta \ln(RPDI) + (1 - \beta)\ln(RFN + RTW) \qquad (3\text{-}5)$$

The consumption decision depends on real disposable income and wealth in the long run. The total wealth consists of the financial wealth and tangible wealth (housing wealth). In equation (3-5), C is real consumption, RPDI is real disposable income, RFN is real net financial assets and RTW is real tangible assets. The dynamics of adjustment in the long run are based on data and differ between countries to take account of the importance of different assets in each country, and also liquidity constraint.

In the long-run, output is tied down by an underlying production function that describes the supply-side of the economy in equation (3). In this each economy relies on a constant return to scale (CES) production function with labour augmenting technological progress. This is embedded within the Cobb-Douglas framework to allow the factor of production to interact with oil usage.

$$YCAP_t = \gamma \left(\left[s(K)^{-\rho} + (1-s)(Le^{\lambda t})^{-\rho} \right]^{-1/\rho} \right)^{\alpha} O^{1-\alpha} \qquad (3\text{-}6)$$

YCAP is real output, K is the total capital stock, L is total hours worked, O is oil input, t is time subscript, (λ) is labour augmenting technological progress, ρ is the elasticity of substitution between capital and labour and α is the output elasticity of the non-oil sector of the economy. This production function shows the potential output and constitutes the theoretical background for the specifications of the factor demand equations. In this, the major force for long term equilibrium in the labour to output ratio is real wage and technical progress, while capital will be determined by the user cost of capital.

In the short run, output is driven by demand. The gap between demand and potential output is measured as capacity utilisation as follows:

$$CU_t = \frac{Y_t}{YCAP_t} \qquad (3\text{-}7)$$

This will be fed into the price system, which gradually adjusts between actual and potential output. For example, if we introduce a shock to demand without changing the factor of production, the short run demand will be larger than actual demand. This will create inflationary pressure that will reduce total demand to equate the potential output to real output.

The economy in the long run will be driven by the supply side as equation (3-6) shows. However in the short to medium run, demand will determine the output.

Prices

Prices are the main factor that adjusts the gap between demand and supply in the long run. Consumer prices are modelled in the following forms.

$$\triangle \ln(ced_t) = \alpha - \beta_1 \left[\frac{\ln(ced_{t-1})}{1 + \frac{1}{2} itr_{t-1}} - \beta_2 \ln(PM_{t-1}) - (1 - \beta_2) \ln(utc_{t-1}) \right] + \beta_3 \triangle \ln(PM_t) + \beta_4 \triangle \ln(utc_{t)}$$

(3-8)

In this equation CED stands for the consumer price deflator, itr is indirect tax rate, PM is the price of imports and UTC is the unit total cost, while α and β are the parameters. In this the consumer price is a function of domestic inflation that is captured by UTC and also imported inflation PM. Furthermore, unit total cost depends on nominal wage growth, productivity and capacity utilisation.

3.7.2.2 NiGEM results compared to FAVAR

We increase the real economic activity in an advanced and emerging economy by 1 per cent. We also shock the oil price by 1 per cent. The impacts of these shocks are reported in Figures 3-23, 3-24 and 3-25. In this exercise we are going to look at variables from the financial market, prices (supply side) and demand components. It is evident from these figures (3-23, 3-24, and 3-25) that the profile is the same: specifically, the direction of movement of the variables and magnitude is nearly the same as those we reported earlier.

3.7.2.3 Demand shocks in advanced and emerging economies

Figures 3-25 and 3-26 show a comparison between FAVAR and NiGEM due to demand shock from advanced and emerging economies. The FAVAR result presented with a 68 per cent credible band is comparable to Figures 3-13 and 3-15. The top panel shows the asset price reaction, the middle the prices and the bottom of the panel the GDP and its components. From comparison of the models in Figure 3-24 we can conclude that the impact of demand in advanced economies on key UK variables under FAVAR and NiGEM is nearly the same in both direction and magnitude. Asset prices, the inflation measure and the output reaction is with the range.

However, looking at figure 3-25, the emerging market shock slightly differs in terms of the reaction of some variables under NiGEM and FAVAR. For example, asset prices like the exchange rate have an initial spike under FAVAR, or the reaction of the long term government bond is stronger. Also response of the prices, output and its components is slightly higher in FAVAR compared to NiGEM reaction. However, we should note that the result is not significantly different under each model.

The notable difference between these two models, FAVAR and NiGEM, is that the GDP reverts back to base, after which the price starts to increase in NiGEM, due to both shocks. Consumption adjustment in NiGEM takes a substantial amount of time — nearly 6 years — to revert while the economy in FAVAR models takes around 3 years. We could say adjustments under FAVAR are faster than in NiGEM, but overall the reaction to these two demand shocks in FAVAR is comparable to NiGEM.

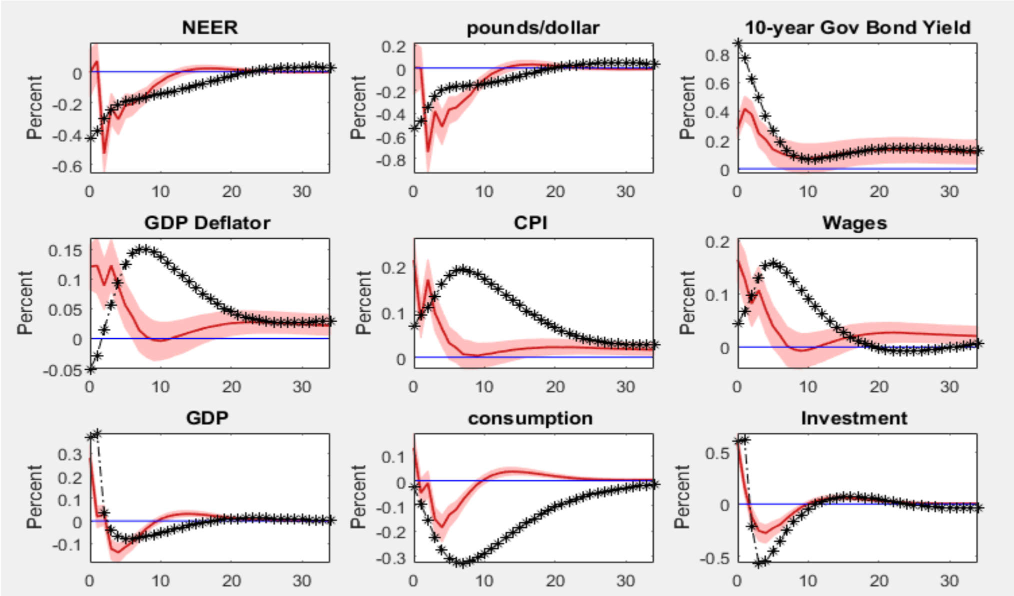


Figure 3-25: Impact of aggregate demand in advanced economies dashed line and NiGEM simulation increase of 1 per cent to output shock in one quarter

In this we increase demand in advanced economies by 1 per cent in one quarter in NiGEM and in FAVAR we increase demand in advanced economies by 1 per cent. Median percentile with 68 per cent band FAVAR and solid line with * NiGEM output simulation

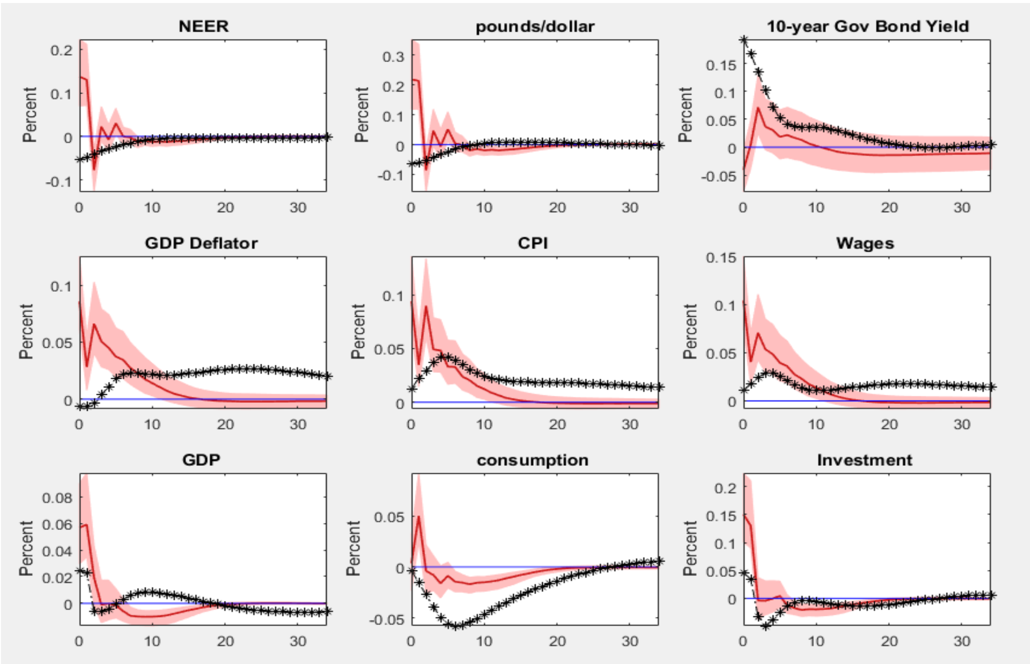


Figure 3-26: Impact of aggregate demand in emerging economies dashed line and NiGEM simulation increase of 1 per cent to output shock in one quarter

In this we increase demand in emerging markets by 1 per cent in one quarter in NiGEM and in FAVAR also we increase demand in emerging market by 1 per cent. Median percentile with 68 per cent band FAVAR and solid line with * NiGEM output simulation.

3.7.2.4 Oil price shock

Figure 3-27 shows the impact of the increases in the oil price by 1 per cent in both FAVAR and NiGEM over the same variables. The dotted line is the outcome from NiGEM while the line with the error band is the outcome from FAVAR. In both models as a result of an oil price shock price measures such as the consumer price deflator, wages and GDP deflator will increase with nearly the same magnitude. This leads to a fall in output, consumption and investment. Financial instruments such as the nominal effective exchange rate, pound sterling to US dollars and 10 year government bond yield are rising. However, the profile for adjustments to the base is different. For example, the exchange rates in FAVAR are more transitory while the reaction of NEER in NiGEM is more prolonged. The outcome in FAVAR is in line with a recent study by Buetzer et al. (2015) that suggests the link between oil price movement and exchange rate is loose. The outcome of the NEER in NiGEM is closer to the theory that links the exchange rate to terms of trade and the wealth effect.

In theory the oil price shock could affect the exchange rate through terms of trade and the wealth effect. A positive term of trade shock for an oil exporter drives up the price of non-tradable goods in the domestic economy and the real exchange rate, that is defined as the relative price of traded to non-tradeable goods between domestic and foreign countries. As prices in the non-tradeable goods sector are sticky, the adjustment of the real exchange rate may require nominal exchange rate appreciation. In addition, it also transfers wealth from oil importers to oil exporters; this will shift the current account balance (Kilian, 2007). To restore the net external financial stability of oil exporters, the real exchange rate has to appreciate to restore the non-oil trade balance (Bodenstein et al., 2012, Sascha Bützer, Maurizio Habib, and Livio Stracca, 2015).

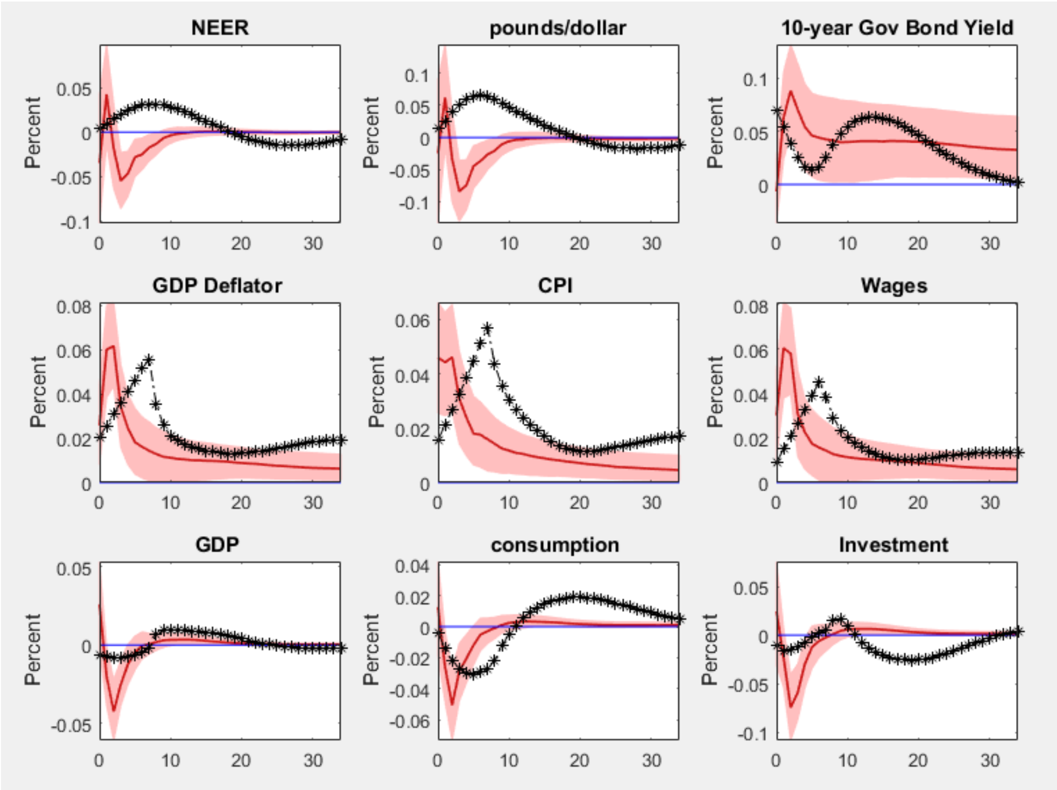


Figure 3-27: Comparing impact of oil price shock in FAVAR and NiGEM simulation

In this we increase oil price by 1 per cent in one quarter in NiGEM and FAVAR also we increase oil price by 1 per cent. Median percentile with 68 per cent band FAVAR and solid line with * NiGEM output simulation

3.7.2.5 Best model choice

We used three exercises that show that a simple and transparent model such as FAVAR can use substantial information from large scale models and produce very similar results. We also provide a 68 per cent credible band which shows that the NiGEM simulation is within the band. Given the simplicity of FAVAR and complexity and running cost of NiGEM, the result from these two models for these simulations are comparable. However, this may require a full model comparison in terms of policy simulation results and forecasting.

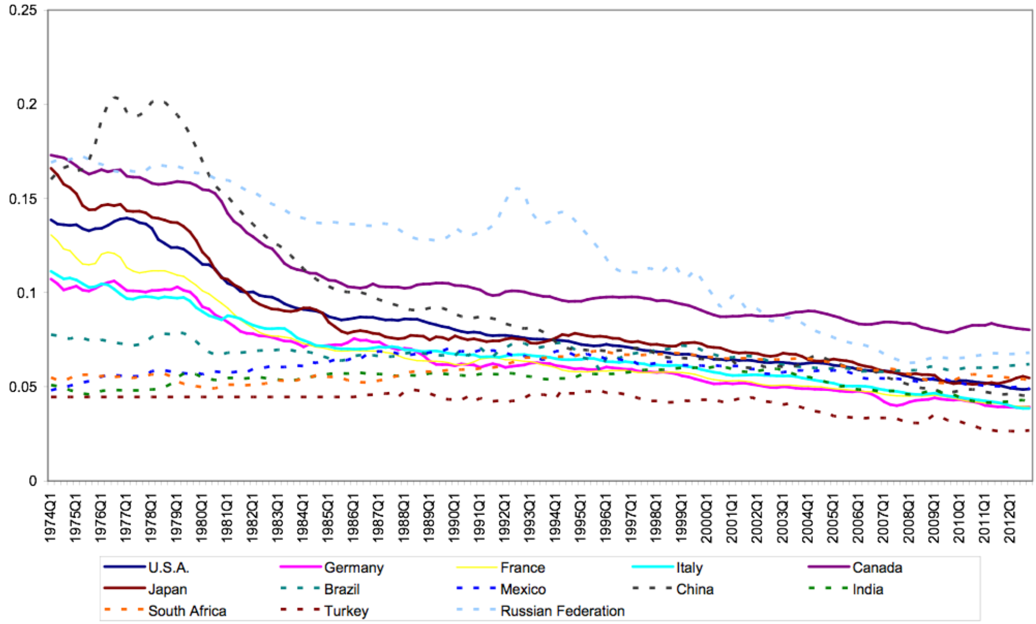
Although this kind of exercise is beyond the scope of this study, we believe it is worthwhile.

3.8 Conclusion

In this paper we employ a rich dataset of around 615 variables to study the impact of supply and demand shocks on the UK economy. Unlike previous studies, we separate shocks from emerging markets, advanced economies and oil prices. We use data on the G7 as representative for advanced economies and BRICS, Mexico and Turkey as representative of emerging economies. Foreign data covers real economy, prices and real oil prices and the UK economy data covers prices, activity, the external sector, government sector, financial sector and the labour market.

An aggregate demand shock in advanced economies increases prices such as CPI, GDP deflator and wages. As a result, the Bank of England increases interest rates to combat inflation. It will take around 3 years to get inflation under control. The increase in rate and high inflation is a drag on the real economy. The real economy goes through painful adjustments which lead to a depreciation in the pound and the nominal effective exchange rate, and as a result the trade balance will improve. The financial sector also follows the real economy, and house prices and equity will fall in line with the real economy. Impacts of demand from emerging markets on the UK have the same kind of profile with a smaller magnitude. Furthermore, a supply shock from advanced and emerging economies reduces prices but a shock from advanced economies will make some products permanently less expensive. Moreover, an oil price shock reduces real economic activity in the UK and in advanced and emerging economies. Prices will increase in these economies, which is in line with the literature. The result that we obtain from FAVAR is in line with established multi country large scale models such as NiGEM. This chapter contributes to policy debates on Brexit as the United Kingdom negotiates its departure from the European Union.

Appendix A. Figure A: oil intensity of the countries under investigation; solid line is for advanced economies and dashed line is for emerging economies



Appendix B: data code, name and transformation, 1 for level, 5 for log difference and, 6 log second differences

code	Name	Transformation
USY	U.S.A.: GDP, US$ Bn (AR), 2009 prices	5
CNY	Canada: GDP, CN$ Mn, 2007 prices	5
JPY	Japan: GDP, Yen Bn, 2005 prices	5
FRY	France: GDP, Euro Bn, 2005 prices	5
ITY	Italy: GDP, Bn Euro, 2005 prices	5
GEY	Germany: GDP, Euro Bn, 2005 prices	5
USQ66..CE	US INDUSTRIAL PRODUCTION VOLA	5
CNQ66..CE	CN INDUSTRIAL PRODUCTION VOLA	5
JPQ66..CE	JP INDUSTRIAL PRODUCTION VOLA	5
FRQ66..CE	FR INDUSTRIAL PRODUCTION VOLA	5
ITQ66..CE	IT INDUSTRIAL PRODUCTION VOLA	5
BDQ66..CE	BD INDUSTRIAL PRODUCTION VOLA	5
USOIO	U.S.A.: Intensity of output (oil)	1
GEOIO	Germany: Intensity of output (oil)	1
FROIO	France: Intensity of output (oil)	1
ITOIO	Italy: Intensity of output (oil)	1
CNOIO	Canada: Intensity of output (oil)	1
JPOIO	Japan: Intensity of output (oil)	1
USXVOL	U.S.A.: Exports of goods and servs, US	5
CNXVOL	Canada: Exports of goods and servs, CN	5
JPXVOL	Japan: Exports of goods and servs, Ye	5
FRXVOL	France: Exports of goods and servs, Eu	5
ITXVOL	Italy: Exports of goods and servs, Bn	5
GEXVOL	Germany: Exports of goods and servs, E	5
USMVOL	U.S.A.: Imports of goods and servs, 20	5
CNMVOL	Canada: Imports of goods and servs, CN	5
JPMVOL	Japan: Imports of goods and servs, 20	5
FRMVOL	France: Imports of goods and servs, Eu	5
ITMVOL	Italy: Imports of goods and servs, Bn	5
GEMVOL	Germany: Imports of goods and servs, E	5
USCED	U.S.A.: Consumer expenditure deflator,	5
CNCED	Canada: Consumer expenditure deflator,	5
JPCED	Japan: Consumer expenditure deflator,	5
FRCED	France: Consumer expenditure deflator,	5
ITCED	Italy: Consumer expenditure deflator,	5
GECED	Germany: Consumer expenditure deflator,	5
USPY	U.S.A.: GDP deflator, 2009=100	5
CNPY	Canada: GDP deflator, 2007=100	5
JPPY	Japan: GDP deflator, 2005=100	5
FRPY	France: GDP deflator, 2005=100	5
ITPY	Italy: GDP deflator, 2005=100	5

GEPY	Germany: GDP deflator, 2005=100	5
USPM	U.S.A.: Deflator, imports of goods and	5
CNPM	Canada: Deflator, imports of goods and	5
JPPM	Japan: Deflator, imports of goods and	5
FRPM	France: Deflator, imports of goods and	5
ITPM	Italy: Deflator, imports of goods and	5
GEPM	Germany: Deflator, imports of goods and	5
USPMCOM	U.S.A.: Import price of commodities, d	5
CNPMCOM	Canada: Import price of commodities, d	5
JPPMCOM	Japan: Import price of commodities, d	5
FRPMCOM	France: Import price of commodities, d	5
ITPMCOM	Italy: Import price of commodities, d	5
GEPMCOM	Germany: Import price of commodities, d	5
USPMNCOM	U.S.A.: Import price of non-commoditie	5
CNPMNCOM	Canada: Import price of non-commoditie	5
JPPMNCOM	Japan: Import price of non-commoditie	5
FRPMNCOM	France: Import price of non-commoditie	5
ITPMNCOM	Italy: Import price of non-commoditie	5
GEPMNCOM	Germany: Import price of non-commoditie	5
USPXCOM	U.S.A.: Price of commodity exports, US	5
CNPXCOM	Canada: Price of commodity exports, US	5
JPPXCOM	Japan: Price of commodity exports, US	5
FRPXCOM	France: Price of commodity exports, US	5
ITPXCOM	Italy: Price of commodity exports, US	5
GEPXCOM	Germany: Price of commodity exports, US	5
USPXNCOM	U.S.A.: Price of non-commodity exports	5
CNPXNCOM	Canada: Price of non-commodity exports	5
JPPXNCOM	Japan: Price of non-commodity exports	5
FRPXNCOM	France: Price of non-commodity exports	5
ITPXNCOM	Italy: Price of non-commodity exports	5
GEPXNCOM	Germany: Price of non-commodity exports	5
USPMCOM	U.S.A.: Import price of commodities, d	5
CNPMCOM	Canada: Import price of commodities, d	5
JPPMCOM	Japan: Import price of commodities, d	5
FRPMCOM	France: Import price of commodities, d	5
ITPMCOM	Italy: Import price of commodities, d	5
GEPMCOM	Germany: Import price of commodities, d	5
USPMNCOM	U.S.A.: Import price of non-commoditie	5
CNPMNCOM	Canada: Import price of non-commoditie	5
JPPMNCOM	Japan: Import price of non-commoditie	5
FRPMNCOM	France: Import price of non-commoditie	5
ITPMNCOM	Italy: Import price of non-commoditie	5
GEPMNCOM	Germany: Import price of non-commoditie	5
USPX	U.S.A.: Deflator, exports of goods and	5

CNPX	Canada: Deflator, exports of goods and	5
JPPX	Japan: Deflator, exports of goods and	5
FRPX	France: Deflator, exports of goods and	5
ITPX	Italy: Deflator, exports of goods and	5
GEPX	Germany: Deflator, exports of goods and	5
CNLR	Canada: Long term interest rate	1
CNR3M	Canada: 3 month interest rates	1
FRLR	France: Long term interest rate	1
FRR3M	France: 3 month interest rates	1
GELR	Germany: Long term interest rate	1
GER3M	Germany: 3 month interest rates	1
ITLR	Italy: Long term interest rate	1
ITR3M	Italy: 3 month interest rates	1
JPLR	Japan: Long term interest rate	1
JPR3M	Japan: 3 month interest rates	1
USLR	U.S.A.: Long term interest rate	1
USR3M	U.S.A.: 3 month interest rates	1
BRY	Brazil: GDP, Bn reais, 1995 prices	5
CHY	China: GDP, Renminbi Bn, 2005 prices	6
RUY	Russian Federation: GDP, Rouble Bn, 2008 prices	5
SAY	South Africa: GDP, Bn ZAR, 2005 prices	5
INY	India: GDP, Bn INR, 2005 prices	5
MXY	Mexico: GDP, Pesos Bn, 2005 prices	5
TUY	Turkey: GDP, Mn lira, 2005 PPP	5
BRQPRI35Q	BR PRODUCTION - TOTAL INDUSTRY EXCL. CONSTRUCTION SADJ	2
CHXIPI..F	CH INDUSTRIAL PRODUCTION INDEX NADJ	5
SAQ66EYCE	SA INDUSTRIAL PRODUCTION: MANUFACTURING VOLA	5
INQ66...F	IN INDUSTRIAL PRODUCTION NADJ	5
MXQ66...F	MX INDUSTRIAL PRODUCTION VOLN	5
TKQ66..BH	TK INDUSTRIAL PRODUCTION VOLA	5
BROIO	Brazil: Intensity of output (oil)	1
MXOIO	Mexico: Intensity of output (oil)	1
CHOIO	China: Intensity of output (oil)	1
INOIO	India: Intensity of output (oil)	1
SAOIO	South Africa: Intensity of output (oil)	1
TUOIO	Turkey: Intensity of output (oil)	1
RUOIO	Russian Federation: Intensity of output (oil)	1
BRXVOL	Brazil: Exports of goods and servs, Bn	5
CHXVOL	China: Exports of goods and servs, Bn	5
RUXVOL	Russian Federation: Exports of goods and servs, Bn	5
SAXVOL	South Africa: Exports of goods and servs, Bn	5

INXVOL	India: Exports of goods and servs, Bn	5
MXXVOL	Mexico: Exports of goods and servs, Bn	5
TUXVOL	Turkey: Exports of goods and servs, Mn	5
BRMVOL	Brazil: Imports of goods and servs, Bn	5
CHMVOL	China: Imports of goods and servs, Bn	5
RUMVOL	Russian Federation: Imports of goods and servs, Bn	5
SAMVOL	South Africa: Imports of goods and servs, Bn	5
INMVOL	India: Imports of goods and servs, Bn	5
MXMVOL	Mexico: Imports of goods and servs, Bn	5
TUMVOL	Turkey: Imports of goods and servs, Mn	5
BRCED	Brazil: Consumer expenditure deflator,	6
CHCED	China: Consumer expenditure deflator,	6
RUCED	Russian Federation: Consumer expenditure delfator,	6
SACED	South Africa: Consumer expenditure deflator,	6
INCED	India: Consumer expenditure deflator,	6
MXCED	Mexico: Consumer expenditure deflator,	6
TUCED	Turkey: Consumer expenditure deflator,	6
BRPY	Brazil: GDP deflator, 1995=100	6
CHPY	China: GDP deflator, 2005=100	6
RUPY	Russian Federation: GDP deflator, 2008 = 100	6
SAPY	South Africa: GDP deflator, 2005=100	6
INPY	India: GDP deflator, 2005=100	6
MXPY	Mexico: GDP deflator, 2005=100	6
TUPY	Turkey: GDP deflator, 2005=100	6
BRPM	Brazil: Deflator, imports of goods and	5
CHPM	China: Deflator, imports of goods and	5
RUPM	Russian Federation: Deflator, imports of goods and	5
SAPM	South Africa: Deflator, imports of goods and	5
INPM	India: Deflator, imports of goods and	5
MXPM	Mexico: Deflator, imports of goods and	5
TUPM	Turkey: Deflator, imports of goods and	6
BRPMCOM	Brazil: Import price of commodities, d	5
CHPMCOM	China: Import price of commodities, d	5
RUPMCOM	Russian Federation: Import price of commodities, d	5
SAPMCOM	South Africa: Import price of commodities, d	5
INPMCOM	India: Import price of commodities, d	5
MXPMCOM	Mexico: Import price of commodities, d	5
TUPMCOM	Turkey: Import price of commodities, d	5
BRPMNCOM	Brazil: Import price of non-commoditie	5
CHPMNCOM	China: Import price of non-commoditie	5

RUPMNCOM	Russian Federation: Import price of non-commoditie	5
SAPMNCOM	South Africa: Import price of non-commoditie	5
INPMNCOM	India: Import price of non-commoditie	5
MXPMNCOM	Mexico: Import price of non-commoditie	5
TUPMNCOM	Turkey: Import price of non-commoditie	5
BRPXCOM	Brazil: Price of commodity exports, US	5
CHPXCOM	China: Price of commodity exports, US	5
RUPXCOM	Russian Federation: Price of commodity exports, US	5
SAPXCOM	South Africa: Price of commodity exports, US	5
INPXCOM	India: Price of commodity exports, US	5
MXPXCOM	Mexico: Price of commodity exports, US	5
TUPXCOM	Turkey: Price of commodity exports, US	5
BRPXNCOM	Brazil: Price of non-commodity exports	5
CHPXNCOM	China: Price of non-commodity exports	5
RUPXNCOM	Russian Federation: Price of non-commodity exports	5
SAPXNCOM	South Africa: Price of non-commodity exports	5
INPXNCOM	India: Price of non-commodity exports	5
MXPXNCOM	Mexico: Price of non-commodity exports	5
TUPXNCOM	Turkey: Price of non-commodity exports	5
BRPMCOM	Brazil: Import price of commodities, d	5
CHPMCOM	China: Import price of commodities, d	5
RUPMCOM	Russian Federation: Import price of commodities, d	5
SAPMCOM	South Africa: Import price of commodities, d	5
INPMCOM	India: Import price of commodities, d	5
MXPMCOM	Mexico: Import price of commodities, d	5
TUPMCOM	Turkey: Import price of commodities, d	5
BRPMNCOM	Brazil: Import price of non-commoditie	5
CHPMNCOM	China: Import price of non-commoditie	5
RUPMNCOM	Russian Federation: Import price of non-commoditie	5
SAPMNCOM	South Africa: Import price of non-commoditie	5
INPMNCOM	India: Import price of non-commoditie	5
MXPMNCOM	Mexico: Import price of non-commoditie	5
TUPMNCOM	Turkey: Import price of non-commoditie	5
BRPX	Brazil: Deflator, exports of goods and	5
CHPX	China: Deflator, exports of goods and	5
RUPX	Russian Federation: Deflator, exports of goods and	5
SAPX	South Africa: Deflator, exports of goods and	5

INPX	India: Deflator, exports of goods and	5
MXPX	Mexico: Deflator, exports of goods and	5
TUPX	Turkey: Deflator, exports of goods and	5
WDPOAA	CRUDE OIL Brent	5
WDPOBA	CRUDE OIL UAE	5
UKGC	U.K.: Gov. consumption, GBP Mn, 2011	5
UKINV	U.K.: Investment (total), GBP Mn, 20	5
UKIB	U.K.: Investment (business), GBP Mn,	5
UKGI	U.K.: Investment (gov.), GBP Mn, 201	5
UKMVOLM	U.K.: Imports (goods and services),	5
UKXVOLM	U.K.: Exports (goods and services),	5
UKXGIM	U.K.: Exports (goods), GBP Mn, 2011	5
UKMGIM	U.K.: Imports of goods, GBP Mn, 2011	5
UKQEXSER	U.K.: Exports (services), GBP Mn, 20	5
UKQMSER	U.K.: Imports (services), GBP Mn, 20	5
BOPL	BOP:EX:SA:Food, beverages and tobacco: SITC 0+1 £M	5
BOPM	BOP:EX:SA:Basic materials: SITC 2+4 £M	5
BOPO	BOP:EX:SA:Semi-manufactures: SITC 5+6 £M	5
BOPP	BOP:EX:SA:Finished manufactures: SITC 7+8 £M	5
BOQI	BOP:EX:SA:Fuels other than oil: SITC 32+34+35 £M	5
BOQL	BOP:EX:SA:Unspecified goods: SITC 9 £M	5
BPBI	BOP:IM:SA:Fuels other than oil: SITC 32+34+35 £M	5
BQAR	BOP:IM:SA:Food, beverages and tobacco: SITC 0+1 £M	5
BQAS	BOP:IM:SA:Basic materials: SITC 2+4 £M	5
BQAU	BOP:IM:SA:Semi-manufactures: SITC 5+6 £M	5
BQAV	BOP:IM:SA:Finished manufactures: SITC 7+8 £M	5
BQAW	BOP:IM:SA:Unspecified goods: SITC 9 £M	5
ELBL	BOP:EX:SA:Oil: SITC 33 £M	5
ENXO	BOP:IM:SA:Oil: SITC 33 £M	5
UKWTRAD	U.K.: World trade (UK perspective)	5
UKTTRAD	U.K.: Terms of trade	5
UKGVAH	U.K.: Whole economy GVA per hour	5
UKSRATE	U.K.: Saving ratio	1
UKTW	U.K.: UK Total Wealth	5
UKPOPT	U.K.: Population (total) , thousands	6
UKCPROS	U.K.: Corporation profit share	5
UKKP	U.K.: Capital stock (private sector	5
UKKG	U.K.: Capital stock (gov.), GBP Mn,	5
UKIPDC	U.K.: Credit (interest, profit, divi	5
UKIPDD	U.K.: Debit (interest, profit, divid	5

UKCOMP	U.K.: Total compensation, GBP Mn	5
UKPSBY	U.K.: Public Sector Net Borrowing (%	1
UKCTO	U.K.: Corporation tax receipts, oil	5
UKNPRNO	U.K.: Net profit, non-oil sector, GB	5
UKNPRO	U.K.: Net profit, oil sector, GBP Mn	2
UKTAX	U.K.: Direct tax receipts (household	5
UKITAX	U.K.: Taxes on expenditure	5
UKTCURR	U.K.: Total current receipts of the	5
UKGIP	U.K.: Gov. interest payments, GBP Mn	5
UKSUBS	U.K.: General gov. subsidies	5
UKTCURE	U.K.: Total current expenditure, pub	5
UKRPDI	U.K.: Real personal disposable incom	5
UKCLU	U.K.: ILO unemployment, thousands	5
UKPI	U.K.: Personal income, GBP Mn	5
UKEE	U.K.: Employees (in employment), tho	5
UKE	U.K.: Employees (total), thousands	5
UKLF	U.K.: Labour force, civilian, thousa	5
UKPOPWA	U.K.: Population (working age), thou	5
UKHOURS	U.K.: Hours worked per employee per	5
UKY	U.K.: Gross Domestic Product, GBP Mn	5
GDQB	ESA95 Output Index: F: Construction:	5
CKYY	IOP: Industry D: Manufacturing: CVMSA NAYear	5
GDQH	SA95 Output Index: I : Transport storage & communication	5
GDQS	SA95 Output Index: G-Q: Total	5
GDQE	ESA95 Output Index: G & H: Distribution, hotels & catering; repairs	5
CKYW	IOP: Industry C,D,E: All production industries	5
CKYZ	IOP: Industry E: Electricity, gas and water supply:	5
CKZA	IOP: Industry DA: Manuf of food, drink & tobacco	5
CKZF	IOP: Industry DF: Manuf coke/petroleum prod/nuclear fuels	5
CKZG	IOP: Industry DG: Manuf of chemicals & man-made fibres	5
UKC	U.K.: Private consumption, GBP Mn, 2	5
UTID	Total	5
LLKX	All furnishing & household	5
ATQX	Furniture and households	5
ATRD	Carpets and other floor coverings	5
XYJP	Major household appliances	5
XYJR	Major tools and equipment	5
LLKY	All Health	5
UWIC	Therapeutic appliances and equipment	5

LLKZ	All Transport	5
TMMI	All Purchase of vehicles	5
TMML	Motor Cars	5
TMMZ	Motor cycles	5
TMNO	Bicycles	5
LLLA	All Communication	5
ATRR	Telephone and telefax equipment	5
LLLB	All recreation and culture	5
ATRV	Audio visual equipment	5
ATRZ	Photo and cinema equip and optical instruments	5
ATSD	Information processing equipment	5
TMNB	Major durables for outdoor recreation	5
XYJT	Musical instruments and major durables for indoor reacreation	5
LLLC	All miscellaneous	5
ZAYM	Jewellery, clocks and watches	5
UTIT	Total	5
LLLZ	All clothing and footwear	5
XYJN	Clothing materials	5
ZAVK	Garments	5
XYJO	Other articles of clothing and clothing accessories	5
ATQV	Shoes and other footwear	5
LLMA	All furnishings and household goods	5
ATRF	Household textiles	5
XYJQ	Small electric household appliances	5
ATRJ	Glassware, tableware and household utensils	5
XYJS	Small tools and miscellaneous accessories	5
LLMB	All transport	5
AWUW	Motor vehicle spares	5
LLMC	All recreation and culture	5
ATSH	Recording media	5
ATSL	Games, toys and hobbies	5
XYJU	Equipment for sport, camping etc	5
CDZQ	Books	5
LLMD	All miscellaneous	5
XYJX	Electrical appliances for personal care	5
ATSX	Other personal effects	5
UTIL	Total	5
ZWUN	All food and non-alcoholic beverages	5
UWBK	All food	5
UWBL	Bread and cereals	5
CCTK	Meat	5

CCTL	Fish	5
CCTM	Milk, cheese and eggs	5
CCTN	Oils and fats	5
CCTO	Fruit	5
UWFD	Vegetables	5
UWFX	Sugar and sweet products	5
UWGH	Food products n.e.c.	5
UWGI	All non-alcoholic beverages	5
CCTT	Coffee, tea and cocoa	5
CCTU	Mineral, water and soft drinks	5
ZAKY	All alcoholic beverages and tobacco	5
UUIS	Spirits	5
UTHW	Wine, cider and perry	5
UUVG	Beer	5
ZWUP	Tobacco	5
LLLL	All Housing, water, electricity, gas and other fuels	5
ATUA	Materials for the maintenance and repair of the dwelling	5
UTZN	Water supply	5
ZWUR	All electricity, gas and other fuels	5
CCUA	Electricity	5
LTZA	Gas	5
LTZC	Liquid fuels	5
TTAB	Solid fuels	5
LLLM	All furnishing and household goods	5
UWHO	Non-durable household goods	5
LLLN	All health	5
UTXP	Pharmaceutical products	5
UWIB	Other medical products	5
LLLO	All transport	5
CCTY	Vehicle fuels and lubricants	5
LLLP	All recreation and culture	5
AWUX	Gardens, plants and flowers	5
UWKQ	Pets and related products	5
CDZY	Newspapers and periodicals	5
XYJV	Miscellaneous printed matter	5
XYJW	Stationery and drawing materials	5
LLLQ	All miscellaneous	5
ATSP	Other products for personal care	5
UTIP	Total	5
LLLR	All clothing and footwear	5
UWHI	Clothing, repair and hire of clothing	5
AWUY	Repair and hire of footwear	5

LLLS	All housing, water, electricity, gas and other fuels	5
ZAVQ	All actual rentals for housing	5
GBFG	Actual rentals paid by tenants	5
GBFK	All imputed rentals for housing	5
CCUO	Imputed rentals of owner-occupiers	5
GBFN	Other imputed rentals	5
AWUZ	Services for the maintenance and repair of the dwelling	5
UTZX	Sewerage collection	5
LLLT	All furnishings and household services	5
UWHM	Repair of furniture, furnishings and floor coverings	5
UWHN	Repair of household appliances	5
UWIA	Domestic and household services	5
LLLU	All health	5
ZAWG	All out-patient services	5
ZAWI	Medical services	5
ZAWK	Dental services	5
UTMH	Paramedical services	5
UTYF	Hospital services	5
LLLV	Total transport	5
AWVA	Vehicle maintenance and repair	5
ZAWQ	Other vehicle services	5
ZAWS	All transport services	5
AWVB	Railways	5
ZAWU	Road	5
AWVC	Air	5
AWVD	Sea and inland waterway	5
AWVE	Other	5
LLLW	All communication	5
CCVM	Postal services	5
ZAWY	Telephone and telefax services	5
LLLX	All recreation and culture	5
UWKO	Repair of audio-visual, photographic and information processing equipment	5
UWKP	Maintenance and repair of other major durables for recreation and culture	5
UWLD	Veterinary and other services for pets	5
ZAXI	All recreational and cultural services	5
ZAXK	Recreational and sporting services	5
ZAXM	Cultural services	5
CCVA	Games of chance	5
ZWUT	Education	5
ZAXS	All restaurants and hotels	5

ZAXU	All catering services	5
ZAXW	Restaurants, cafes etc.	5
ZAYC	Canteens	5
ZAYE	Accommodation services	5
LLLY	All miscellaneous	5
CCVZ	Hairdressing salons and personal grooming establishments	5
ZAYO	Social protection	5
ZAYQ	All insurance	5
UTYH	Life insurance	5
ZAYU	Insurance connected with health	5
ZAYW	Insurance connected with transport	5
ZAZA	All financial services n.e.c.	5
ZAZC	All financial services other than FISIM	5
ZAZE	Other services n.e.c.	5
TR	trade balance	2
FRAH	RPI Total Food	5
FRAI	RPI Total Non-Food	5
FRAK	RPI Total All items other than seasonal Food	5
UKULC	U.K.: Unit labour costs	5
UKP	U.K.: Wholesale prices, 2011=100	5
UKCED	U.K.: Consumer expenditure deflator,	5
UKPY	U.K.: Deflator (GDP), 2011=100	5
ROYJ	Wages	5
CP	CPI	5
UTKT	Total	5
LLOS	All furnishing & household	5
AWQK	Furniture and households	5
AWQL	Carpets and other floor coverings	5
AWQN	Major household appliances	5
AWQQ	Major tools and equipment	5
LLOT	All Health	5
AWQW	Therapeutic appliances and equipment	5
LLOU	All Transport	5
UTPP	All Purchase of vehicles	5
AWRA	Motor Cars	5
AWRB	Motor cycles	5
AWRC	Bicycles	5
LLOV	All Communication	5
UTPT	Telephone and telefax equipment	5
LLOW	All recreation and culture	5
AWRM	Audio visual equipment	5
AWRN	Photo and cinema equip and optical instruments	5
AWRO	Information processing equipment	5

AWRR	Major durables for outdoor recreation	5
AWRS	Musical instruments and major durables for indoor recreation	5
LLOX	All miscellaneous	5
AWSL	Jewelry, clocks and watches	5
UTLB	Total	5
LLPU	All clothing and footwear	5
AWPP	Clothing materials	5
AWPQ	Garments	5
AWPR	Other articles of clothing and clothing accessories	5
AWPT	Shoes and other footwear	5
LLPV	All furnishings and household goods	5
UTPH	Household textiles	5
AWQO	Small electric household appliances	5
UTPJ	Glassware, tableware and household utensils	5
AWQR	Small tools and miscellaneous accessories	5
LLPW	All transport	5
AWRD	Motor vehicle spares	5
LLPX	All recreation and culture	5
AWRP	Recording media	5
AWRU	Games, toys and hobbies	5
AWRV	Equipment for sport, camping etc	5
AWSC	Books	5
LLPY	All miscellaneous	5
AWSJ	Electrical appliances for personal care	5
AWSM	Other personal effects	5
UTKX	Total	5
UTJO	All food and non-alcoholic beverages	5
UTOV	All food	5
AWPB	Bread and cereals	5
AWPC	Meat	5
AWPD	Fish	5
AWPE	Milk, cheese and eggs	5
AWPF	Oils and fats	5
AWPG	Fruit	5
AWPH	Vegetables	5
AWPI	Sugar and sweet products	5
AWPJ	Food products n.e.c.	5
UTOW	All non-alcoholic beverages	5
AWPK	Coffee, tea and cocoa	5
AWPL	Mineral, water and soft drinks	5
UTJP	All alcoholic beverages and tobacco	5
AWPM	Spirits	5

AWPN	Wine, cider and perry	5
AWPO	Beer	5
UTOY	Tobacco	5
LLPG	All Housing, water, electricity, gas and other fuels	5
AWPZ	Materials for the maintenance and repair of the dwelling	5
AWQB	Water supply	5
UTPF	All electricity, gas and other fuels	5
AWQF	Electricity	5
AWQG	Gas	5
AWQH	Liquid fuels	5
AWQI	Solid fuels	5
LLPH	All furnishing and household goods	5
AWQS	Non-durable household goods	5
LLPI	All health	5
AWQU	Pharmaceutical products	5
AWQV	Other medical products	5
LLPJ	All transport	5
AWRE	Vehicle fuels and lubricants	5
LLPK	All recreation and culture	5
AWRW	Gardens, plants and flowers	5
AWRX	Pets and related products	5
AWSD	Newspapers and periodicals	5
AWSJ	Stationery and drawing materials	5
LLPL	All miscellaneous	5
AWSK	Other products for personal care	5
UTKZ	Total	5
LLPM	All clothing and footwear	5
AWPS	Clothing, repair and hire of clothing	5
AWPU	Repair and hire of footwear	5
LLPN	All housing, water, electricity, gas and other fuels	5
AWPV	All actual rentals for housing	5
AWPV	Actual rentals paid by tenants	5
UTPC	All imputed rentals for housing	5
AWPX	Imputed rentals of owner-occupiers	5
AWPY	Other imputed rentals	5
AWQA	Services for the maintenance and repair of the dwelling	5
AWQD	Sewerage collection	5
LLPO	All furnishings and household services	5
AWQM	Repair of furniture, furnishings and floor coverings	5
AWQP	Repair of household appliances	5

AWQT	Domestic and household services	5
LLPP	All health	5
UTPN	All out-patient services	5
AWQX	Medical services	5
AWQY	Dental services	5
AWQZ	Paramedical services	5
UTPO	Hospital services	5
LLPQ	Total transport	5
AWRF	Vehicle maintenance and repair	5
AWRG	Other vehicle services	5
UTPR	All transport services	5
AWRH	Railways	5
AWRI	Road	5
AWRJ	Air	5
AWRK	Sea and inland waterway	5
AWRL	Other	5
LLPR	All communication	5
UTPS	Postal services	5
UTPU	Telephone and telefax services	5
LLPS	All recreation and culture	5
AWRQ	Repair of audio-visual, photographic and information processing equipment	5
AWRY	Veterinary and other services for pets	5
UTPY	All recreational and cultural services	5
AWRZ	Recreational and sporting services	5
AWSA	Cultural services	5
AWSB	Games of chance	5
UTJX	Education	5
UTJY	All restaurants and hotels	5
UTQG	All catering servies	5
AWSG	Restaurants, cafes etc.	5
AWSH	Canteens	5
UTQH	Accomodation services	5
LLPT	All miscellaneous	5
AWSI	Hairdressing salons and personal grooming establishments	5
UTQK	Social protection	5
UTQL	All insurance	5
AWSN	Life insurance	5
AWSO	Insurance connected with the dwelling	5
AWSP	Insurance connected with health	5
AWSQ	Insurance connected with transport	5
UTQM	All financial services n.e.c.	5
AWSS	All financial services other than FISIM	5
UTQN	Other services n.e.c.	5

UKIDFL	U.K.: Imports deflator	5
UKXDFL	U.K.: Deflator (exports)	5
M4SA	m4	5
M4ISA	M4	5
M4OSA	m4	5
M4PSA	m4	5
M4LISA	M4lending	5
M4LOSA	m4lending	5
M4LPSA	m4lending	5
UKARR	U.K.: Rate of household mortgage arr	1
UKCC	U.K.: Consumer credit held by househ	5
UKCORPL	U.K.: Non-financial corporate debt,	5
UKMFIL	U.K.: Bank lending to non-financial	5
UKMORTH	U.K.: Mortgage debt of households, G	5
HP	Real Nationwide house prices	5
FTSE	FTSE ALL Share Index	5
EX1	pounds/dollar	5
EX2	pounds/euro	5
EX3	pounds/yen	5
EX4	NEER	5
EX5	pound/canada dollar	5
EX6	pound\australia	5
UKIPREM	U.K.: Investment premium	1
UKLENDW	U.K.: Rate Spread - household (borro	1
UKPREM	U.K.: Equity price risk premium	1
Bond1		1
Bond2		1
Bond3		1
Bond4		1
Bond5		1
Bond6		1
Bond7		1
Bond8		1
Bond9		1
Bond10		1
Bond11		1
Bond12		1
Bond13		1
Bond14		1
Bond15		1
Bond16		1

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