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Abstract

We develop and apply a new methodology to study the transmission mechanisms of international macroeconomic and financial shocks in the context of emerging markets. Our approach combines aspects of factor analysis and GVAR models by replacing the cross-unit averages that serve as foreign variables in the GVAR model with macroeconomic and financial factors extracted from potentially unbalanced panels of country-level data. Factors are extracted at the country, region and global levels, with a natural hierarchical structure. Furthermore, we allow for time variation in both the model parameters and shock volatility. Our key empirical findings are as follows. First, there is substantial time-variation in the responses of our chosen emerging economies to foreign financial, interest rate and macroeconomic shocks. Second, in response to tighter global financial conditions, policy rates increase in most of our chosen emerging economies, particularly after the crisis. They appear more concerned with financial stability and capital inflows, given that they increase their short term rates more at the expense of large drops in equity prices and output. Third, financial tightening in other emerging market country groups has a loosening effect on domestic financial conditions. Fourth, as we include a global financial risk factor along with the US monetary policy rate, our results suggest that the contractionary effects of US interest rate shocks are taken over by the global financial risk shock. Lastly, we find some evidence that macroeconomic interdependencies among emerging economies have been increasing while their dependencies on advanced economies have been decreasing over time.

Keywords: Time-varying parameter GVAR model, Factor analysis, Dual Kalman Filter, Transmission channels of external shocks, Monetary policy

JEL ClassificationCodes: C30, C32, C38, E44, F41

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Non-technical Summary

In the last few decades the integration of emerging markets with the global economy has deepened due to increased participation in global trade and financial markets. More recently, it has been argued that emerging markets have become more insulated from global shocks and their interdependence has increased. Despite their umbrella label, however, emerging markets are highly heterogenous due to differing vulnerabilities. In this study, we analyse macroeconomic and financial shock transmission between countries and country groups and how these differ both across emerging economies and over time. To this end, we propose a multi-level factor augmented time-varying parameter model which combines aspects of factor analysis, the GVAR and panel VAR models. Working in a data-rich environment, we extract hierarchical factors at global, region and country levels which are then incorporated into a GVAR-type model to analyse the origins and transmission mechanisms of external shocks. The main value of our set up is that we replace the cross unit averages that are used as a means of dimensionality reduction in GVAR models with our data-driven exogenous regional and global factors to investigate their relative importance to an emerging economy. Allowing for time variation seems highly relevant for studying emerging economies given the frequent changes in their macroeconomic conditions and policies over this period. We focus on Turkey, Mexico and South Korea, studying the time-varying effects of external changes in interest rates, financial conditions and risk appetite on their macroeconomic and financial conditions over the period 1978Q1-2016Q4.

Our main findings are as follows. First, there is substantial time-variation in the responses of our chosen emerging economies to foreign financial, interest rate and macroeconomic shocks. Second, in response to tighter global financial conditions, policy rates increase, particularly after the crisis except in Mexico. We find that Turkey and South Korea are more concerned with financial stability and capital inflows given that they increase their short term rates more at the expense of large drops in equity prices and output. Third, financial tightening in other emerging country groups has a loosening effect on financial conditions particularly in Turkey and Mexico. Fourth, as we include

a global financial risk factor along with the US monetary policy rate in our model, our results suggest that the well documented contractionary effects of US interest rate shocks are taken over by the global financial risk shock. Lastly, we find some evidence that macroeconomic interdependencies among emerging economies have been increasing while their dependencies on advanced economies have been decreasing over time.

1 Introduction

In the last few decades the significance of emerging markets in the global economy has risen due to their increased integration in global trade and financial markets. Moreover, their contribution to global output has increased dramatically since the 1990s. As their trade and financial ties along with their share of global output have become more pronounced, it has become necessary for macroeconomic analysis to take into account their interdependencies with other economies. On the other hand, emerging markets face substantially different policy issues to advanced economies. Factors like liability dollarisation, non-continuous access to international capital markets, high import dependence and more vulnerable financial systems impose restrictions on exchange rate regimes, stabilisation policies and inflation management in these countries. Furthermore, despite their umbrella label, emerging markets as a country group are highly heterogeneous due to their differing vulnerabilities. Therefore, constructing a model that would account for all of the complex channels of interaction is a challenging task in empirical economics.

Recent studies[1] have argued that emerging markets have been decoupling from advanced economies and have become more isolated from global shocks. At the same time the interdependence between emerging markets has risen due to growth in trade and financial flows between them. In this context, an important research question is how the relative importance of global, country group or country specific events has changed as globalisation deepened over the last few decades. Therefore, while identifying the international transmission channels it would be of great interest to investigate whether they evolve over time. This issue is particularly relevant for rapidly growing emerging economies whose trade and financial relations with the rest of the world have been evolving with a similar speed. Over the past couple of decades many emerging markets have also changed macroeconomic policy frameworks in an attempt to make themselves more resilient against domestic and international shocks, which had previously resulted in crises in Latin America, East Asia, Russia and Turkey in the late 90's and early 2000's.

[1] See Kose et al. (2012) among others

These policy changes included a freely floating exchange rate, an explicit target for inflation over the medium run and a stable government debt to GDP ratio, all of which had already been adopted by advanced economies. More recently, after the global financial crisis emerging markets also introduced macroprudential policies to mitigate the impact of financial shocks. These changes in policy regime and economic conditions necessitate a more flexible approach. Although a number of studies utilise a time invariant framework to identify shock transmission mechanisms, in many cases there may be parameter instability due to changes in the underlying structure of economies.

Taking into account the issues discussed above, we develop an econometric modelling approach to analyse international macroeconomic and financial shock transmission for the case of emerging markets. Working in a data-rich environment we begin by extracting macroeconomic and financial factors at the country, region and global levels in a similar way to Kose et al. (2003). The global factors capture the common events that affect all of the countries under investigation whereas the group specific factors capture shocks that affect a group of countries due to their similarities in the level of economic development or common macroeconomic vulnerabilities. Finally, country specific factors represent idiosyncratic issues that affect an individual country such as changes in macroeconomic policies. Unlike Kose et al, we then proceed to incorporate these factors into a factor augmented vector autoregressive modelling (FAVAR) framework. Our model structure shares some characteristics with the global VAR (GVAR) approach of Pesaran et al. (2004), however the cross unit averages that are used as a means of dimensionality reduction in GVAR models are replaced with our exogenous regional and global factors. The key advantages of this are that our factors are data-driven rather than being ad-hoc and allow us to separate these exogenous effects into regional and global components. More specifically, the hierarchical factor structure allows us to investigate the extent that macroeconomic and financial fluctuations in emerging markets are driven by factors at each of these three levels and whether their relative significance changes across countries and country groups. We work in a time-varying parameter framework to allow for the possibility of changes in the shock transmission mechanisms caused by structural changes of the type discussed above.

For the purposes of this study we limit our focus to the time-varying effects of external changes in financial conditions, risk appetite, monetary policy and macroeconomic activity on the macroeconomic and financial conditions in our focus emerging economies, namely, Turkey, Mexico and South Korea over the period 1978Q1-2016Q4. Our main results are as follows. First, there is substantial time-variation in the responses of our chosen emerging economies to foreign financial, interest rate and macroeconomic shocks. Second, in response to tighter global financial conditions, policy rates increase, particularly after the crisis except in Mexico. We find that Turkey and South Korea are more concerned with financial stability given that they increase their short term rates more at the expense of large drops in equity prices and output. Third, financial tightening in other emerging market groups has a loosening effect on the financial conditions in a given emerging economy, particularly in Turkey and Mexico. This occurs as emerging markets compete with each other for international capital. Fourth, as we include a global financial risk factor along with the US monetary policy rate in our model, our results suggest that the well documented contractionary effects of US interest rate is taken over by the global financial risk shock. Lastly, we find some evidence that macroeconomic interdependencies among emerging economies have been increasing while their dependencies on advanced economies have been decreasing over time.

Our work builds on past research on the importance of external shocks for emerging markets that was initiated by the influential work of Calvo et al. (1993), who study the characteristics of capital inflows to Latin America and find that external shocks increase the macroeconomic vulnerability of these economies. Canova (2005) also studies the underlying channels of shock transmission and estimates the effects of U.S. monetary policy shocks on Latin American economies. He establishes that U.S. shocks explain a substantial fraction of fluctuations in macroeconomic variables of these countries, such as inflation, money and trade balance. Maćkowiak (2007) estimates an SVAR model for 8 emerging markets to evaluate the effects of external shocks on these economies. His results suggest that U.S. shocks strongly affect interest rates and exchange rates of these countries and therefore should be included in models built for emerging economies.

Our work is also related to the growing literature in macroeconomic research that focuses on both domestic interdependencies and interdependencies between countries. This strand of literature revealed that while domestic interdependencies across sectors cause domestic business cycle fluctuations, increasing trade and financial linkages produce comovement between important macroeconomic indicators. In particular Kose et al. (2003) use a dynamic common factor model to study the underlying dynamics of business cycles within countries as well as across regions and the world. They find that a common world component accounts for a considerable proportion of macroeconomic fluctuations in the countries under consideration. Moreover the country specific component and the idiosyncratic component appears to explain more variation in developing economies. Other studies that investigate the international interdependencies between countries focusing on the decomposition common factors include Kose et al. (2012), Moench et al. (2013), Breitung and Eickmeier (2016) and Mumtaz and Theodoridis (2017). However, most of this line of literature focus solely on factor analysis. There are also a number of studies that use constant and time varying parameter FAVAR models to investigate domestic and international transmission mechanisms. Mumtaz and Surico (2009) use an open economy FAVAR to study the interplay between the UK economy and the rest of the world and identify shock transmission mechanisms. Other FAVAR based studies including Korobilis (2013) and Abbate et al. (2016) also focus on advanced economies.

Finally, the current work is also related methodologically and empirically to the literature on GVAR models, which was proposed by Pesaran et al. (2004) to analyse the effects of macroeconomic events like adverse global or regional shocks on major financial institutions. It was later extended by Dees et al. (2007) to explore the international linkages in the Euro Area by developing a theoretical framework to explain common factor interdependencies and international business cycles. In another study Chudik and Fratzscher (2011) study the transmission of the recent financial crisis using a GVAR model and find that the transmission process is different across countries. While financial tightening was the main source of transmission for advanced economies it was the real side of the economy that was more adversely affected in emerging markets. Finally, Feldkircher and Huber (2016) estimate a Bayesian GVAR to investigate the transmission of US demand and supply shocks along with a contractionary US monetary policy shock to a sample of emerging and advanced economies. They find systematic cross-regional differences in response to these shocks. In particular, their findings suggest that responses of emerging economies' output to US shocks are more gradual whilst those of advanced economies are more immediate but dissipate slowly. Moreover, Latin American responses to interest rate shocks is more pronounced compared to the other country groups.

As noted above, the key difference between the methodology we develop here and traditional GVAR models is that we replace the cross unit averages that are used as a means of dimensionality reduction in GVAR models with our data-driven exogenous regional and global factors to investigate their relative importance to an emerging economy. Moreover, all of these studies employ a constant-parameter approach and therefore do not account for the potential time-variation in the relationship between the model variables. We contribute to the existing GVAR and factor model literature by combining aspects of these model structures to construct a time-varying multi-level factor augmented GVAR model that accounts for the time-varying interdependencies between major emerging and advanced economies. We use our approach to establish the heterogeneity in macroeconomic and financial spillovers among emerging countries and how these relationships vary over time. As we allow time variation in our parameters along with the covariances, we let the changes in our parameters reflect changes in the underlying relationships. Our model captures the differences in the international transmission mechanisms of various sources of macroeconomic and financial shocks among emerging economies and documents the time-variation in these mechanisms.

The rest of the paper is organised as follows. The next two sections present the factor extraction strategy and the general framework of the proposed time-varying factor augmented GVAR model that will be used for our empirical analysis. In section 4 we present our data as well as our estimated factors. In Section 5 we report our empirical results. In section 6 we conclude the paper.

2 Multilevel Factor Extraction

In our model the N_C cross-sectional units are countries which are grouped into N_G groups based on regional economy types (Advanced economies, Emerging Asia, Emerging Europe and Latin America). Gourio et al. (2013) show that there is extensive comovement between country level risk indices constructed using local financial indicators which suggests the existence of common exogenous global factors that would affect all economies. There are indeed many studies showing that volatility is highly synchronized across advanced economies. However, emerging markets are more heterogeneous as a country group compared to advanced economies. Therefore, when it comes to emerging markets idiosyncratic or regional events may not be captured by factors generated from pooled data series of different country groups where advanced economies may dominate. Although events like the Asian crisis of 1997 and the Tequila Crisis of 1995 affected countries in the respective regions, they were not necessarily reflected on variables of advanced economies. Carrière-Swallow and Céspedes (2013) establish that whilst global series capture the response of uncertainty shocks in emerging markets, when measures of local uncertainty are used, the response of real variables is more pronounced, suggesting the importance of idiosyncratic and regional factors for emerging markets.

There are two main methods for factor extraction in non-overlapping block factor models that we will use in the current work, namely the panel block factor model of Kose et al. (2003) and the hierarchical factor model of Moench et al. (2013). The two approaches differ in terms of the correlation structure between levels of factors and their ability to reduce the number of parameters to estimate. The factors extracted at each level using the method of Kose et al. (2003) are uncorrelated with each other whereas those of the Moench et al. (2013) method are driven by the higher level factors. Our choice of approach will depend on the explanatory power and the informational content of the factors extracted using each of the methods. Given that the hierarchical method of factor extraction follows a bottom-up approach and factors estimated at each level drive the higher level factors, the amount of information the hierarchical set of factors contains is limited by the amount of information the lowest level factors contains. On the other hand, factors extracted using the top-down panel block factor model of Kose et al. (2003) are uncorrelated with the higher level factors, therefore lower level factors contain country/region-specific information that is not reflected in the higher level factors. As we are interested in explaining the time varying importance of idiosyncratic and regional events for our countries of interest, the block factor model of Kose et al. (2003) suits the purposes of our study better.

In order to give our factors a more direct economic interpretation, we extract separate macroeconomic and financial factors at country, group and global levels. We denote these by $F_{i,t}, i = 1, \dots N_C$, $G_{j,t}, j = 1, \dots N_G$ and H_t respectively, where each level of factors contains both macroeconomic and financial factors. All variables used in the analysis, which are disaggregated by countries and regional economic groups, are driven by our global macroeconomic and financial factors, H_t. Therefore, we begin by extracting the first k_h^m and first k_h^f principal components from the real activity and financial blocks of the stacked data of each country, $X_{i,t}$ to obtain our global factors. At the regional level, we estimate k_g^m and k_g^f principal components from the respective macroeconomic and financial blocks of the pooled dataset of countries in each region once we have purged the global factors extracted in the previous stage from all variables. Finally, at the country level, we extract the first k_f^m and k_f^f principal components from the respective block of the country datasets purged of the global and regional factors.[2].

Since we extract our factors using the principal components method, the signs and scales of our factors and their loadings are not separately identified. Therefore, in order to identify the signs of our factors we condition one of the factor loadings to be positive at each level of factor extraction. More specifically, the loading for the macroeconomic global factor is normalised to be positive for the real GDP growth series of the United States, the regional macroeconomic factors are conditioned to load positively on the real

[2] At each level we purge the higher level factors from the variables from which the next lower level factors are extracted since those variables all depend on the higher level factors. Thus for regional factors we take the first k_g principal components of the respective data blocks of $X_{g,t}$ - $\lambda_h H_t$ and for the country level factors we take the first k_f principal components of the respective data blocks of $X_{i,t}$ - $\lambda_h H_t$ - $\lambda_g G_{j,t}$

GDP growth series of the largest country in their respective region and the loadings of the country level macroeconomic factors are required to be positive for their respective GDP growth series. As for the identification of the signs of our financial factors, we normalise our financial factor loadings to be negative for the credit growth series at each respective level. Therefore, an increase (decrease) in our financial factors indicates that financial conditions are tighter (looser).

It is also important to disentangle the dynamics driven by financial developments from the macroeconomic ones before extracting factors. To this end, Bernanke et al. (2005) defines categories of 'slow moving' and 'fast moving' variables. Macroeconomic variables fall into the first category as they are mostly predetermined in the current period. On the other hand financial variables are highly sensitive to contemporaneous economic developments and therefore fall into the second category. For this reason, we assume that macroeconomic factors can affect the financial variables contemporaneously, however, financial factors cannot affect their macroeconomic counterparts immediately. We therefore purge our financial variables of macroeconomic factors and extract our financial factors from the residuals of the first stage regressions of the financial variables on the macroeconomic factors following Eickmeier et al. (2014).

Given the complex structure of our estimation problem, we choose to implement the computationally simpler two-step principal components approach of Bernanke et al. (2005), who show that this method produces qualitatively similar results compared to its single-step Bayesian likelihood counterpart. We therefore estimate our time varying factor augmented GVAR model in two stages. The first stage involves extracting our country level factors, F_t, regional factors, G_t, and global factors, H_t using the non-parametric principal component based estimator of Stock and Watson (2002)[3]. We treat these factors as given and in the second stage we estimate the time varying parameters of our observation equations and factor augmented GVAR model. To that end, we convert each of our equations into state space form and obtain filtered estimates of our model

[3]Stock and Watson (2002, 2008) show that factors are estimated consistently by principal components even in the presence of time variation in the loading parameters as the factor estimates are only weighted averages of the variables of interest at time (t).

parameters using Kalman filter recursions. The details of the estimation procedure will be discussed in the methodology section.

3 The Multilevel Factor Augmented GVAR Model

3.1 The Model Setup

We propose a multi level factor augmented GVAR model which combines aspects of factor analysis, the GVAR and PVAR models. In particular, it is inspired by the multi-level factor model introduced by Kose et al. (2003) in terms of the factor structure but it also takes advantage of the parsimony of GVAR models while keeping the flexibility offered by factor analysis. GVAR is a two step modelling approach linking separate VAR models for different economies through an unobservable factor that is proxied with cross-unit averages of model variables in an attempt to reduce the number of parameters to be estimated. In this way, it decomposes the underlying high-dimensional VARs into a smaller number of conditional models, which are interlinked through these cross-unit averages. Although this parsimonious aspect of the GVAR model provides dimensionality reduction, the underlying structure for the dynamics implied by the data from different countries in the model could be restrictive as it is determined by country specific weights, which are static and fixed a priori. The main advantage of our setup is that we replace these cross unit averages with our data driven exogenous regional and global factors to avoid the dimensionality problem inherent in large-scale multi-country VAR based models. Moreover, our choice of structure allows us to model the dynamic linkages across countries selectively using a panel VAR structure that imposes zero restrictions on other countries. In particular, our country level factors are constructed to represent events specific to that country and are assumed to have no effect on the other individual countries in the model.[4]. The higher level regional and global factors on the other hand enter our model without coefficient restrictions and are able to affect the country level factors with a lag.

[4]with the exception of US policy rate

More specifically, the basic features of our model are similar to that of Bernanke et al. (2005) in that it contains two sub-equations, namely an observation equation and a transition equation. We assume that our full set of multi country financial and macroeconomic indicators contained in the $(N \times 1)$ vector X_t depend on the unobservable multilevel macroeconomic and financial factors as well as the $(M \times 1)$ observed variable vector Y_t. Y_t in our case contains a set of policy rates and the unobservable factors include the country level factors, $F_{i,t}, i = 1, \ldots N_C$, regional group level factors, $G_{j,t}, j = 1, \ldots N_G$ and the global level factors, H_t. Therefore our observation equation for a country i in group j takes the form

$$X_{i,t} = \Lambda^F_{i,t} F_{i,t} + \Lambda^G_{i,t} G_{j,t} + \Lambda^H_{i,t} H_t + \Lambda^Y Y_{i,t} + u_{i,t} \tag{1}$$

where $\Lambda^F_{i,t}$ and $\Lambda^Y_{i,t}$ are the $(N_i \times k)$ and $(N \times M)$ matrices of factor loadings while u_t is a $(N \times 1)$ vector of zero mean disturbances.

In matrix notation, the observation equation takes the form:

$$\begin{bmatrix} X_{1,t} \\ Y_{1,t} \\ X_{2,t} \\ Y_{2,t} \\ \vdots \\ X_{N_C,t} \\ Y_{N_C,t} \end{bmatrix} = \begin{bmatrix} \Lambda^F_{1,t} & \Lambda^Y_{1,t} & 0 & \cdots & & & 0 & \Lambda^G_{1,t} & \Lambda^H_{1,t} \\ 0 & I & 0 & \cdots & & & & & \\ 0 & 0 & \Lambda^F_{2,t} & \Lambda^Y_{2,t} & 0 & \cdots & 0 & \Lambda^G_{2,t} & \Lambda^H_{2,t} \\ 0 & 0 & 0 & I & 0 & \cdots & & & \\ \vdots & & & & & & & & \vdots \\ 0 & \cdots & & & 0 & \Lambda^F_{N_C,t} & \Lambda^Y_{N_C,t} & \Lambda^G_{N_C,t} & \Lambda^H_{N_C,t} \\ 0 & \cdots & & & 0 & 0 & I & 0 & 0 \end{bmatrix} \begin{bmatrix} F_{1,t} \\ Y_{1,t} \\ F_{2,t} \\ Y_{2,t} \\ \vdots \\ F_{N_C,t} \\ Y_{N_C,t} \\ G_t \\ H_t \end{bmatrix} + u_t \tag{2}$$

where $\Lambda^F_{i,t}$ is the time varying matrix of factor loadings for the endogenous variables of country (i) on its own country level factor(s). In a similar way $\Lambda^Y_{i,t}$ is the time varying matrix of factor loadings for the endogenous variables of country (i) on its own observables. We impose blocks of zero restrictions on our overall matrix of factor loadings, Λ_t, to reflect that the macroeconomic and financial series for a given country are driven only by the domestic country level factors and the set of exogenous regional and global factors. u_t is a vector of zero mean Gaussian idiosyncratic shocks whose time varying covariance matrix V_t is assumed to be diagonal. The dimensions of the factor loading matrices and the remaining identity and zero matrices are determined by the number of factors and observables for each country.

Our transition equation is similar in structure to a FAVAR with endogenous country level factors and observables but we augment it with our weakly exogenous regional and global factors by imposing zero restrictions on some of the elements of the coefficient matrices. These restrictions follow from our modelling assumption that economies can affect each other through our higher level regional and global factors but that no country level factor except the US factors has a direct effect on other individual country level factors. By including these weakly exogenous factors we aim to reduce the potential degree of correlation of the shocks across countries. Consequently, our transition equation is of the form

$$\begin{pmatrix} Z_t^E \\ Z_t^X \end{pmatrix} = \begin{pmatrix} B_t^1 & C_t^1 \\ 0 & D_t^1 \end{pmatrix} \begin{pmatrix} Z_{t-1}^E \\ Z_{t-1}^X \end{pmatrix} + \cdots + \begin{pmatrix} B_t^p & C_t^p \\ 0 & D_t^p \end{pmatrix} \begin{pmatrix} Z_{t-p}^E \\ Z_{t-p}^X \end{pmatrix} + \begin{pmatrix} \varepsilon_t^E \\ \varepsilon_t^X \end{pmatrix} \tag{3}$$

where $Z_t^E = \left[F_{1,t}^{m,f} \; Y_{1,t}, \ldots F_{N_C,t}^{m,f} \; Y_{N_C,t}\right]'$ is a vector containing all endogenous factors and observables whereas $Z_t^X = \left[G_t^{m,f} \; H_t\right]'$ contains the weakly exogenous regional and global factors. The time-varying matrices $D_t^1, \ldots, D_t^p$ describe the autoregressive dynamics of the weakly exogenous factors in order to derive the impulse responses for shocks to these factors. ε_t is a vector of zero mean Gaussian disturbances with time varying covariance matrix Q_t.

$$\begin{pmatrix} \varepsilon_t^E \\ \varepsilon_t^X \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \Sigma_{11,t} & \Sigma_{12,t} \\ \Sigma_{21,t} & \Sigma_{22,t} \end{pmatrix}\right] \tag{4}$$

The time-varying matrices of autoregressive coefficients for the endogenous factors and observables, $B_t^1, \dots, B_t^p$, have a block diagonal structure so that the factors and observables for each country are only affected by their own lagged values and the lagged weakly exogenous global and regional macroeconomic and financial factors. These weakly exogenous group and global factors' lagged values affect the factors and observables for all countries through the full matrices $C_t^1, \dots, C_t^p$. In light of this, the transition equation of the model has a panel VAR structure that for the simplest case of a single lag is given by:

$$\begin{bmatrix} F_{1,t} \\ Y_{1,t} \\ F_{2,t} \\ Y_{2,t} \\ \vdots \\ F_{N_C,t} \\ Y_{N_C,t} \\ G_t \\ H_t \end{bmatrix} = \begin{bmatrix} b_{1,t} & 0 & \cdots & & 0 & c_{G,1,t} & c_{H,1,t} \\ & & & & & & \\ 0 & b_{2,t} & 0 & \cdots & 0 & c_{G,2,t} & c_{H,2,t} \\ & & & & & & \\ \vdots & & & & & & \\ 0 & \cdots & & 0 & b_{N_C,t} & c_{G,N_C,t} & c_{H,N_C,t} \\ & & & & & & \\ \vdots & \cdots & & & 0 & d_{G,t} & 0 \\ & \cdots & & & & 0 & d_{H,t} \end{bmatrix} \begin{bmatrix} F_{1,t-1} \\ Y_{1,t-1} \\ F_{2,t-1} \\ Y_{2,t-1} \\ \vdots \\ F_{N_C,t-1} \\ Y_{N_C,t-1} \\ G_{t-1} \\ H_{t-1} \end{bmatrix} + \varepsilon_t \tag{5}$$

As previously discussed, the assumption of time variation provides flexibility that may be necessary when dealing with financial and macroeconomic data, particularly in the case of emerging economies given their frequent changes in macroeconomic conditions and policies over the last few decades. In order to specify the dynamics of the time-varying factor loadings we define their vectorised version as $\lambda_t = vec(\Lambda_t)$, where vec is the matrix vectorisation operator that transforms a matrix into column vector form. In the same way we define β_t as the vectorised version of the coefficient matrix from the VAR(1) representation of our VAR(p) model. Following the time-varying parameter VAR literature, the time variation in factor loadings and VAR coefficients is characterised by multivariate random walks of the form:

$$\lambda_t = \lambda_{t-1} + v_t \tag{6}$$

$$\beta_t = \beta_{t-1} + \eta_t \tag{7}$$

where $v_t \sim N(0, W_t)$ and $\eta_t \sim N(0, R_t)$. The disturbance terms are assumed to be uncorrelated with each other and over time.

3.2 Estimation

Our proposed model is estimated in two stages. In the first stage we obtain principal components estimates of our factors using the approach of Bernanke et al. (2005). In the second stage we treat our estimated factors as given and estimate the time varying matrices of factor loadings and autoregressive coefficients of the multilevel factor augmented GVAR model we propose in equations (3) and (4). Moreover, we estimate our model by converting the measurement and the transition equations of our model into two separate state space models:

$$\beta_t = \beta_{t-1} + \eta_t \tag{8}$$

$$z_t = z_{t-1}\beta_t + \varepsilon_t \tag{9}$$

$$\lambda_t = \lambda_{t-1} + v_t \tag{10}$$

$$X_t = z_t\lambda_t + u_t \tag{11}$$

where $z_t = \left[F_t^{m,f} \; Y_t \;\; G_t^{m,f} \;\; H_t^{m,f}\right]'$ is the vector of endogenous country level factors $F_{i,t}$ and observables $Y_{i,t}$ augmented by the exogenous group level and global factors, $G_{j,t}$ and H_t respectively.

For the purposes of parsimony in terms of the number of parameters to be estimated, we set the VAR lag length at $p_m = 2$ for our macroeconomic factors and $p_f = 1$ for our financial factors and observables. A lag length of two is a standard choice for quarterly data in the literature, however, the fact that we allow for parameter time variation is also likely to reduce the need for including more lags. As a robustness check we estimated the model with two lags for all variables and found no significant difference compared to our benchmark results. These results are available upon request.

The likelihood-based estimation strategies such as Bayesian methods that implement Markov Chain Monte Carlo (MCMC) algorithms involve very complex and computationally intensive estimation techniques in high dimensions. Therefore, in terms of the estimation procedure we follow Koop and Korobilis (2014)[5], and employ a two step estimation algorithm that is based on the Kalman filter and smoother to provide estimates of the time varying model parameters. In order to reduce the computational burden they combine the variance discounting and Kalman filter approaches to approximate time variation in parameters. Following their work we first extract the principal components estimates of our multi level factors $F_{i,t}$, $G_{j,t}$ and H_t and initialise the model parameters[6]:

$$\lambda_0 \sim N(0, I)$$

$$B_0 \sim N(0.9 \times I, V_{MIN})$$

$$C_0 \sim N(0, 10 \times I)$$

$$D_0 \sim N(0.9 \times I, V_{MIN})$$

$$V_0 \equiv 1 \times I$$

$$Q_0 \equiv 1 \times I$$

where V_{MIN} is defined as $4/p^2$ for coefficient on lag p. The Minnesota prior covariance matrix is typically assumed to be diagonal.

[5]Estimation is performed in MATLAB based on the code provided by Dimitris Korobilis available on https://sites.google.com/site/dimitriskorobilis/matlab/forecasting-tvp-favar

[6]Since the estimates of W_t and R_t are proportional to the respective state covariance matrices we compute using the Kalman filter, these matrices do not need to be initialised

Whilst the time varying coefficient matrices of the observation and transition equations are estimated using the Kalman filter and smoother, the time variation in the covariance matrices (V_t, Q_t, W_t, R_t) is approximated using variance discounting methods to minimise the computational burden. V_t and Q_t are modelled using the exponentially weighted moving average (EWMA) method with decay parameters κ_1 and κ_2 respectively. As for W_t and R_t, since their dimensions are very large these matrices are estimated using forgetting factors κ_3 and κ_4 respectively, which are similar to decay parameters in spirit[7]. These determine the degree of time variation in the model parameters and are calibrated based on the expected amount of time variation. Lower levels of both decay and forgetting parameters put more weight on the more recent observation. When decay/forgetting factors are set to 1, the model becomes constant parameter. In this study we set the decay factors κ_1 at 0,96 and κ_2 at 0.94, as these values produce volatility estimates consistent with the findings in the stochastic volatility literature, such as Primiceri (2005), Korobilis (2013) and Eickmeier et al. (2015). As for the forgetting factors κ_3 and κ_4, we assume slow and stable changes in the coefficients and therefore set these to 0.99.

Our estimation algorithm then consists of the following steps:

1. Once we obtain the the principal components estimates of our factors, $\tilde{f}_t$, and the initial conditions described above, we compute the filtered estimates of the time varying parameters λ_t and B_t using the following recursion. Given initial conditions and $z_t = \tilde{z}_t$, obtain filtered estimates of λ_t, β_t, V_t and Q_t ..

$$\lambda|Data_{1:t-1} \sim N\left(\lambda_{t|t-1}, \Sigma^{\lambda}_{t|t-1}\right)$$

$$\beta|Data_{1:t-1} \sim N\left(\beta_{t|t-1}, \Sigma^{\beta}_{t|t-1}\right)$$

where $\lambda_{t|t-1} = \lambda_{t-1|t-1}$, $\Sigma^{\lambda}_{t|t-1} = \Sigma^{\lambda}_{t-1|t-1} + \widehat{W}_t$, $\beta_{t|t-1} = \beta_{t-1|t-1}$ and $\Sigma^{\beta}_{t|t-1} = \Sigma^{\beta}_{t-1|t-1} + \widehat{R}_t$. The error covariance matrices are estimated as $\widehat{W}_t = (\kappa_3^{-1} - 1)\Sigma^{\lambda}_{t-1|t-1}$ and $\widehat{R}_t = (\kappa_4^{-1} - 1)\Sigma^{\beta}_{t-1|t-1}$ using forgetting factors.

[7]The observation window required by the two approaches is different. The EWMA approach requires an observation window of $\kappa_i/2 - 1$ for $i = 1, 2$ whereas the forgetting factor approach requires $1/(1 - \kappa_i)$ for $i = 3, 4$

2. Estimates of the matrices V_t and Q_t are computed using the following EWMA forms with decay parameters κ_1 and κ_2:

$$\widehat{V}_{i,t} = \kappa_1 V_{i,t-1|t-1} + (1-\kappa_1)\hat{u}_{i,t}\hat{u}'_{i,t}$$

$$\widehat{Q}_t = \kappa_2 Q_{i,t-1|t-1} + (1-\kappa_2)\hat{\varepsilon}_t\hat{\varepsilon}'_t$$

where $\hat{u}_{i,t} = x_{i,t} - \tilde{z}_t\lambda_{i,t|t-1}$ for $i = 1, \ldots N$ and $\hat{\varepsilon}_t = \tilde{z}_t - \tilde{z}_{t-1}\beta_{t|t-1}$

3. Update λ_t and β_t given information at time t using the Kalman Filter update step. The update step for each of the loadings $\lambda_{i,t}$ for $i = 1, \ldots N$ is given by:

$$\lambda_{i,t}|Data_{1:t} \sim N\left(\lambda_{i,t|t}, \Sigma^{\lambda}_{ii,t|t}\right)$$

where the conditional mean and variance are given by:

$$\lambda_{i,t|t} = \lambda_{i,t|t-1} + \Sigma^{\lambda}_{ii,t|t-1}\tilde{z}'_t\left(\widehat{V}_{ii,t} + \tilde{z}_t\Sigma^{\lambda}_{ii,t|t-1}\tilde{z}'_t\right)^{-1}\left(x_t - \tilde{z}_t\lambda_{t|t-1}\right)$$

and:

$$\Sigma^{\lambda}_{ii,t|t} = \Sigma^{\lambda}_{ii,t|t-1} - \Sigma^{\lambda}_{ii,t|t-1}\tilde{z}'_t\left(\widehat{V}_{ii,t} + \tilde{z}_t\Sigma^{\lambda}_{ii,t|t-1}\tilde{z}'_t\right)^{-1}\tilde{z}_t\Sigma^{\lambda}_{ii,t|t-1}$$

β_t is updated following:

$$\beta_t|Data_{1:t} \sim N\left(\beta_{t|t}, \Sigma^{\beta}_{t|t}\right)$$

where the conditional mean and variance of β_t are given by:

$$\beta_{t|t} = \beta_{t|t-1} + \Sigma^{\beta}_{t|t-1}\tilde{z}'_{t-1}\left(\widehat{Q}_t + \tilde{z}_{t-1}\Sigma^{\beta}_{t|t-1}\tilde{z}'_{t-1}\right)^{-1}\left(\tilde{z}_t - \tilde{z}_{t-1}\beta_{t|t-1}\right)$$

and:

$$\Sigma^{\beta}_{t|t} = \Sigma^{\beta}_{t|t-1} - \Sigma^{\beta}_{t|t-1}\tilde{z}'_{t-1}\left(\widehat{Q}_t + \tilde{z}_{t-1}\Sigma^{\beta}_{t|t-1}\tilde{z}'_{t-1}\right)^{-1}\tilde{z}_{t-1}\Sigma^{\beta}_{t|t-1}$$

4. We compute updates of the covariance matrices V_t and Q_t using the EWMA ap-

proach as:

$$\widehat{V}_{i,t|t} = \kappa_1 V_{i,t-1|t-1} + (1-\kappa_1)\hat{u}_{i,t|t}\hat{u}'_{i,t|t}$$

$$\widehat{Q}_{t|t} = \kappa_2 Q_{i,t-1|t-1} + (1-\kappa_2)\hat{\varepsilon}_{t|t}\hat{\varepsilon}'_{t|t}$$

where $\hat{u}_{i,t|t} = x_{i,t} - \tilde{z}_t \lambda_{i,t|t}$ and $\hat{\varepsilon}_{t|t} = \tilde{z}_t - \tilde{z}_{t-1}\beta_{t|t}$

5. Finally, we compute the smoothed estimates of λ_t, β_t, V_t and Q_t for $t = T-1, \ldots 1$ according to the following recursions:

   We smooth $\lambda_{i,t}$ for each $i = 1, \ldots N$ from

$$\lambda_{i,t}|Data_{1:T} \sim N\left(\lambda_{i,t|t+1}, \Sigma^{\lambda}_{ii,t|t+1}\right)$$

   where the conditional mean and variance are given by:

$$\lambda_{i,t|t+1} = \lambda_{i,t|t} + C^{\lambda}_t \left(\lambda_{i,t+1|t+1} - \lambda_{i,t+1|t}\right) \tag{12}$$

   and:

$$\Sigma^{\lambda}_{ii,t|t+1} = \Sigma^{\lambda}_{ii,t|t} + C^{\lambda}_t \left(\Sigma^{\lambda}_{ii,t+1|t+1} - \Sigma^{\lambda}_{ii,t+1|t}\right) C^{\lambda}_t \text{ , where } C^{\lambda}_t = \Sigma^{\lambda}_{ii,t|t}\left(\Sigma^{\lambda}_{ii,t+1|t}\right)^{-1} \tag{13}$$

   We smooth β_t from:

$$\beta_t|Data_{1:T} \sim N\left(\beta_{t|t+1}, \Sigma^{\beta}_{t|t+1}\right)$$

   where the conditional mean and variance are given by:

$$\beta_{t|t+1} = \beta_{t|t} + C^{\beta}_t \left(\beta_{t+1|t+1} - \beta_{t+1|t}\right) \tag{14}$$

   and:

$$\Sigma^{\beta}_{t|t+1} = \Sigma^{\beta}_{t|t} + C^{\beta}_t \left(\Sigma^{\beta}_{t+1|t+1} - \Sigma^{\beta}_{t+1|t}\right) C^{\beta}_t \text{ where } C^{\beta}_t = \Sigma^{\beta}_{t|t}\left(\Sigma^{\beta}_{t+1|t}\right)^{-1} \tag{15}$$

Finally we update V_t and Q_t using:

$$V_{t|t+1}^{-1} = \kappa_1 V_{t|t}^{-1} + (1 - \kappa_1) V_{t+1|t+1}^{-1}$$

$$Q_{t|t+1}^{-1} = \kappa_2 Q_{t|t}^{-1} + (1 - \kappa_2) Q_{t+1|t+1}^{-1}$$

4 Data

We use quarterly macroeconomic and financial data over the period 1978Q1-2016Q4 for 13 economies and 1 regional aggregate, Euro area. The full set of countries includes subgroups of emerging and advanced economies listed in Table 1. We use the full data set to extract our higher level regional and global factors using the principal components method. However we only extract five country level factors for our analysis for the sake of parsimony, which are Turkey, Mexico, South Korea, United States and the Euro Area. As we focus on the macroeconomic and financial interdependencies between countries and country groups, we tried to base our choice of countries on their macroeconomic and financial relationships in addition to their data availability. Turkey is an important trade partner to EU and it is a big economy with high financial integration. Mexico is chosen over other Latin American countries because of its close financial and macroeconomic integration with the US and it is more similar to the rest of the emerging economies under investigation in the sense that its exports are not commodity-dependent. As for South Korea, it is one of the most important economies in the region and it has high financial integration with the US.

Since we focus on how regional group and global level factors affect the macroeconomic and financial conditions of domestic economies, the choice of variables depends on both their information content and consistency across countries. We prioritise these objectives over a broader data set since including more data may not guarantee better results in factor analysis as shown by Boivin and Ng (2006). Overall, our dataset includes 210 macroeconomic series and 109 financial series and is unbalanced due to data availability. Where required, all variables are transformed to ensure stationarity by differencing prior to the analysis. Interest rate spreads, unemployment rates and equity return volatilities are used in levels. Once stationarity is ensured, all series are standardised to have a zero mean and unit variance. Moreover, asset price and credit data are divided by the GDP deflator in order to convert them into real terms. Data are collected from various resources including Datastream, FRED, the IMF, BIS and Bloomberg. The data appendix contains a list of all series used and the transformations used to ensure stationarity of each series. More detailed information about the series such as start dates and sources are available upon request.

Table 1: Complete Country and Group List

Emerging Europe and Turkey:	**Emerging Latin America:**
Turkey*	Brazil
Hungary	Chile
Poland	Mexico*
Emerging Asia:	**Advanced:**
South Korea*	United States
Thailand	Canada
Indonesia	Euro Area
India	United Kingdom

The table lists all countries and country groups for multi-level factor extraction. Countries indicated with an asterisk are those included directly in the main empirical analysis

The macroeconomic block of our dataset covers measures of real economic activity (GDP, personal and government consumption, investment, industrial production, trade and unemployment rate) and aggregate price variables (GDP deflator, CPI, import and export price indices and wages). In the financial block, as we aim to obtain easily interpretable financial factors, we follow Arregui et al. (2018), who construct financial conditions indices across advanced and emerging market economies. They focus on how global factors affect financial conditions in domestic markets and aim to account for as many parts of the financial system as possible, including equity, housing, bond and interbank markets. We therefore include real effective exchange rate, credit growth, term spreads, interbank spreads, sovereign spreads, changes in long term interest rates, residential property prices and equity returns and return volatility, all of which should allow us to model the transmission channels of monetary and macroprudential policies. We include realised equity price volatility as a proxy for uncertainty, which we calculate using quarterly realised volatility. We use the following standard formula which is based on the summation of daily squared stock price returns:

$$\sigma_{it} = \sum_{\tau=1}^{D_{it}} (r_{it}(\tau) - \bar{r}_{it})^2 \tag{16}$$

where $r_{it}(\tau)$ is the log return of the equity index for country i in the τ-th day of quarter t, $\bar{r}_{it}$ is the mean of the returns within quarter t and D_{it} is the number of trading days in quarter t for country i.

In order to determine the number of factors various information criteria are available in the factor model literature, including Bai and Ng (2002), Onatski (2010) and Hallin et al. (2007) among others. However, none of these apply to multi level factor models and most of this line of the literature sets the number of global and regional factors to one. Eickmeier et al. (2014) base their choice of the number of factors on the variance shares explained by each factor on average over all variables and require these factors to explain roughly 50 percent of the variation. Inspired by this we use the following approach to determine the number of factors. We run individual regressions for macroeconomic and financial variables of our selected countries and compute the R-squared for each regression. We then calculate the average R-squared values across the set of macroeconomic variables, the set of financial variables and both sets combined. When we set the number of factors at each level to one macroeconomic and one financial factor, we obtain around or above 0.60, suggesting that our factors explain more than half of the variation in the model variables. We report these results in Table 2 below.

Table 2: Average R-squared for variables in observation equation

	Macroeconomic	Financial	All
Turkey	0.58	0.60	0.59
Mexico	0.72	0.59	0.67
South Korea	0.76	0.64	0.72
United States	0.60	0.62	0.61
Euro Area	0.63	0.56	0.60

4.1 Estimated Country Level, Regional and Global Factors

As described in the previous section we extract our multi-level macroeconomic and financial factors from the data of the relevant country/country group. The shaded areas represent the recession dates for the relevant country as indicated by OECD composite leading indicators. Our multi-level factors seem to capture episodes of macroeconomic and financial events well. Figure 1 plots the Turkish country, regional and global macroeconomic and financial factors. Movements in the Turkish macroeconomic factor appears to be consistent with the crisis periods of Turkey. The figure reveals that the two earlier domestic crises, 1994 and 2001, are clearly much more major events than the global financial crisis. The global macroeconomic factor seems to have captured most of the effect of the recent financial crisis and Turkey seems to be less affected compared to both the countries in its region and advanced economies. As for the financial factor, Turkish financial conditions appear to be affected most by the Gulf War, the domestic crises of 1994, 2001 and the European Debt Crisis. While financial conditions were tightest during the 1994 crisis, with the help of the timely policy decisions of Turkish Central Bank and the expansionary policy measures of advanced economies, Turkish financial conditions seem to have recovered relatively quickly after the initial shock of the global financial crisis.

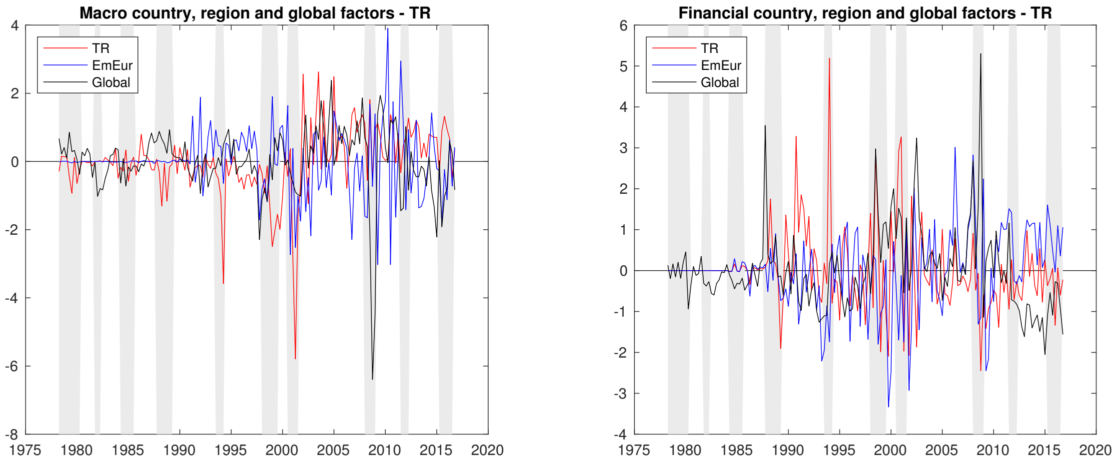

Figure 1: Estimates of global, emerging Europe and the Turkish factor

Figure 2 plots the Mexican, Latin American and the global factors and shows that Mexican macroeconomic and financial conditions follow their regional and global counterparts. However, they were clearly affected by some country and region specific events especially during the 1990's. The Mexican Peso was devalued unexpectedly in December 1994, which was followed by a severe economic crisis in 1995. This important period is mostly reflected in the macroeconomic country and regional factor as its main effects were felt on the real side of the economy. However, after a period of recovery, Mexico was hit again by the external shocks of Asian financial crisis that started in 1997 and Russian crisis in 1998, both of which hit emerging economies. These external developments are mostly reflected on the financial country factor as they reduced Mexico's capital inflows through contagion at the time. The global financial crisis was another important event in Mexico's economic history, although it affected Mexico's macroeconomic conditions less than its local Peso crisis. As for Mexico's financial conditions during and after the crisis, they seem to be more affected by the episodes of European sovereign debt crisis of 2011-2012 and the taper tantrum of early 2013 compared to the global financial crisis itself.

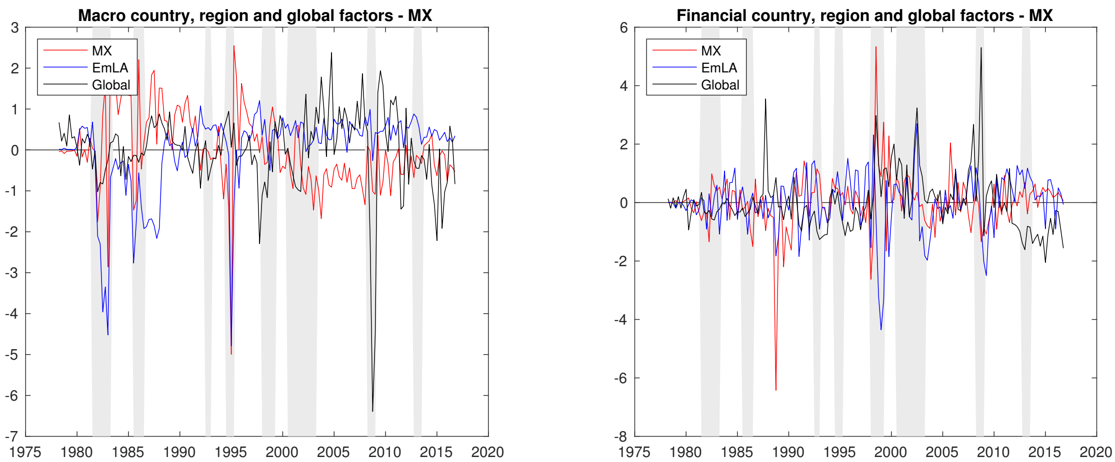

Figure 2: Estimates of global, emerging Latin America and Mexican factors

South Korean country level factors along with their regional and global counterparts are plotted in figure 3. South Korea was one of the countries worst hit by the 1997-98 Asian crisis. Its effects are reflected both on the macroeconomic and the financial country and regional level factors, although the effect on the financial side of the economy seems to be stronger compared to the other economies in the region. Like Turkey and Mexico, domestic crisis of South Korea was a more major event compared to the global financial crisis. This can be attributed to the fact that South Korea was one of the most efficient countries in terms of its post-crisis economic and financial reforms. The country level financial factor shows that the taper tantrum of early 2013 affected South Korea's financial conditions more than the crisis. This finding is in line with Chudik and Fratzscher (2011), who shows that emerging Asian countries are more susceptible to US liquidity conditions as it has a greater financial dependence on the US.

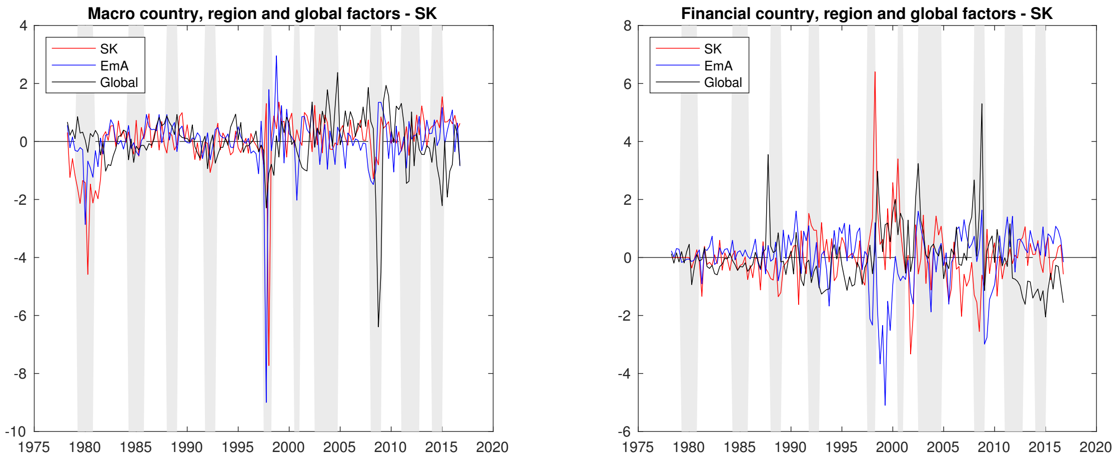

Figure 3: Estimates of global, emerging Asian and South Korean factors

US, advanced and global factors displayed in figure 4 capture all of the crisis periods of the US including the recessions of early 1980 and early 1990 as well as the 2001 and the recent financial crisis. The global, advanced and the US factors closely follow each other most of the time, although the global financial factor seems to have captured most of the tightening effects of financial conditions during the episodes of Black Monday, Dot.com crisis, stock market downturn of 2002 and the recent financial crisis. However, US specific events like taper tantrum in 2013 and FED rate hike of 2015 are reflected on the US country level financial factor.

Figure 5 plots the Euro Area, advanced economies and global factors. Euro Area factor captures the European Exchange Rate (ERM) crisis in 1992, the recent financial

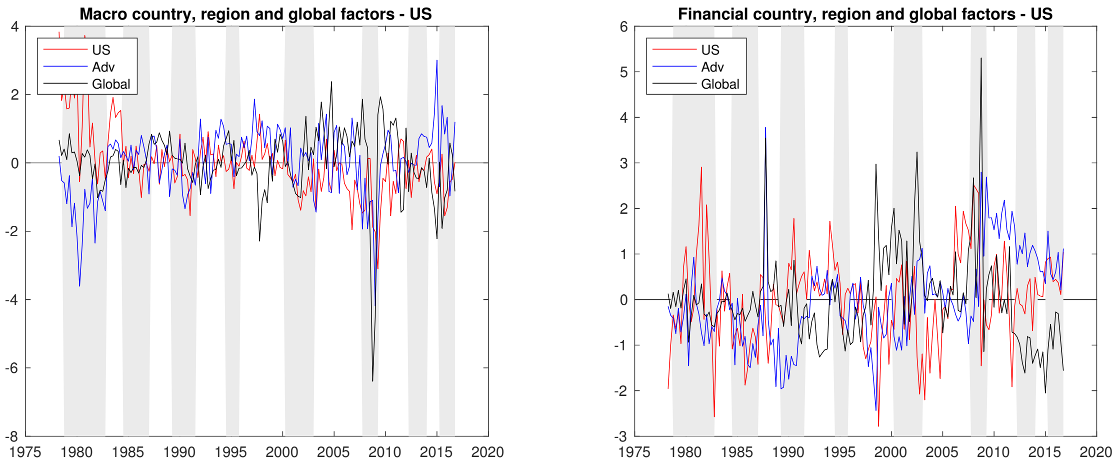

Figure 4: Estimates multi-level macroeconomic factors

crisis and the European debt crisis. It also appears to be affected by the recessions of the US. Overall EU factor seems to have a lower volatility compared to the US factor. Clearly, most of the important episodes for macroeconomic and financial conditions of the Euro Area, including the ERM crisis, European debt crisis, and the Quantitative Easing of the European Central Bank were reflected in the country level factors rather than their higher level counterparts, as these events were more localised. The financial factors seems to reveal this phenomenon better given that the global financial factor captures most of the tightening of financial conditions during the recent financial crisis while the impact of the European debt crisis and the Quantitative Easing of the European Central Bank on the Euro Area financial conditions is mostly reflected on the country level financial factor.

5 Empirical Results

5.1 Time Varying Volatility of Monetary Policy Shocks

Figures 6, 7, 8 and 9 display the estimated time varying volatility of the monetary policy shocks of US, Mexico, South Korea and Turkey. What stands out is that the time varying volatility of the Mexican monetary policy shock almost mimics that of the US monetary policy shock, with the exception of the relatively large peak during the Peso crisis. We

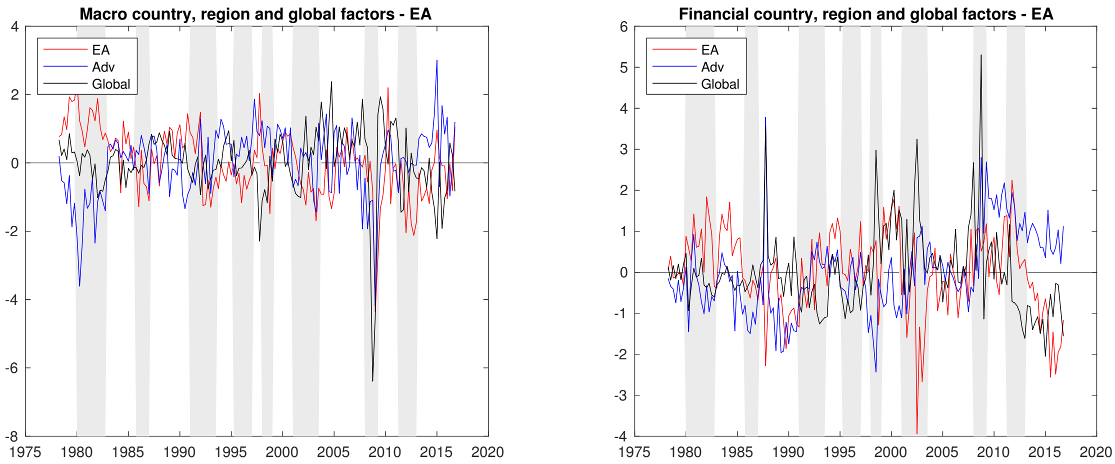

Figure 5: Estimates of global, advanced and the EA factor

find that the volatility of the US monetary policy shocks is highest in the early 1980's during the Volcker disinflation period, whilst another peak after this period is around the global financial crisis. Our estimates of the time varying volatility of US monetary policy shock are in line with the studies in the stochastic volatility literature, such as Primiceri (2005), Korobilis (2013) and Eickmeier et al. (2015).

The time varying volatility of the South Korean monetary policy follows a similar pattern in terms of its decline over time, as one would expect given its financial dependence on the US. It peaks during the Asian Crisis as well as the global financial crisis.

The volatility of the Turkish monetary policy shock has two peaks, the biggest of which coincides with the 1994 crisis whilst the second largest peak is around the 2001 crisis. During this period Turkey went through important policy changes, including the adoption of the floating exchange rate regime and implicit inflation targeting between 2001 and 2006 before moving on to full fledged inflation targeting from 2006 onwards. The volatility of monetary policy shocks appears to have decreased in response to these policy changes, which started increasing again during and after the global financial crisis.

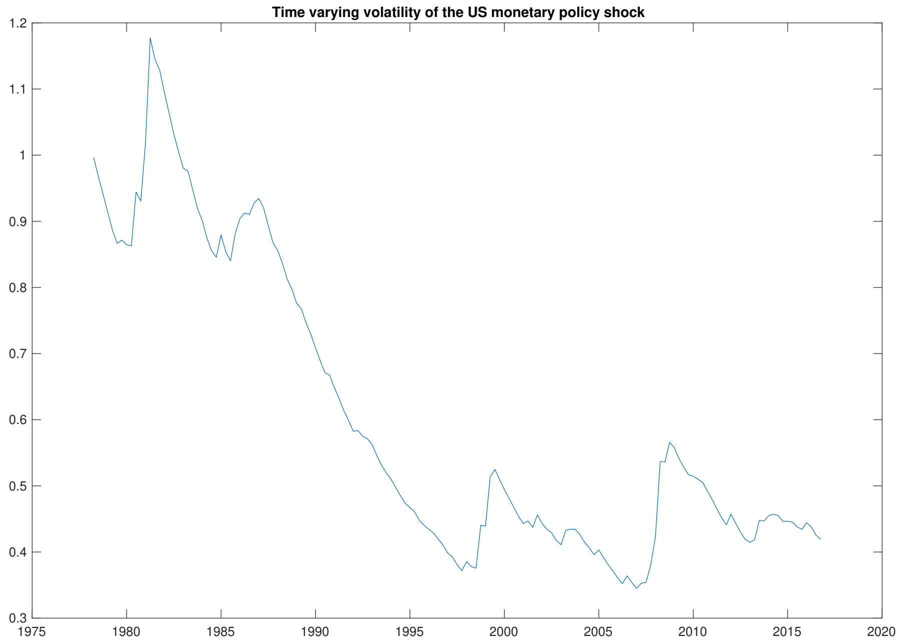

Figure 6: Time varying volatility of the US monetary policy shock

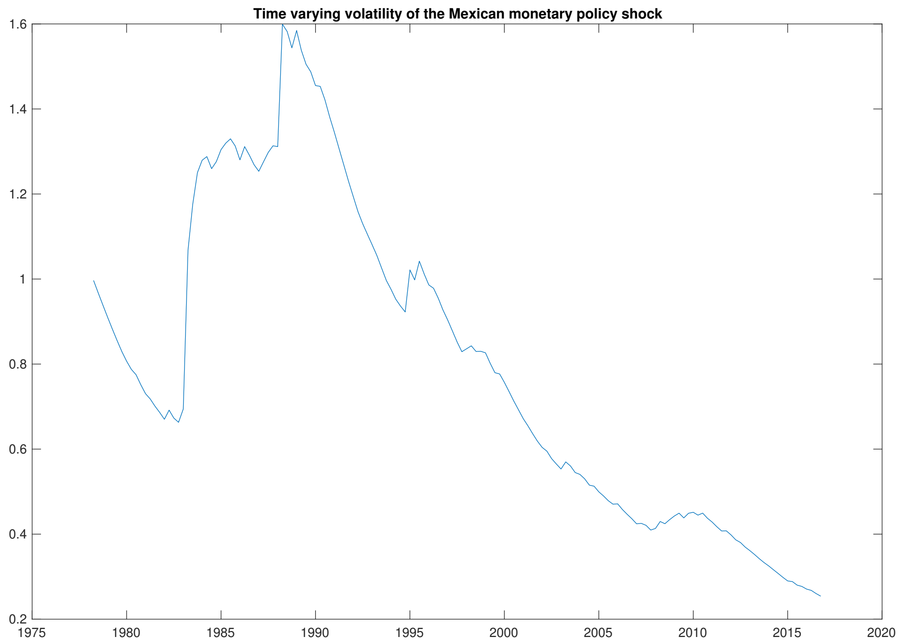

Figure 7: Time varying volatility of the Mexican monetary policy shock

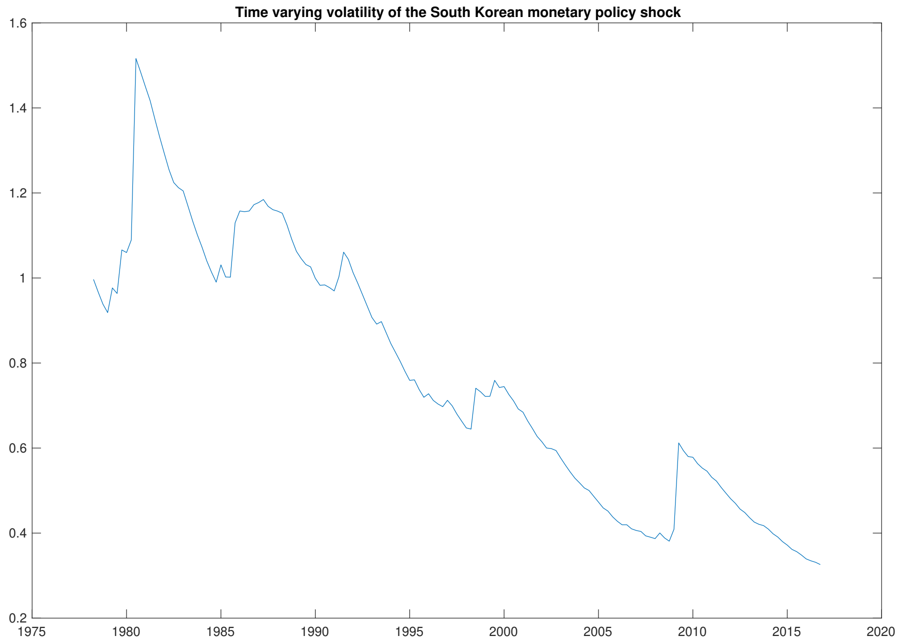

Figure 8: Time varying volatility of the South Korean monetary policy shock

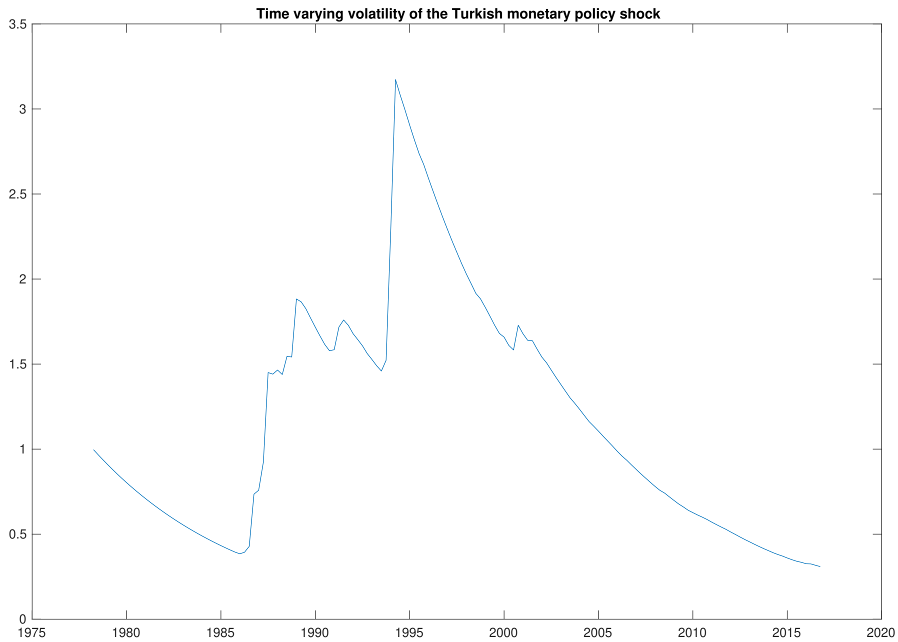

Figure 9: Time varying volatility of the Turkish monetary policy shock

5.2 Variance Decomposition for Selected Variables

In this section we address the question of how important have the country, regional and global level factors been in driving the key macroeconomic and financial variables of our focus emerging economies. We analyse the contribution of our multi-level macroeconomic and financial factors to the variance of selected macroeconomic and financial variables over time. To this end, we decompose the unconditional variance of these variables into contributions of these factors. In particular, our observation equation can be expressed in terms of the variances of both sides:

$$var(X_{i,t}) = (\lambda^F_{i,t})^2 var(F_{i,t}) + (\lambda^G_{i,t})^2 var(G_t) + (\lambda^H_{i,t})^2 var(H_t) + (\lambda^Y_{i,t})^2 var(Y_{i,t}) + var(u_{i,t}) \tag{17}$$

where the variance terms on the right hand side are calculated using the sample variances of the factors, the squares of our time varying factor loadings and the time varying variance of the idiosyncratic error term, u_t.

Table 3 represents the average of the contributions over time. The first 5 columns of the table show the variance decompositions for selected macroeconomic variables of our focus emerging economies. What stands out is that regional factors are estimated to be more important for the volatility of the macroeconomic variables of Mexico and South Korea while for Turkey country-specific components are more responsible for driving these variables. In South Korea's case, global macroeconomic factor also has a non-negligible contribution. In contrast, idiosyncratic component has a major role in driving the selected financial variables of our focus countries although for equity prices, country level financial factors are still important.

Figures 10 to 12 present changes in the contributions of our multi-level factors to the unconditional volatilities of GDP, CPI, private credit and equity price volatility of our focus emerging economies over time. For Turkish GDP and equity price volatility, an important turning point seems to be the move to the floating exchange rate regime. As is well known, floating exchange rate regimes make countries more insulated against macroeconomic developments in other countries. This finding is supported by the variance decomposition of domestic inflation. Before its financial liberalisation in 1989, Turkish inflation is mostly affected by the domestic factors. The dominant effect of the country level factors has been consistently decreasing until the year 2001, when Turkey moved to floating exchange rate regime. After this date, the contribution of domestic uncertainty to the volatility of inflation increases again.

In Mexico's case, as shown in figure 11, advanced economies, global and regional level factors unsurprisingly play a major role in driving the variance of Mexican GDP, CPI, private credit and equity price volatility given Mexico's export orientation and its close integration with the US. Moreover, these factors' contribution to the unconditional volatility of these variables seems to have increased after the crisis.

As for South Korea, our model predicts that country specific uncertainty has been more important in explaining private credit and CPI volatilities and that 1997-98 Asian crisis was an important turning point for these variables, as revealed by figure 12. Furthermore, global factors seem to have the highest contribution to the volatility of South Korean equity price volatility and 1997-98 Asian crisis was again a major event, which affected the pattern of the variance decompositions.

5.3 Computing Time Varying Impulse Responses

Impulse response analysis for structural models involves the identification of structural shocks. Performing such an analysis requires that the correlation across different shocks is taken into consideration, which in our case corresponds to the correlation of shocks across countries. One of the most common identification strategies involves orthogonalised impulse response functions, which requires a causal ordering of the variables in the system. For GVAR models such a causal ordering of the variables from different countries may not be feasible in most cases. An alternative approach more suitable for GVAR models which is not sensitive to the ordering of the variables is computing generalised impulse response functions (GIRF) which was introduced by Koop et al. (1996). The GIRF approach explains shocks to individual errors in a time series model by integrating

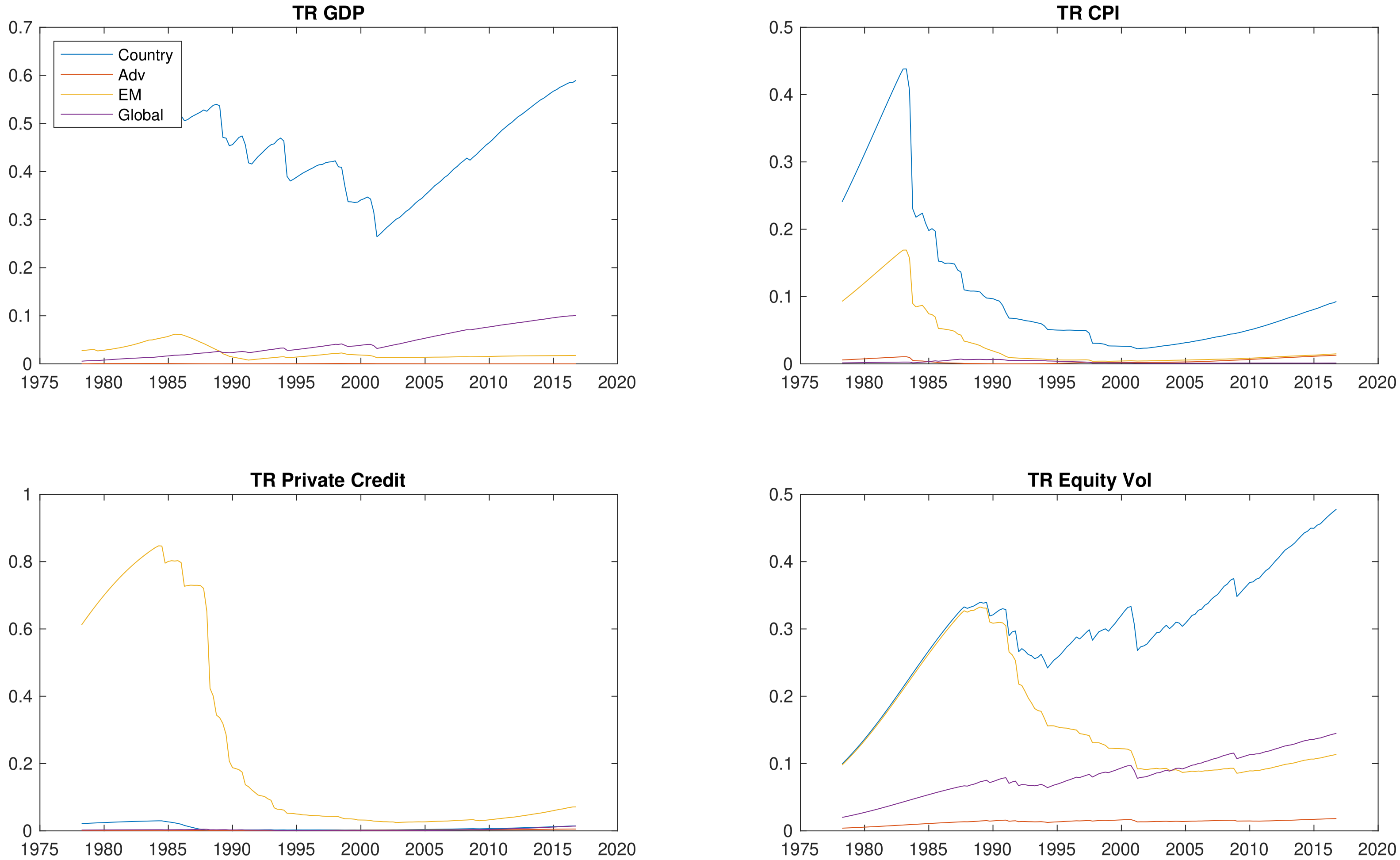

Figure 10: Time varying variance decomposition of Turkish macroeconomic and financial variables.

Figure 11: Time varying variance decomposition of Mexican macroeconomic and financial variables.

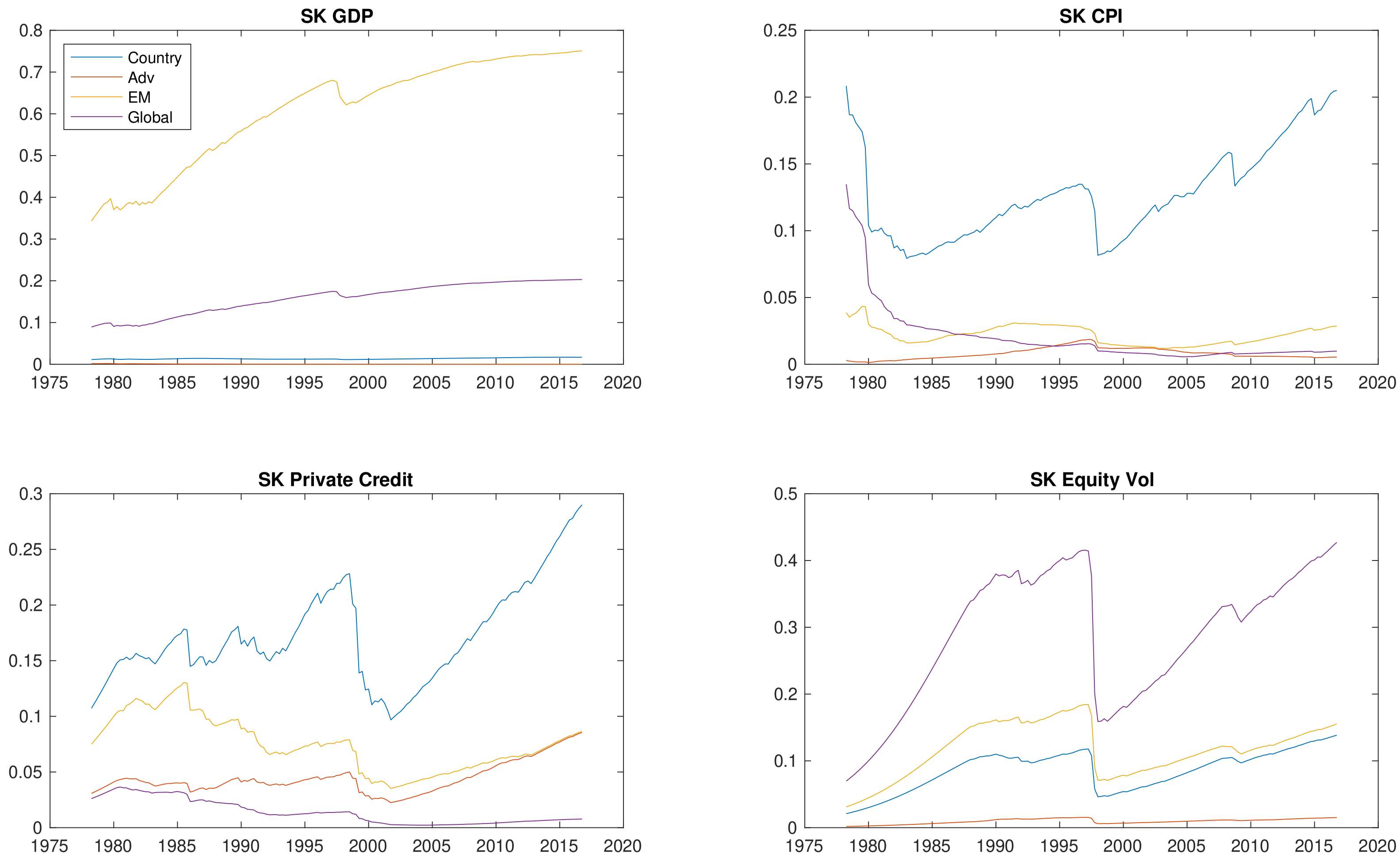

Figure 12: Time varying variance decomposition of South Korean macroeconomic and financial variables.

Table 3: Variance Decompositions

	GDP	Inv.	Cons.	CPI	Tr. Bal.	REER	Pr. Cred.	Eq. Price	Eq. Vol.
(a) Turkey:									
Turkey M	0.460	0.227	0.264	0.109	0.075	0.179	0.001	0.007	0.073
Turkey F	0.002	0.002	0.001	0.001	0.000	0.009	0.008	0.321	0.232
Emerging Europe M	0.011	0.002	0.002	0.011	0.016	0.002	0.010	0.001	0.023
Emerging Europe F	0.006	0.000	0.003	0.010	0.010	0.027	0.217	0.131	0.130
Global M	0.040	0.144	0.121	0.001	0.132	0.019	0.001	0.022	0.017
Global F	0.003	0.016	0.019	0.002	0.004	0.000	0.002	0.025	0.066
(b) Mexico:									
Mexico M	0.007	0.122	0.115	0.131	0.093	0.191	0.004	0.000	0.010
Mexico F	0.006	0.000	0.000	0.000	0.001	0.002	0.432	0.134	0.060
Emerging LA M	0.150	0.619	0.580	0.602	0.085	0.361	0.001	0.001	0.009
Emerging LA F	0.004	0.000	0.000	0.000	0.003	0.017	0.100	0.021	0.001
Global M	0.057	0.053	0.069	0.063	0.006	0.021	0.006	0.208	0.037
Global F	0.002	0.001	0.000	0.000	0.033	0.004	0.026	0.040	0.061
(c) South Korea:									
South Korea M	0.013	0.009	0.003	0.126	0.026	0.019	0.100	0.001	0.011
South Korea F	0.001	0.000	0.000	0.002	0.012	0.015	0.071	0.223	0.076
Emerging Asia M	0.607	0.561	0.599	0.009	0.000	0.159	0.007	0.141	0.024
Emerging Asia F	0.000	0.001	0.000	0.001	0.009	0.019	0.039	0.141	0.080
Global M	0.157	0.171	0.162	0.018	0.033	0.047	0.004	0.055	0.138
Global F	0.001	0.001	0.001	0.002	0.002	0.025	0.010	0.016	0.150

The table reports the average contribution of the country, regional and global level factors to the variance of selected macroeconomic and financial variables over time out the effects of other shocks using either assumed or observed distribution of errors. Following Primiceri (2005), we compute our impulse responses with the assumption that all parameters remain at the values estimated for the period when the shock occurs. This approach is widely used in the time varying parameter literature. One advantage of our setup is that, as our transition equation is a similar structure to a FAVAR, we can compute generalised impulse response functions for the individual variables within the vector X_i using the observation equation as:

$$\Upsilon^{X_i}_{j,n,t} = \lambda^F_{t,i}\Upsilon^{F_i}_{j,n,t} + \lambda^G_{t,i}\Upsilon^G_{j,n,t} + \lambda^H_{t,i}\Upsilon^H_{j,n,t} + \lambda^Y_{t,i}\Upsilon^{Y_i}_{j,n,t} \tag{18}$$

where $\Upsilon^{F_i}_{j,n,t}, \Upsilon^G_{j,n,t}, \Upsilon^H_{j,n,t}$ and $\Upsilon^{Y_i}_{j,n,t}$ are the vectors of generalised impulse responses for F_i, G, H and Y_i to a shock to the j-th variable at horizon n at time t.

In order to compute the confidence intervals for the time-varying impulse response functions, we use the Kalman smoother estimates of the coefficient matrices λ_t and β_t and their respective smoothed variance covariance matrices. For λ_t we generate 100 draws from the $N(\lambda_{t|t+1}, \Sigma^\lambda_{t|t+1})$ distribution and for β_t we generate 100 draws from the $N(\beta_{t|t+1}, \Sigma^\beta_{t|t+1})$ distribution with the conditional means and covariances given in equations (13), (14), (15) and (16). For each of these draws we compute impulse responses and we then obtain the 2.5^{th} and the 97.5^{th} quantile of these impulse responses from these draws for each time period, variable and horizon, which we use as our 95% confidence interval.

Against this background, we evaluate the time-varying effects of foreign financial conditions, foreign interest rates and foreign macroeconomic activity on the macroeconomic and financial conditions in our focus countries; namely, Turkey, Mexico and South Korea.

5.3.1 Effects of External Financial shocks on Domestic Macroeconomic Activity

Figures 13 to 15 show the time varying impulse responses to a shock to the global financial factor for selected time periods before the crisis, during the crisis and after the crisis. To begin with, all three of our selected emerging economies are largely affected by global financial conditions as one would expect and there seems to be time variation in the responses of their macroeconomic conditions to a shock to global financial conditions. Before the crisis, tightening in global financial conditions had a relatively smaller effect on the macroeconomic conditions of Turkey, Mexico and South Korea which is not statistically different from zero for most of the individual macroeconomic variables included in the analysis. During and after the crisis, however, GDP, investment and consumption growth decrease in all three countries in response to tighter global financial conditions while this effect is particularly stronger during the crisis. None of our focus emerging economies display a subsequent overshoot in macroeconomic activity. On the other hand a rise in global financial risk in some cases has an inflationary effect with the exception of the crisis period. The response of consumer prices matches the response of the real effective exchange rate to a tightening shock to global financial conditions in Mexico and South Korea, as shown in figures 26 to 27. This result seems plausible given that exchange rate is an important transmission mechanism for emerging economies. Overall, our results indicate that the macroeconomic conditions in our focus emerging countries became more sensitive during and after the recent financial crisis.

5.3.2 Effects of a US monetary policy shock on Domestic Macroeconomic Activity

We now turn to the effects of a one standard deviation shock to the US policy rate, shown in figures 16 to 18. Due to zero-lower bound issues during the period covered in the study, we rely on shadow rates calculated by Krippner (2013) to measure the effects of US monetary policy shock. These provide a measure of monetary policy stance for both conventional and unconventional monetary policy times such as the period of quantitative easing. To identify the monetary policy shock we follow Altavilla et al. (2016) and use a recursive identification scheme with US variables ordered first in each block of factors. We assume that macroeconomic factors for each country are ordered before policy rates and financial factors assuming that output and prices respond to a

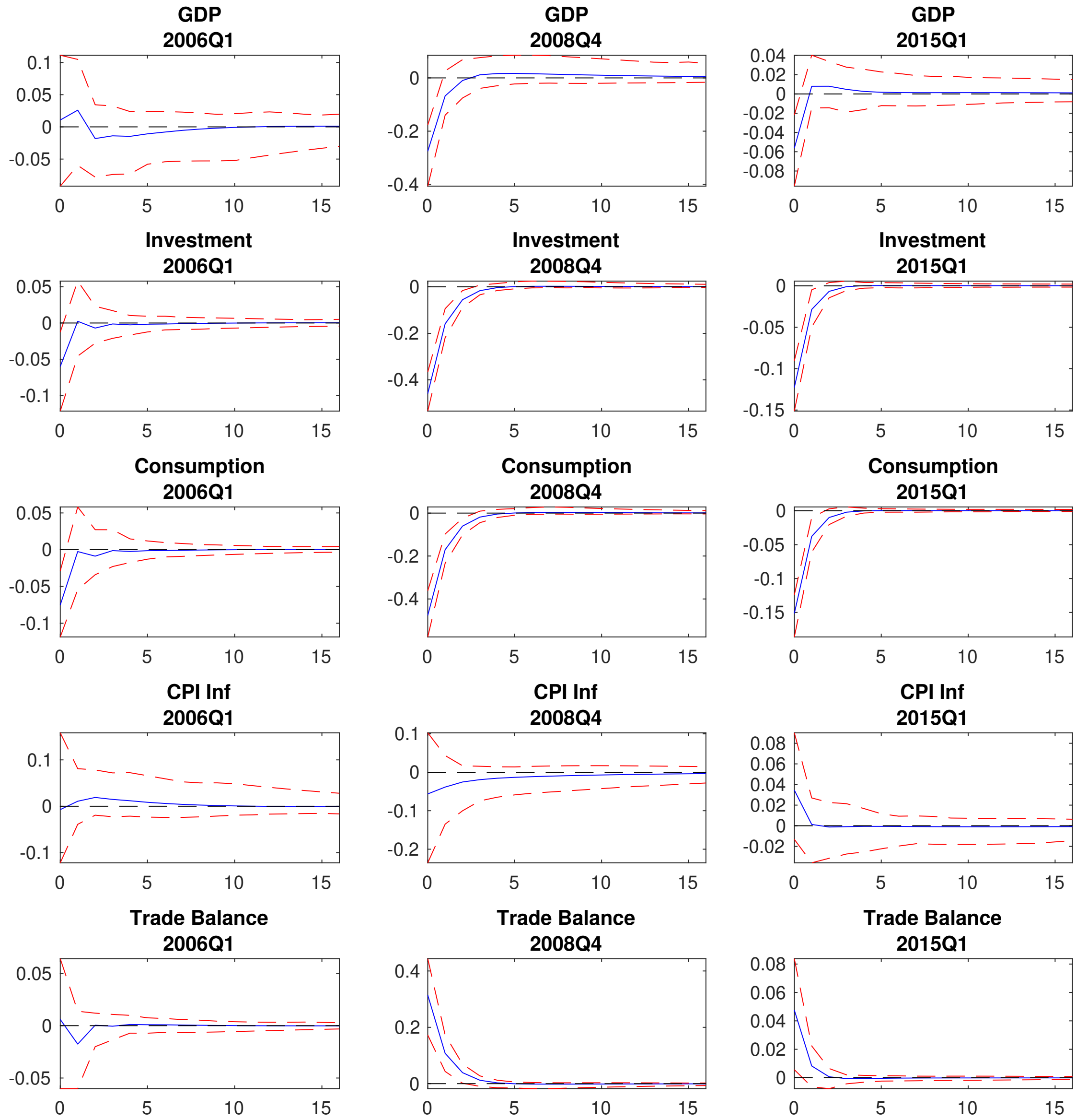

Figure 13: Time varying impulse responses of the selected Turkish macroeconomic variables to a one standard deviation shock to global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

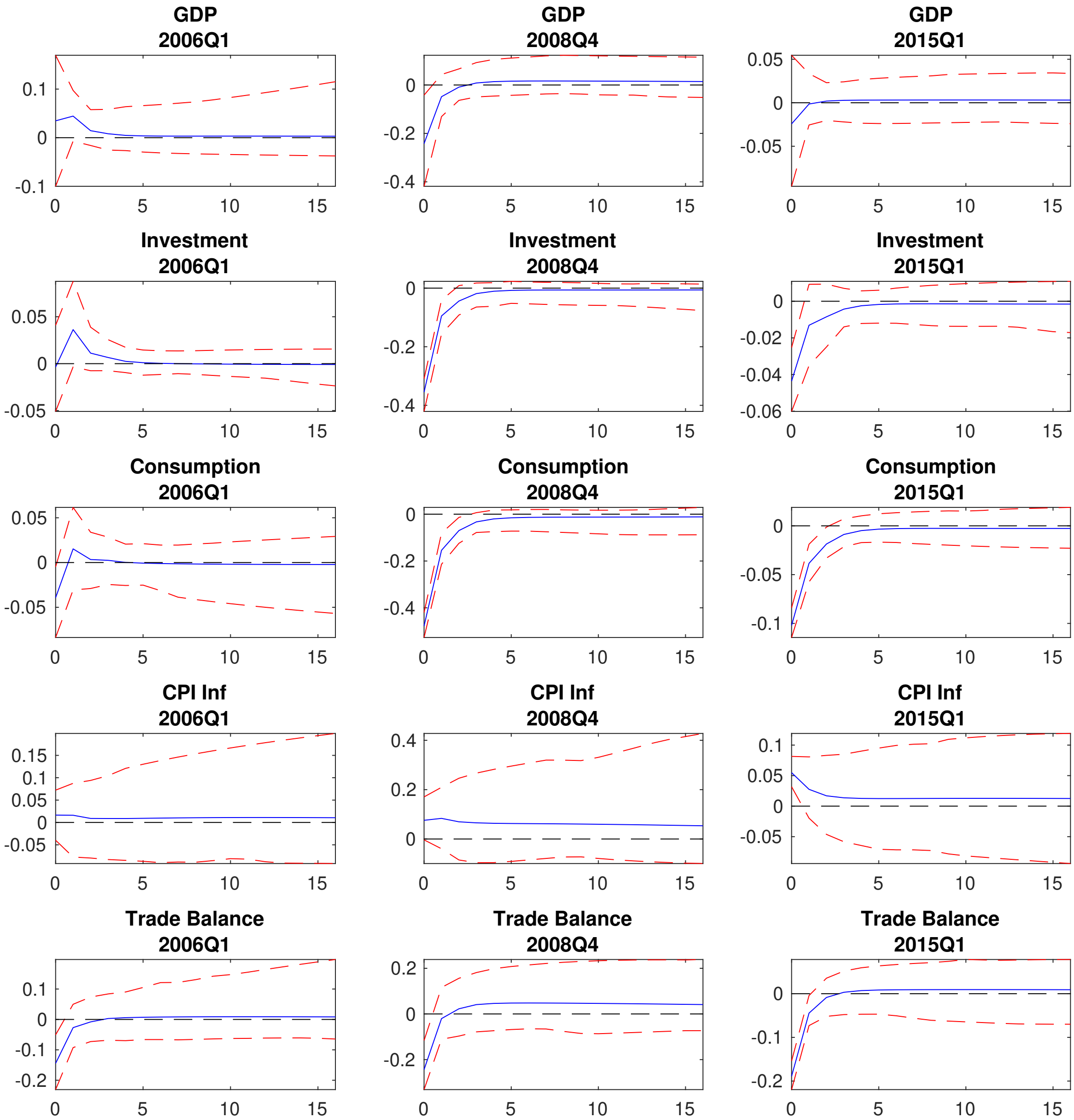

Figure 14: Time varying impulse responses of the selected Mexican macroeconomic variables to a one standard deviation shock to global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

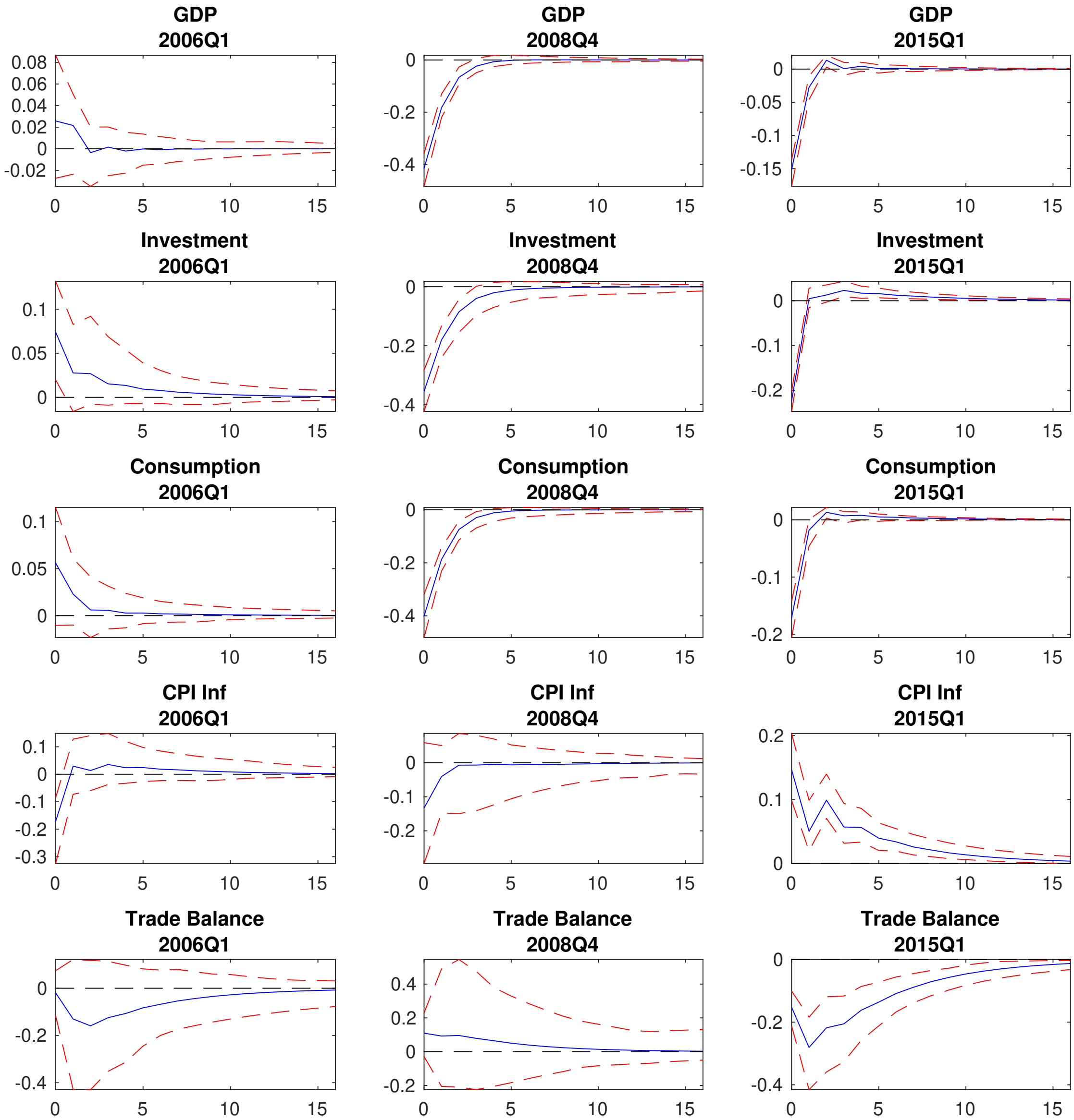

Figure 15: Time varying impulse responses of the selected South Korean macroeconomic variables to a one standard deviation shock to global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

monetary policy shock with one period lag while real domestic shocks affect financial markets contemporaneously. We further assume that risk-free interest rates can have a contemporaneous effect on financial factors but not vice versa. As Christiano et al. (1999) argues the ordering of variables in the blocks before and after the US policy rate does not matter since we only identify the US monetary policy shock.

During the crisis our focus emerging economies respond positively to a contractionary US monetary policy shock except Mexico given its export orientation and its close integration with the US. Since we use the shadow rate as our measure of US monetary policy stance, which at the onset of the crisis represents the unconventional expansionary monetary policy measures of the US, this result is not very surprising. However, contrary to the findings in the existing literature, real activity variables in Turkey and South Korea respond positively to a contractionary monetary policy shock originating from the US after the crisis. We explain this phenomenon by the fact that macroeconomic variables in emerging economies, consumption and investment in particular, are highly sensitive to global financial risks as these components of aggregate demand mostly rely on expectations about future events. Moreover, as established by Miranda-Agrippino and Rey (2015), US monetary policy shocks have a direct effect on the 'Global Financial Cycle', which is characterised by global risk aversion and capital inflows. In contrast with the studies based on small scale-VARs analysing the effects of US monetary policy shocks, we include a global financial factor that in our case is highly correlated with the US stock market volatility index, which in many studies has been used as a proxy for global financial risk. Therefore we argue that the well documented contractionary effect of US interest rate shocks is taken up by global financial risk shocks in our analysis. This aspect of financial shocks is overlooked by the literature on emerging economies with the exception of the study of Akıncı (2013), which estimates a structural VAR using pooled emerging market data and therefore does not perform country specific analysis. In order to check the validity of this argument, we estimate our VAR model excluding the global and advanced economies' financial factors. Our results provide some evidence for Turkey and South Korea that the well established contractionary effect of the US monetary policy shock is indeed taken up by the financial factor which is strongly associated with global uncertainty.

5.3.3 Effects of Foreign Financial Shocks on Domestic Financial Conditions

Figures 22 to 24 show the GIRF of a shock to the multi-level financial factors to the Turkish, Mexican and South Korean financial factors. Before the crisis, tightening in global financial conditions resulted in tightening in country level financial conditions for all three emerging economies that we focus on in our analysis. This effect was more pronounced in Mexico, which has greater financial dependence on the US. During and after the crisis however, tightening in global and advanced countries' financial conditions resulted in loosening of financial conditions in Turkey, Mexico and South Korea, which can be explained by the deployment of unusual monetary and fiscal policy measures by advanced economies after the initial effect of the crisis. What stands out is that financial tightening in other emerging country groups has a loosening effect on the financial conditions particularly in Mexico. This might be due to the fact that emerging markets compete with each other for international capital flows and financial stress in these countries may cause investors to shift resources to a profitable and still safer option. Given that Turkey and Latin American countries have similar vulnerabilities due to their experiences with much higher levels of inflation and nominal interest rates, it seems plausible that they are exposed to similar risks. This effect is less pronounced in South Korea, whose financial markets are more developed. However, after the crisis a financial tightening in its own country group still has the expected tightening effect while a tightening in other emerging country groups has the opposite effect. This change might be due to changes in perceptions of risk in emerging markets after the crisis.

Figures 25 to 27 shows the impulse responses of selected domestic financial variables of our focus countries to a global financial shock, which in our case represents global risk shocks. To begin with in response to tighter global financial conditions the monetary policy rate increases after the global financial crisis except in Mexico. We find that Turkey and South Korea attach more importance to financial stability and capital inflows given

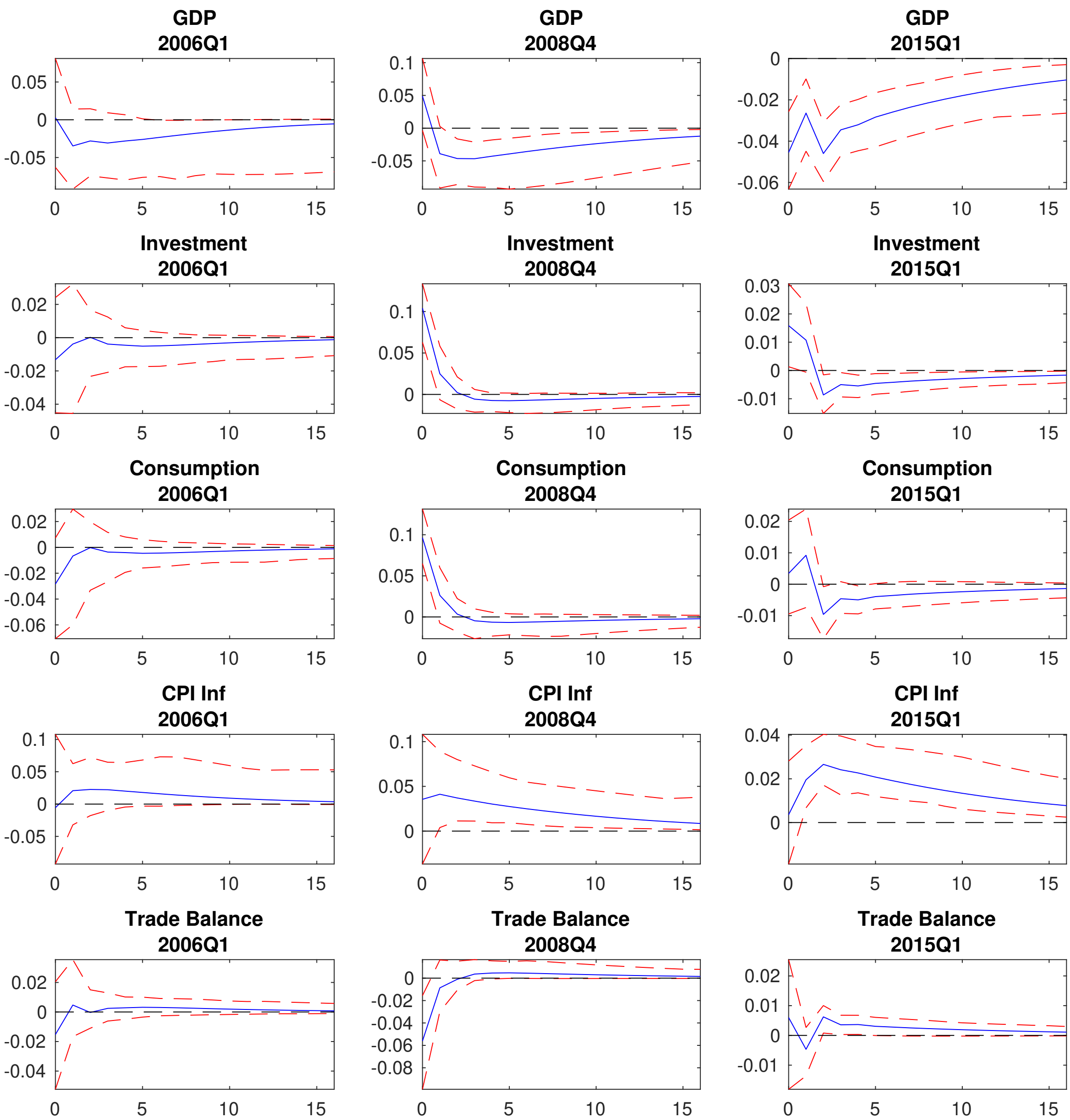

Figure 16: Time varying impulse responses of the selected Turkish macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

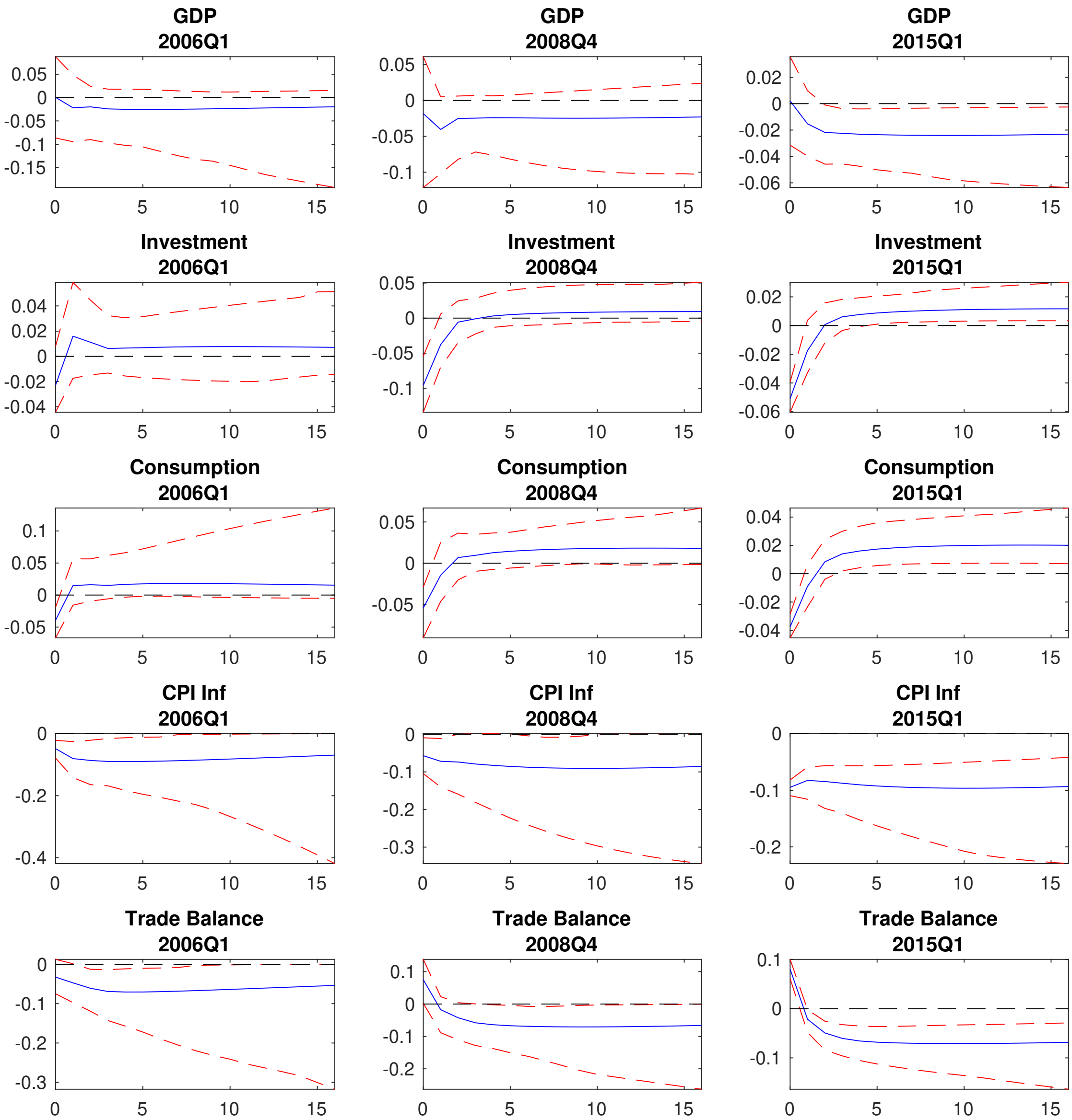

Figure 17: Time varying impulse responses of the selected Mexican macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

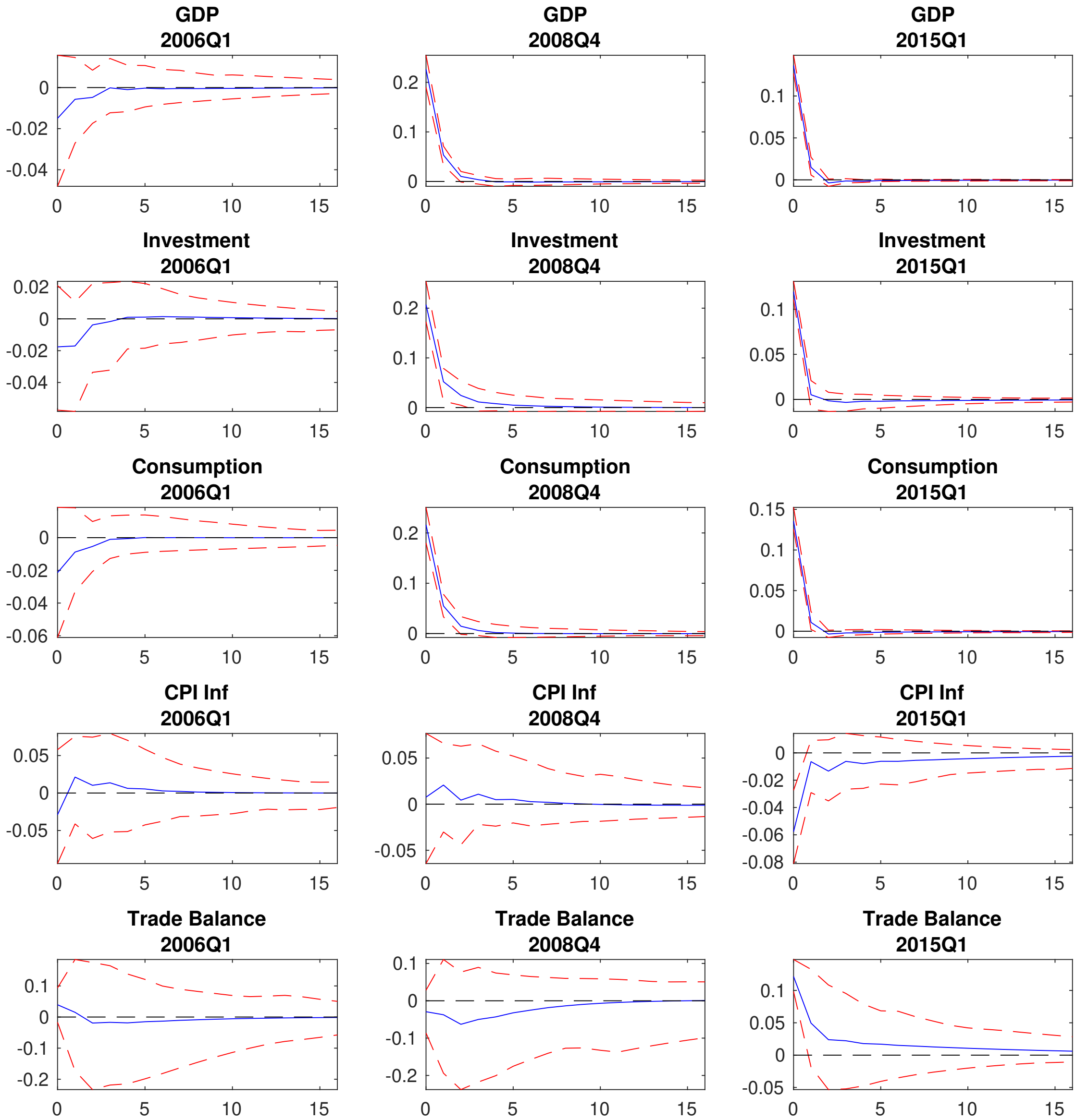

Figure 18: Time varying impulse responses of the selected South Korean macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

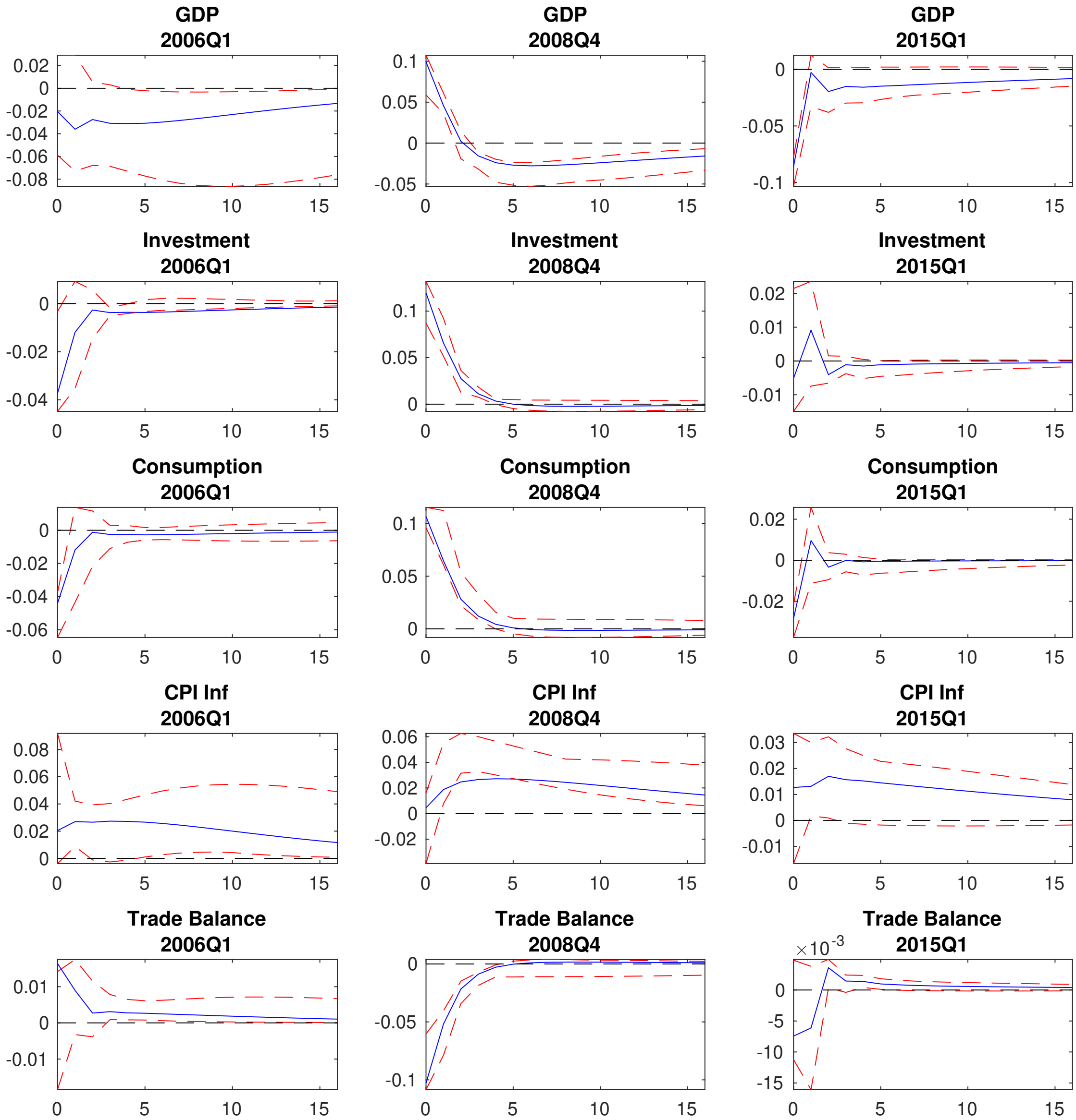

Figure 19: Counterfactual exercise: Time varying impulse responses of the selected Turkish macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

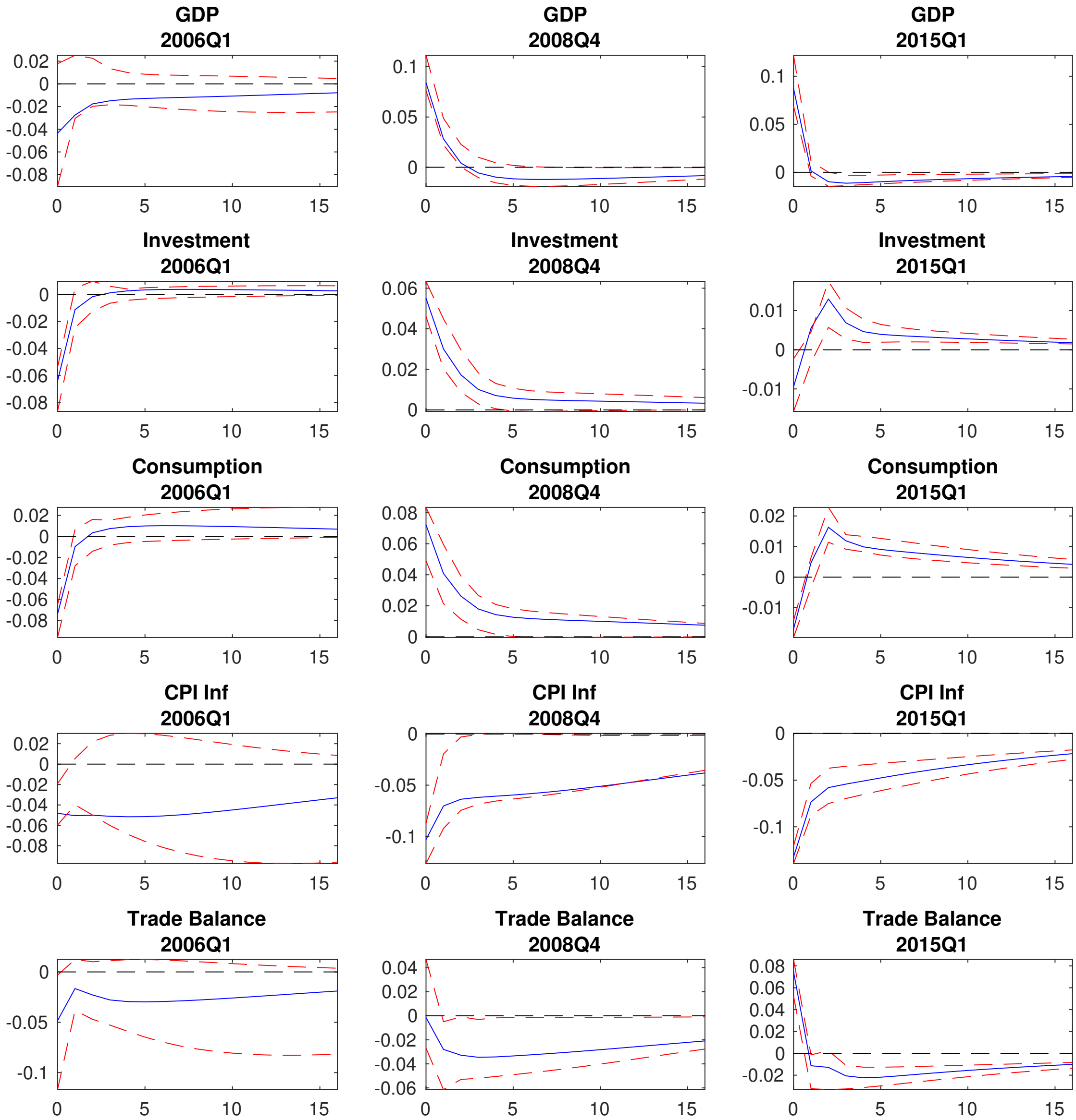

Figure 20: Counterfactual exercise: Time varying impulse responses of the selected Mexican macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

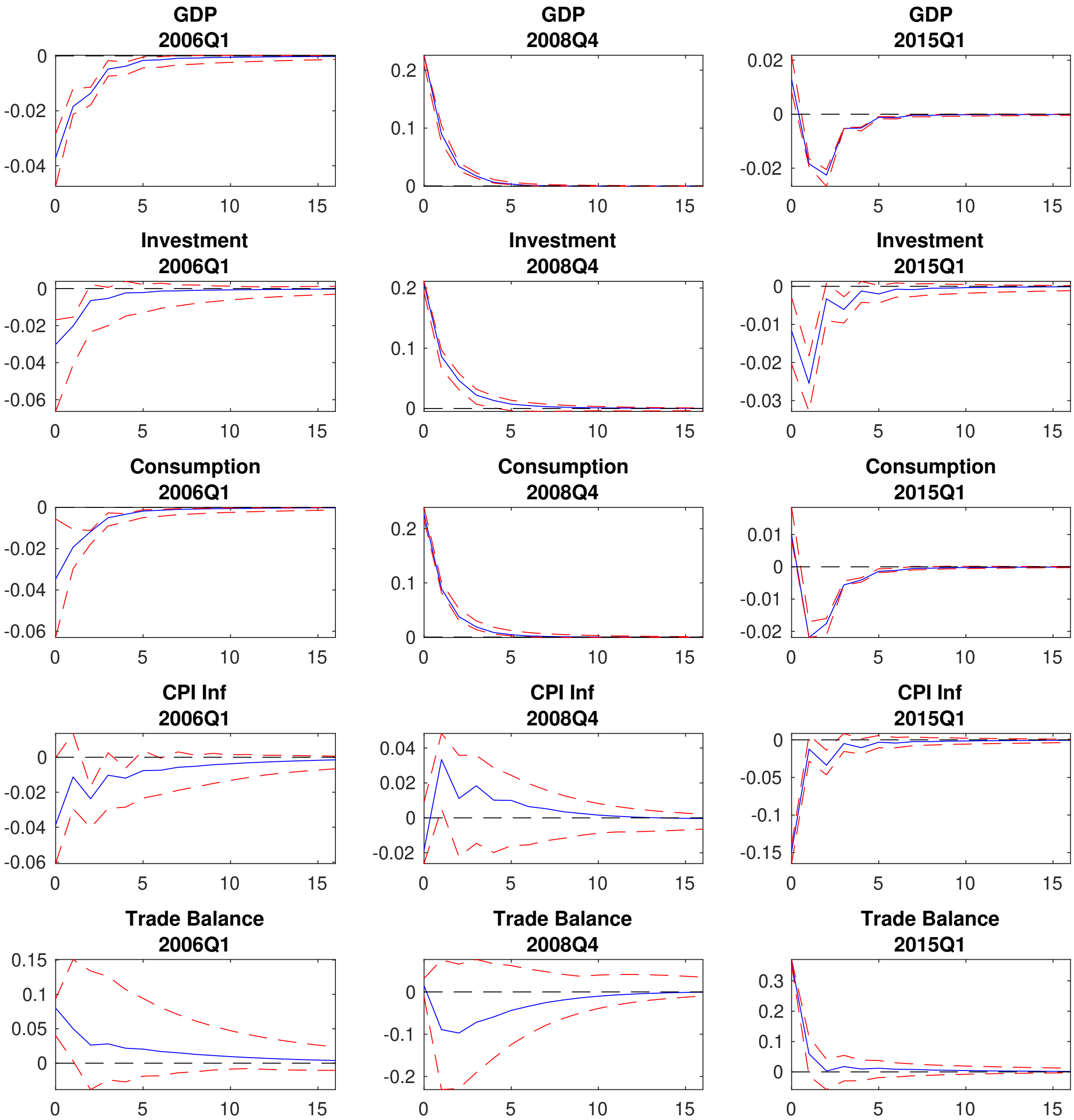

Figure 21: Counterfactual exercise: Time varying impulse responses of the selected South Korean macroeconomic variables to a one standard deviation shock to US policy rate. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

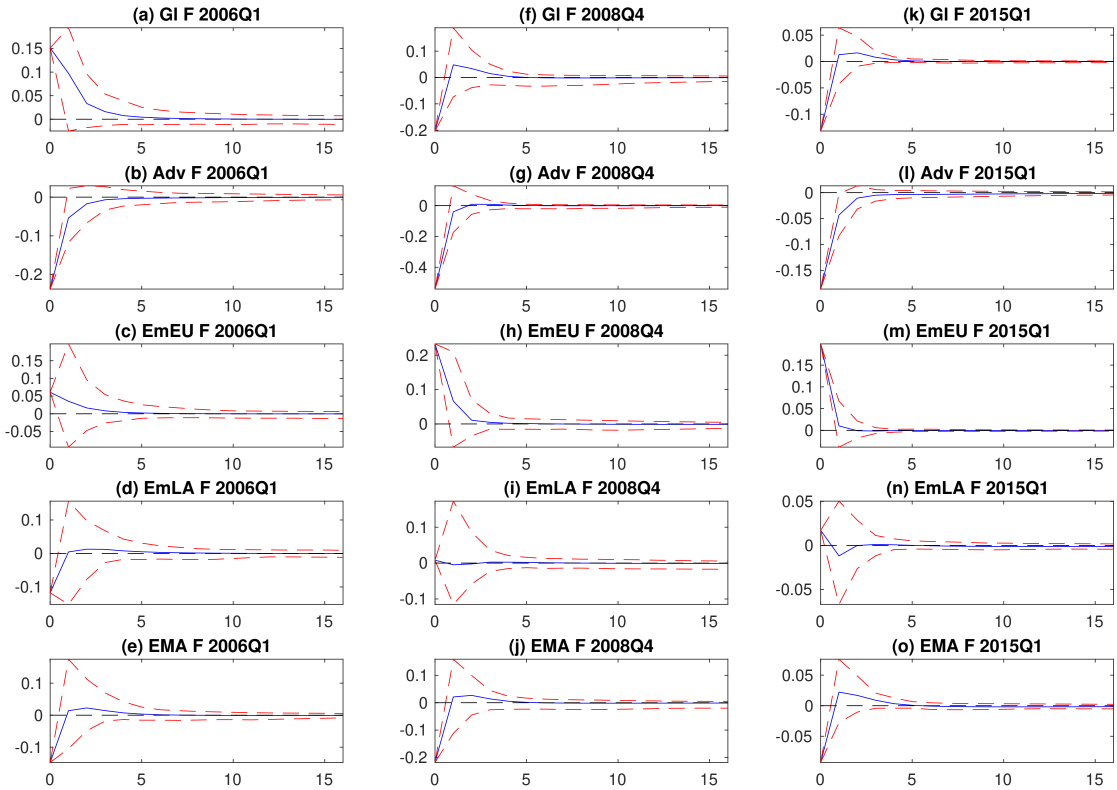

Figure 22: Time varying impulse responses of the Turkish financial factor to a one standard deviation shock to (a) Global financial factor (b) Advanced financial factor (c) Emerging Europe financial factor (d) Latin American financial factor (e) Emerging Asian financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

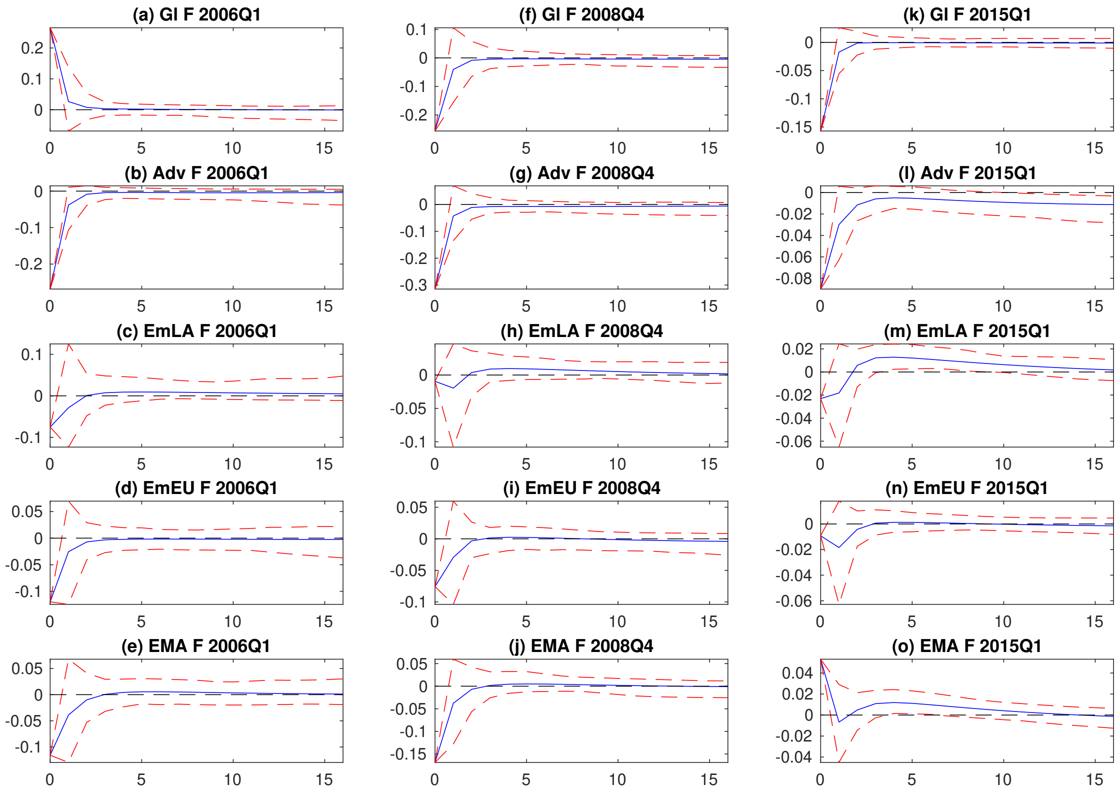

Figure 23: Time varying impulse responses of the Mexican financial factor to a one standard deviation shock to (a) Global financial factor (b) Advanced financial factor (c) Latin American financial factor (d) Emerging Europe financial factor (e) Emerging Asian financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

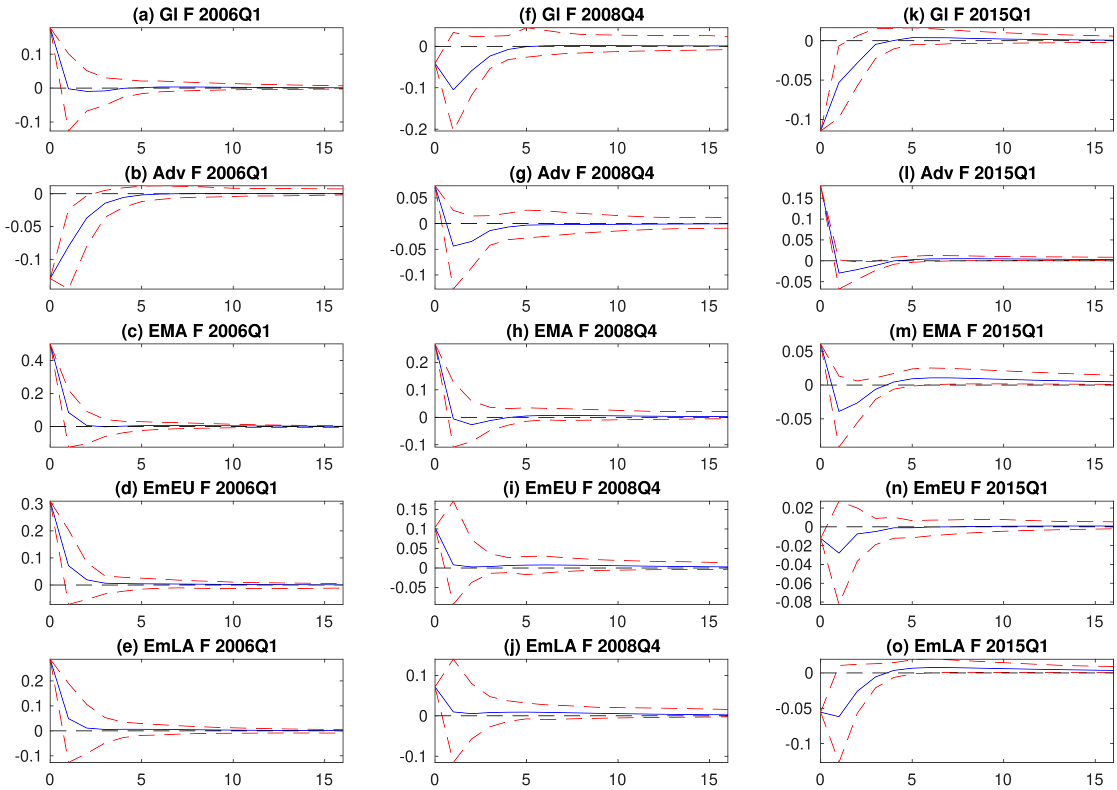

Figure 24: Time varying impulse responses of the South Korean financial factor to a one standard deviation shock to (a) Global financial factor (b) Advanced financial factor (c) Emerging Asia financial factor (d) Emerging European financial factor (e) Latin America financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

that they increase their short term rates more at the expense of large drops in equity prices and output. Moreover, real effective exchange rate responds by depreciating in response to tighter global financial conditions especially during and after the crisis.The global financial shock also has a large effect on the equity markets, which is in line with what theoretical models would predict. The fact that emerging markets are perceived more risky during turbulent periods such as periods of higher financial risk is reflected on their asset prices as well as their borrowing costs represented by their country spreads. Equity prices in our focus emerging economies decrease sharply in the face of a global financial shock, whilst equity price volatility increases. These effects are observed consistently across time periods although equity prices and equity price volatility become more sensitive to global financial shocks during the crisis period as compared to the pre-crisis period. Moreover the effects of a global financial shock are much more pronounced in South Korea, whose financial markets are more developed and therefore who is more vulnerable to a financial shock.

5.3.4 Effects of Foreign Macroeconomic Shocks on Domestic Macroeconomic Conditions

Figures 28 to 30 give the impulse response functions for a positive global macroeconomic shock. In response to this shock, as one would expect, output growth increases and trade balance deteriorates except in Mexico. This positive shock, however does not result in an increase in inflation in Turkey and Mexico. This might be due to the real exchange rate appreciation as a result of the positive macroeconomic shock since exchange rate pass through is still relatively high in these countries.

Figures 31 to 33 show the GIRF of a shock to the multi-level macroeconomic factors to the Turkish, Mexican and South Korean macroeconomic factors. Our findings are in line what one would expect given the trade ties of our focus emerging economies with advanced and other emerging economies. A positive shock to the multilevel macroeconomic factors almost always causes an improvement in the macroeconomic conditions of these countries. What stands out is that we find some evidence that macroeconomic

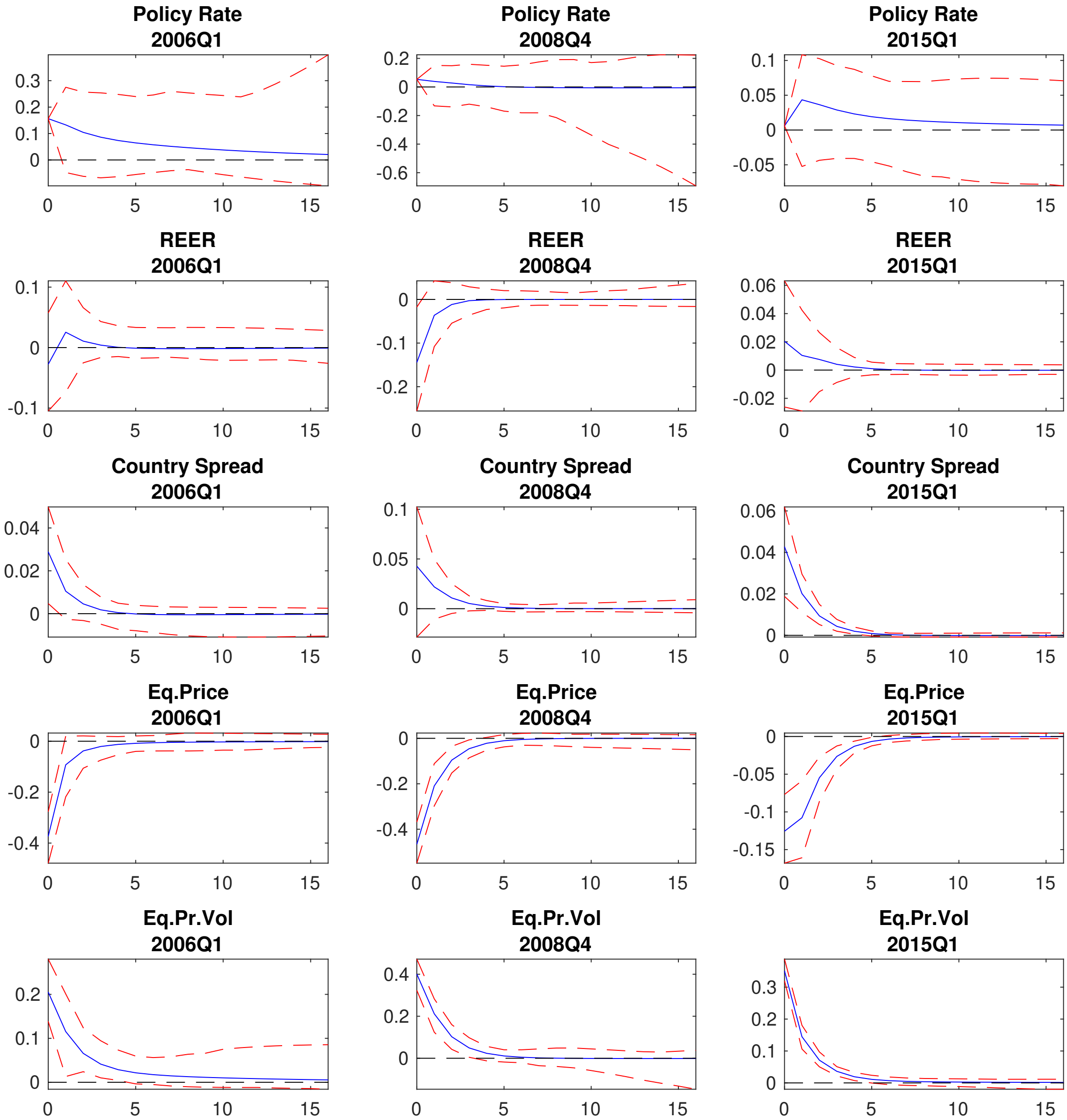

Figure 25: Time varying impulse responses of selected Turkish financial variables to a one standard deviation shock to the global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

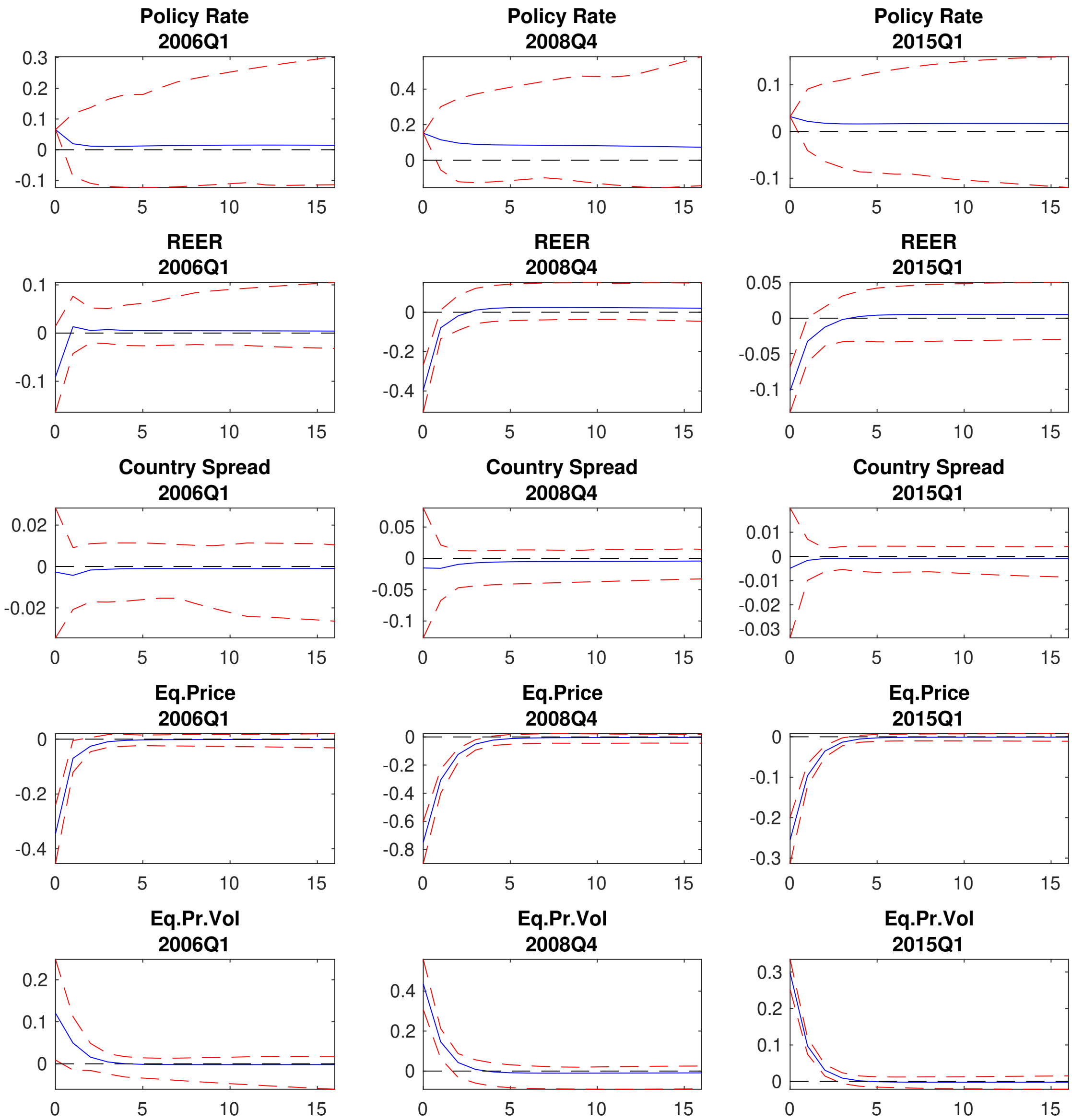

Figure 26: Time varying impulse responses of selected Mexican financial variables to a one standard deviation shock to the global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

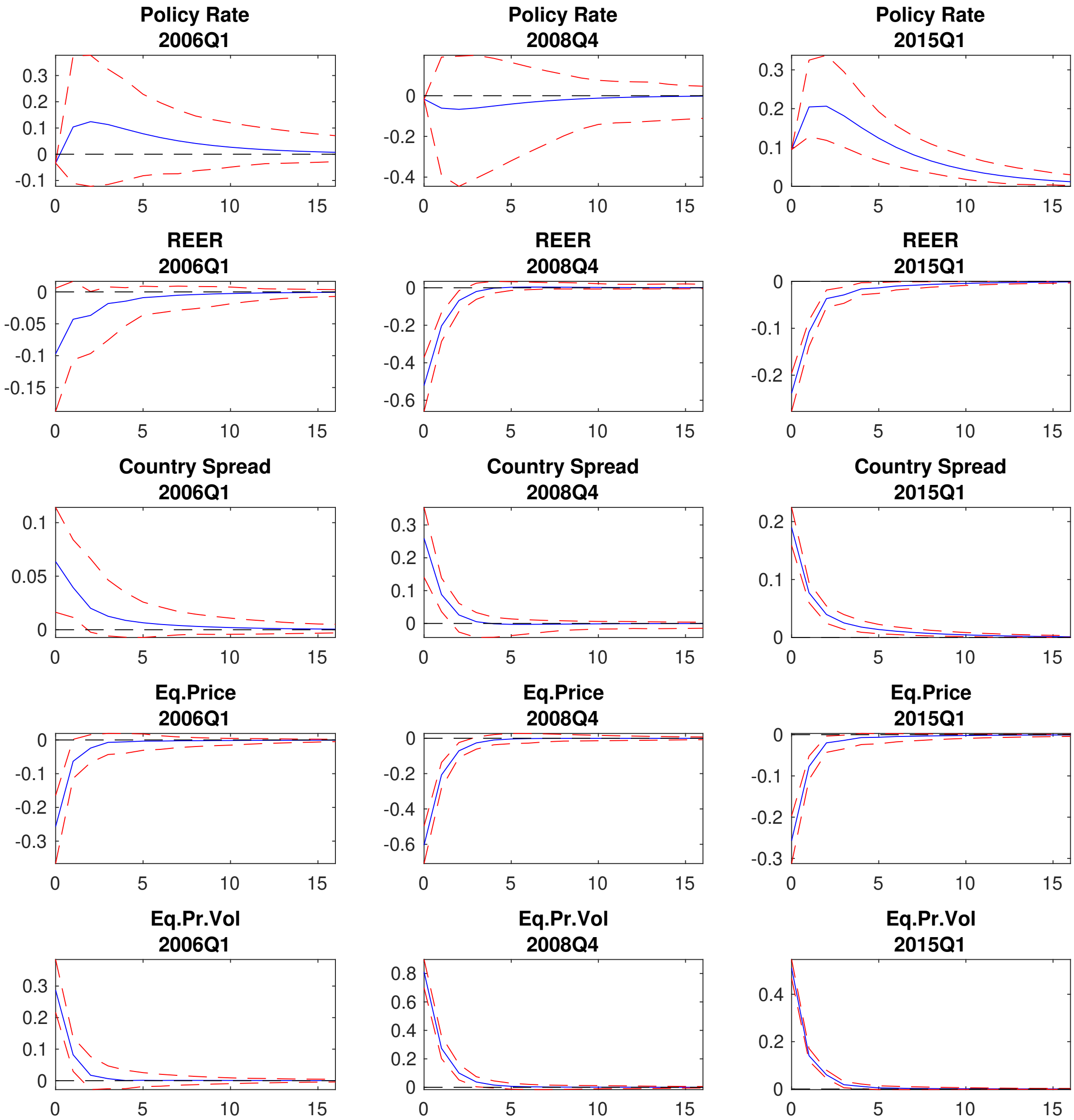

Figure 27: Time varying impulse responses of selected South Korean financial variables to a one standard deviation shock to the global financial factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

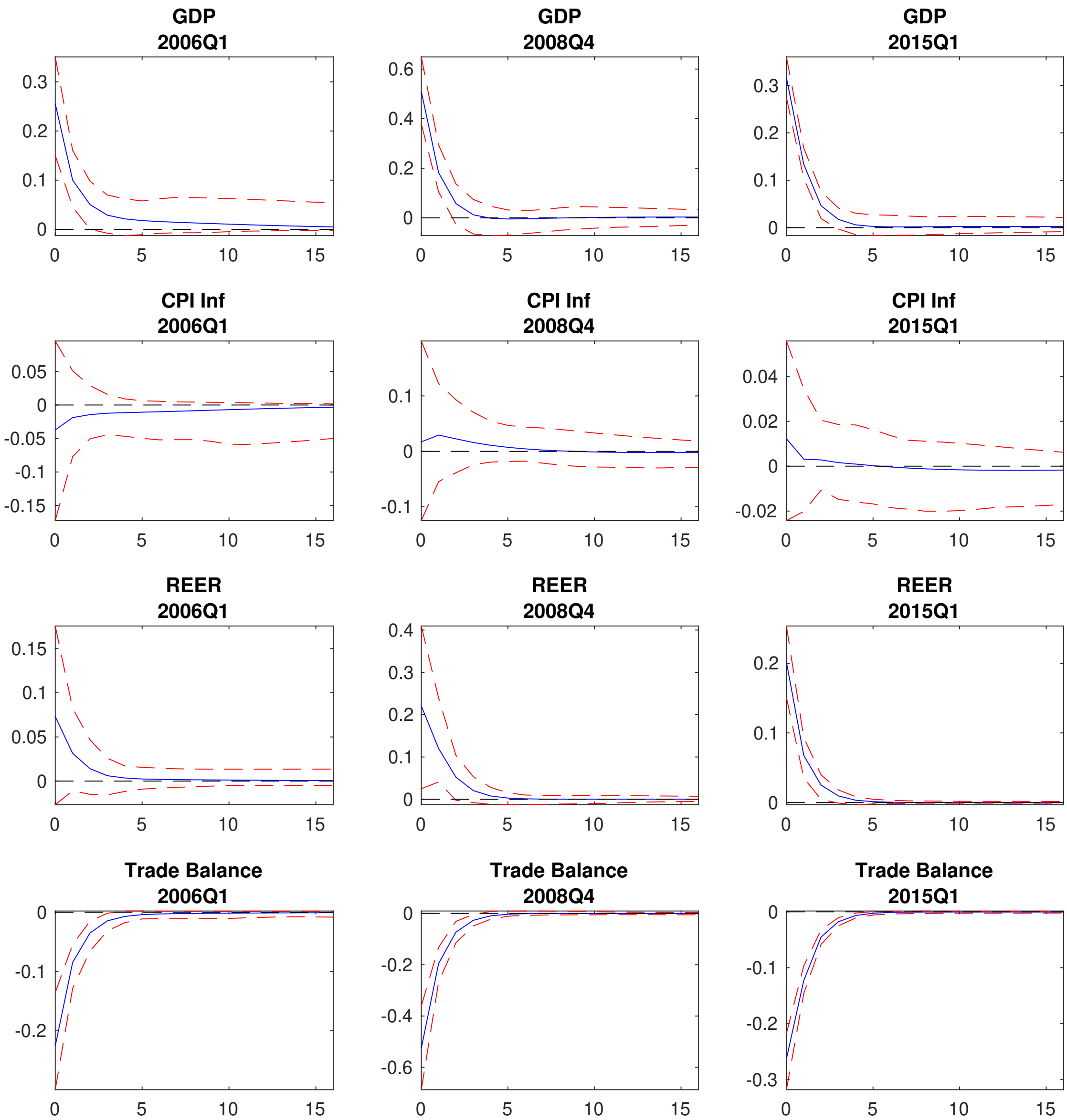

Figure 28: Time varying impulse responses of selected Turkish macroeconomic variables to a one standard deviation shock to the global macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

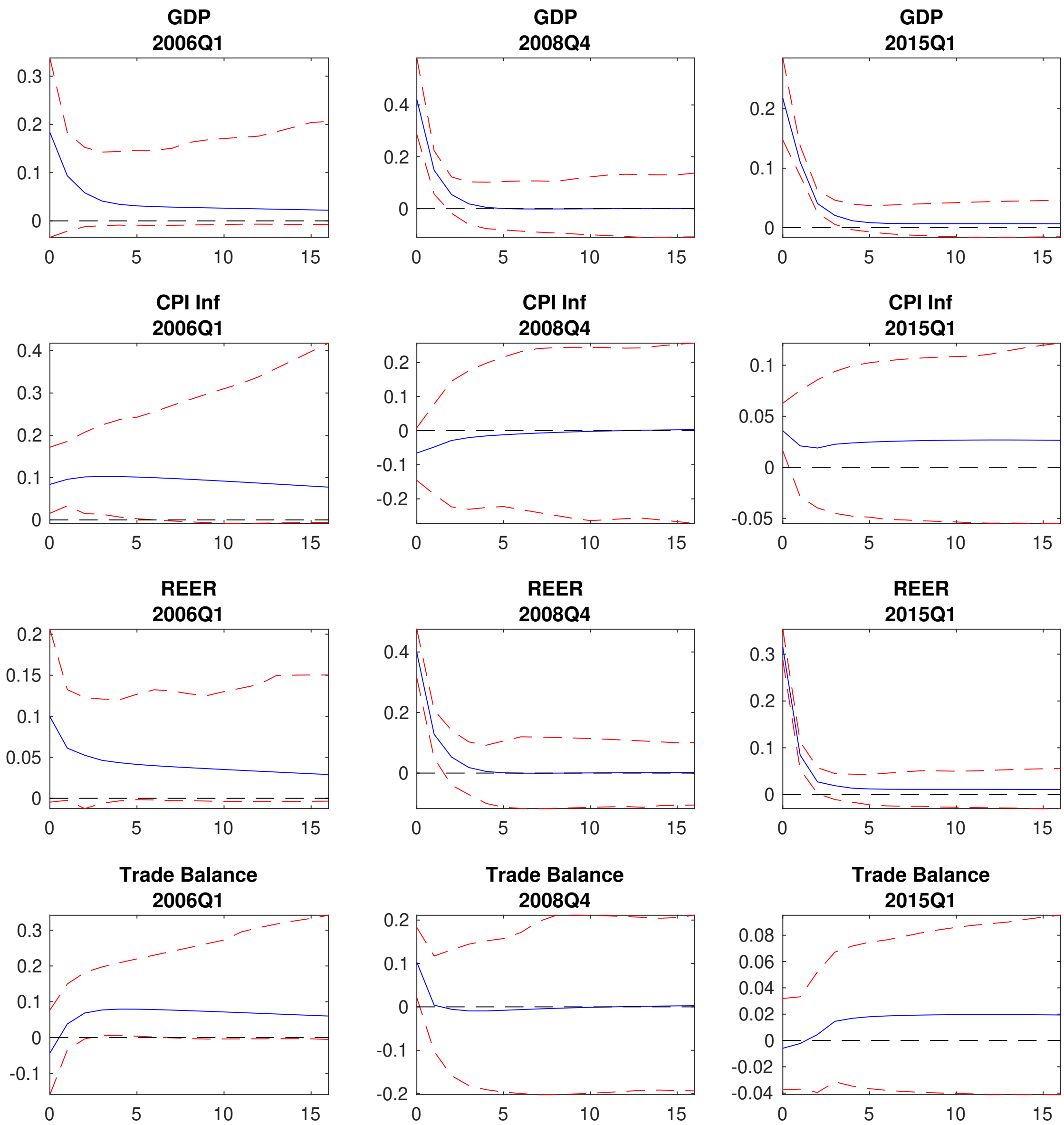

Figure 29: Time varying impulse responses of selected Mexican macroeconomic variables to a one standard deviation shock to the global macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

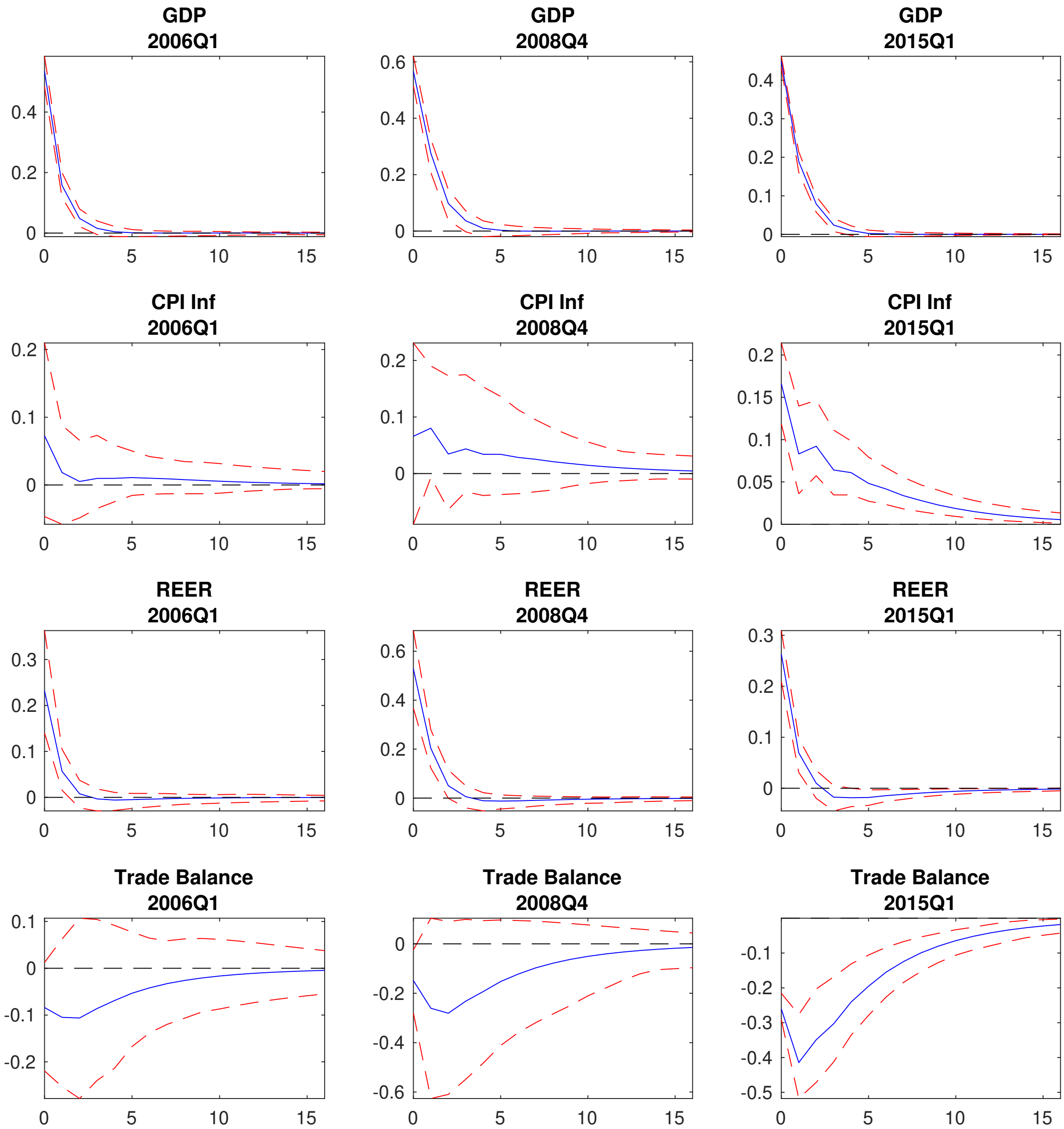

Figure 30: Time varying impulse responses of selected South Korean macroeconomic variables to a one standard deviation shock to the global macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

interdependencies among emerging economies have been increasing while their dependencies on advanced economies have been decreasing over time, which is in line with the findings of Kose et al. (2012). This effect is most obvious for the case of Turkey, while in South Korea's case we only find evidence for an increase in its interdependence with other emerging economies.

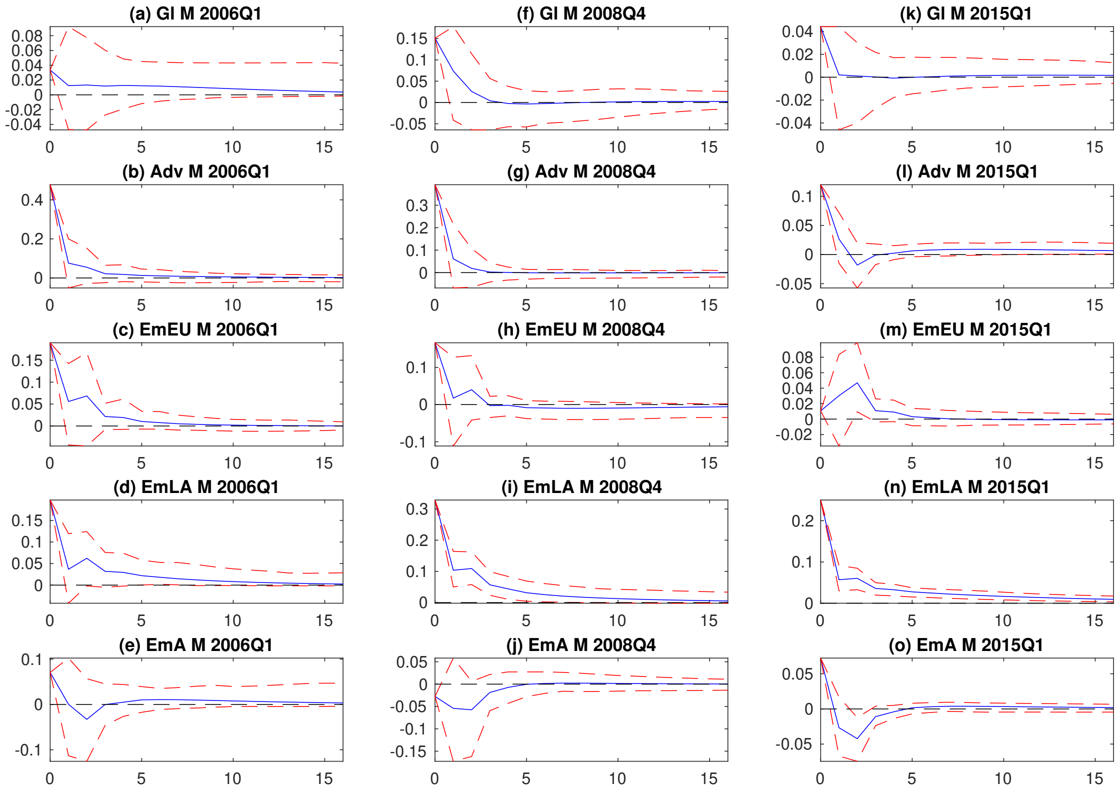

Figure 31: Time varying impulse responses of the Turkish macroeconomic factor to a one standard deviation shock to (a) Global macroeconomic factor (b) Advanced macroeconomic factor (c) Emerging Europe macroeconomic factor (d) Latin American macroeconomic factor (e) Emerging Asian macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

6 Conclusion

This study has attempted to improve our understanding of the origins and transmission mechanisms of international shocks in the context of emerging markets, which is

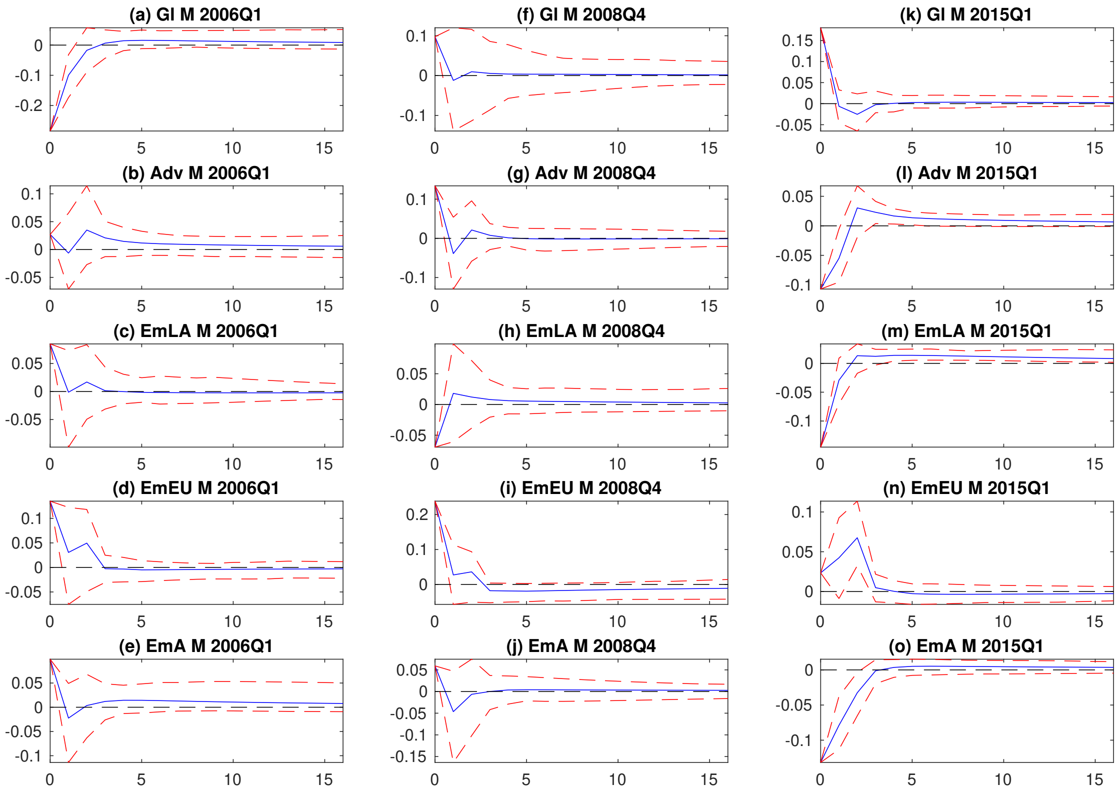

Figure 32: Time varying impulse responses of the Mexican macroeconomic factor to a one standard deviation shock to (a) Global macroeconomic factor (b) Advanced macroeconomic factor (c) Latin America macroeconomic factor (d) Emerging European macroeconomic factor (e) Emerging Asian macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

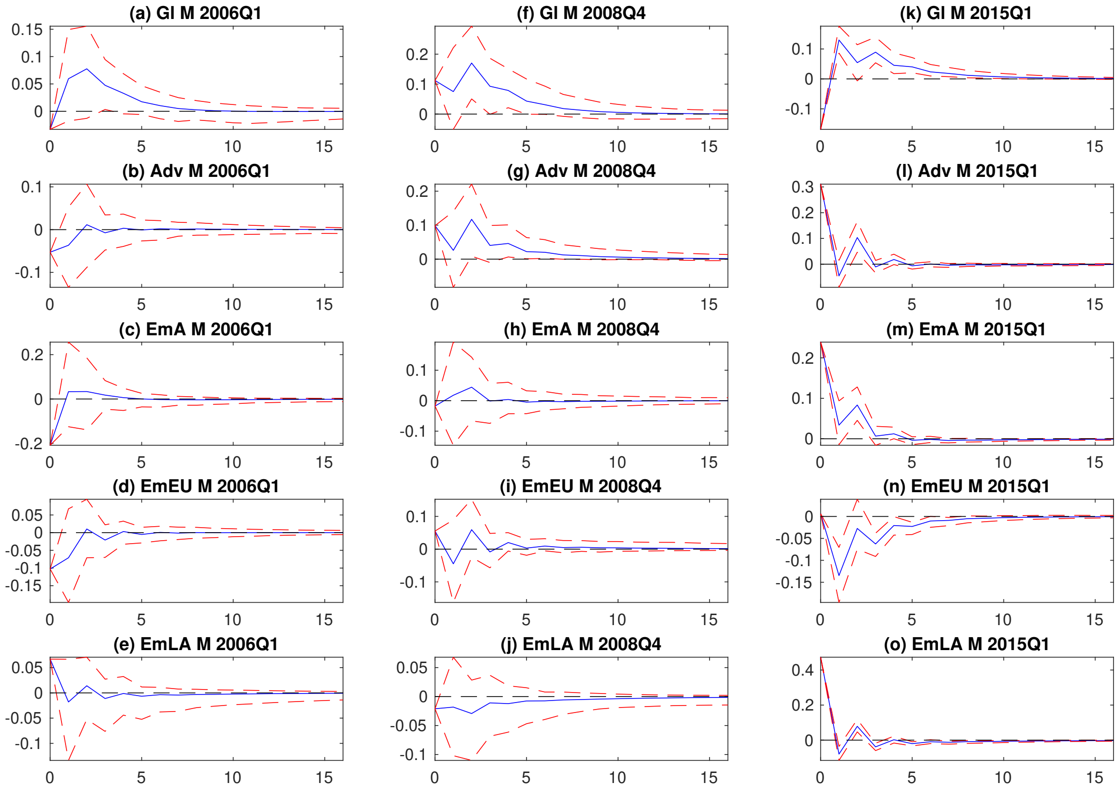

Figure 33: Time varying impulse responses of the South Korean macroeconomic factor to a one standard deviation shock to (a) Global macroeconomic factor (b) Advanced macroeconomic factor (c) Emerging Asia macroeconomic factor (d) Emerging European macroeconomic factor (e) Latin America macroeconomic factor. Note that solid lines represent point estimates of impulse responses and dashed lines represent 95% confidence intervals

of great interest to both academics and policy makers as well as market participants. We contribute to this area of research by proposing a novel framework that extends the existing GVAR model using factor analysis to account for the interdependencies between emerging and advanced economies. For the purposes of this study we limited our focus to the effects of external shocks originating from both emerging and advanced economies on Turkey, Mexico and South Korea. In particular, we investigated the implications of external changes in interest rates, output, financial conditions and risk appetite on these countries by studying the time profile of the aforementioned macroeconomic and financial shocks to the emerging and advanced economies in our sample.

Our main findings can be summarised as follows: (i) The impulse responses of the macroeconomic and financial variables of our focus emerging economies Turkey, Mexico and South Korea to various external shocks differ before, during and after the crisis, indicating substantial time-variation in the model parameters. (ii) Tighter global financial conditions cause policy rates to increase, particularly after the crisis except in Mexico. We find that Turkey and South Korea are more concerned with financial stability and capital inflows given that they increase their short term rates more at the expense of large drops in equity prices and output. (iii) Financial tightening in other emerging country groups has a loosening effect on the financial conditions particularly in Mexico. This might be due to the fact that emerging markets compete with each other for international capital flows and financial stress in these countries may cause investors to shift resources to a profitable and still safer option. Given that Turkey and Latin American countries have similar vulnerabilities due to their experiences with much higher levels of inflation and nominal interest rates, it seems plausible to think that they are exposed to similar risks. This effect is less pronounced in South Korea, whose financial markets are more developed. (iv) Contrary to the findings in the existing literature, the impulse responses to a shock to the US policy rate does not have the expected contractionary effects. Our explanation for this phenomenon is that macroeconomic variables in emerging markets are highly sensitive to risk perception as these components of aggregate demand rely heavily on expectations. As we include a global financial factor along with the US monetary policy rate in our model, the well documented contractionary effects of US interest rate is taken over by the global financial risk shock in our analysis. (v) In response to a positive global macroeconomic shock, as one would expect, output growth increases and trade balance deteriorates. This positive shock, however does not result in an increase in inflation in Turkey and Mexico which might be due to a real exchange rate appreciation as a result of the positive macroeconomic shock since exchange rate pass through is still relatively high in these countries. Moreover, we find some evidence that macroeconomic interdependencies among emerging economies have been increasing while their dependencies on advanced economies have been decreasing over time, which is in line with the findings of Kose et al. (2012). Most of these effects are significant and are robust to different values of decay and forgetting factors as well as the choice of priors.

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Appendices

A List of Variables

Variable Name	**Transformation**
GDP (real)	5
Exports of goods and services	5
Imports of goods and services	5
Gross Fixed Capital Formation (total, or if available disaggregated)	5
Industrial Production	5
Private final consumption	5
Government final consumption	5
Unemployment rate	1
Unemployed, all persons (if unemployment rate not used)	5
Consumer price index	5
Producer price index	5
GDP deflator	5
Unit labour cost	5
Import prices	5
Export prices	5
Real effective exchange rate	5
Private credit (real)	5
Interbank spread (interbank interest rate minus yield on 3 month T-bill)	1
Term spread (yield on 10 year govt bond minus yield on 3 month T-bill)	1
Sovereign spread (diff between 10 year govt bond yield in country and benchmark country)	1
Long term interest rate	2
Equity price index (real)	5
Residential property price (real)	5
Equity price volatility	1

Transformation codes: 1- No transformation 2- First difference 5- First difference of logarithm

B Correlation Between Factors

	US	EA	TR	MX	SK	Adv	EmEU	EmLA	EmA	Gl
(a) Macro:										
US	1.00									
EA	0.45	1.00								
TR	-0.19	-0.23	1.00							
MX	0.20	0.12	-0.19	1.00						
SK	-0.29	-0.25	0.12	-0.06	1.00					
Adv	0.00	0.00	0.02	-0.01	0.27	1.00				
EmEU	0.22	0.13	0.02	0.06	0.04	-0.04	1.00			
EmLA	-0.05	-0.12	0.04	0.02	-0.03	0.07	0.05	1.00		
EmA	-0.27	-0.36	-0.02	0.04	-0.01	0.12	0.01	-0.20	1.00	
Gl	0.00	0.00	0.07	0.00	0.00	0.00	-0.07	0.01	0.00	1.00
(b) Financial:										
US	1.00									
EA	0.15	1.00								
TR	-0.15	0.00	1.00							
MX	0.01	0.05	-0.08	1.00						
SK	-0.08	0.13	-0.06	0.06	1.00					
Adv	0.00	-0.05	-0.25	0.01	0.08	1.00				
EmEU	0.28	-0.09	-0.13	-0.08	-0.04	-0.06	1.00			
EmLA	0.28	-0.05	0.00	0.01	0.12	0.01	0.39	1.00		
EmA	0.24	-0.22	0.01	-0.09	0.03	-0.06	0.38	0.61	1.00	
Gl	-0.03	0.01	-0.01	0.00	0.02	0.00	-0.01	0.01	-0.04	1.00

Note: This table summarizes the pairwise correlations between our multi-level factors

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