Capital flows and GDP in emerging economies and global spillovers

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March 1, 2016

Abstract

This paper provides a global analysis of capital flow impacts on GDP for selected emerging economies. As additional control variables, we also include currency reserves and effective exchange rates in our analysis and distinguish between gross and net capital flows. Accounting for the fact that common factors have been the main drivers of capital flows while country-specific determinants ('pull' factors) drive the response to such shocks, we analyze shocks to country groups but consider country specific responses based on a Bayesian time-varying panel VAR framework in the spirit of Canova and Ciccarelli (2009). Based on a sample of 24 economies, our results show a robust positive effect of capital flows on GDP. Except for Korea, both gross and net capital flows display a positive impact for around two quarters. The impact of effective exchange rates on GDP hardly offers an explanation for a possible transmission of capital flow effects with effective depreciations both positively and negatively linked to GDP.

Keywords: Bayesian econometrics, capital flows, currency reserves, exchange rates, Panel VAR

JEL classification: C32, F31, F32

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1 Introduction

The different facets of financial integration have been the subject of controversial discussions in recent years. In particular, the ambiguous effects of capital flows have led to different views and policy suggestions for emerging economies. Some economists argue that the recent financial downturn has had a large impact on capital flow patterns. Forbes (2014) labels the recent development as financial deglobalization and finds that financial flows increase over time, fall sharply in times of crisis and do not rebound to anything close to the pre-crisis levels.[1] Concerns have been raised in particular for emerging markets as their capital flows will be negative in 2015 for the first time since 1988 according to the Institute of International Finance (IIF, 2015).

Similar to the discussions about global current account imbalances, costs and benefits of financial integration in the form of capital flows are potentially different for surplus and deficit economies. They bear the potential to result in optimal allocation of production and improved economic performance. While financial markets per se have become more globalized, emerging economies have experienced the most drastic changes of their financial system over the last decades. Capital flows have played a key role in this context while inflows are responsible for fueling domestic financial markets and investments and unwinding outflows are potentially harming the domestic economy, for example during the Asian crisis. Rapidly increased foreign capital inflows are labeled as 'surges' and include several potential risks like contagion, suboptimal transmission of capital flows into the domestic economy and disruptive adjustments. Countries with underdeveloped financial systems are particularly vulnerable in case of 'sudden stops', which are reversals of capital flows (Forbes and Warnock, 2012).[2] Capital flow liberalization is more beneficial and less risky if countries have reached specific thresholds of financial and institutional development (IMF, 2012).

The macroeconomic implications of capital flows are closely related to exchange rates and currency reserves. If a country experiences large capital inflows, an accumulation of currency reserves is often considered to be aimed at improving competitiveness through preventing domestic appreciations although conclusive evidence of this view is hard to establish (Aizenman and Lee, 2008). From 1999 to the beginning of the subprime crisis in September 2008, foreign exchange reserves held by developing countries had more than quadrupled (Beck and Rahbari, 2011).[3]

[1] International capital inflows were only 1.6% of global GDP, ten times less than the peak of 16% in 2007 (Forbes, 2014).

[2] One view according to the first generation model of currency crisis is that unwinding capital flows result in speculative attacks on domestic currencies (Krugman, 2000).

[3] Fukuda and Kon (2010) analyze an unbalanced panel for the period between 1980 and 2004 and find a positive

This paper contributes to the literature by analyzing the macroeconomic linkages and effects of capital flows and reserve accumulation from a new global perspective. We focus on two main questions: (1) Is GDP in emerging markets affected by capital flows? (2) Are possible effects different for capital flows from emerging and industrial economies? Capital flows to emerging economies have historically mainly comprised foreign direct investments (FDIs) while recent capital flows mainly consisted of short-term inflows such as portfolio investments (IIF, 2015). Putting the effects on GDP over the last decades under closer scrutiny is therefore well suited to analyze whether emerging markets have surpassed the (theoretically) required thresholds to experience a positive effect resulting from capital flows if both the overall size and the structure have increased over the sample period under investigation. In order to account for possible transmission channels, we also consider exchange rate effects stemming from capital flows. To tackle the questions mentioned above, we impose a factorization that allows for one common factor for industrialized economies and one for emerging markets besides country- and variable specific factors which accounts for linkages between both groups. Relying on an extension of the dataset of Forbes and Warnock (2012), we analyze effects of both net and gross capital flows and explicitly include the period of the recent financial crisis. Our quarterly dataset compromises 24 economies and includes India, Korea, Mexico, the Philippines, South Africa, and Thailand as emerging economies. We are aware that some of these countries might be considered as industrial economies nowadays after experiencing economic and financial transformations over the sample period under investigation.

The need to consider a global perspective when analyzing effects of capital flows and financial integration is obvious. However, even if a panel of countries is analyzed, a caveat of previous studies is that they are not considering cross-country dynamics of capital flows and macroeconomic aggregates. Such a setting does not account for common shocks which have turned out to be a key driver of capital flows and the resulting dynamics during the recent crisis (Fratzscher, 2012). The corresponding effects have also been highly heterogeneous across countries so that a country aggregation when analyzing a response to shocks might result in biased conclusions. Altogether, common 'push' factors have been the main drivers of capital flows during the crisis, while country-specific determinants ('pull' factors) have been dominant in accounting for the resulting dynamics, in particular for emerging markets (Fratzscher, 2012). The importance of considering cross-country dependencies is also important when emerging markets are analyzed based on historical evidence during the nineties. The Asian crisis

influence of foreign exchange reserves on economic growth which is not observed when controlling for an impact through investment.

is a textbook example of a situation where capital flow spillover effects resulted in contagion and significantly affected the real economy. Therefore, it is reasonable to consider the impact of a shock to all emerging economies rather than a country-specific shock while the response to those shocks should be analyzing based on country-specific responses.

To account for these issues, we a adopt a Bayesian time-varying panel VAR framework according to Canova and Ciccarelli (2009) which offers two types of advantages over single-country or two-country VARs: First, the use of cross-sectional information can help to overcome the problem of having too small sample periods and therefore to achieve better estimates. Second, the model is able to capture shocks resulting from lagged interdependencies between countries, instead of treating them as 'common shocks' as in the case of single- or two-country VARs (Canova and Ciccarelli, 2009). In addition, the chosen framework has several benefits compared to reasonable alternatives offered by the recent literature such as factor models (often also labeled as factor augmented VAR models) or global VAR models. Compared to traditional factor models in the spirit of Stock and Watson (2002), the factor structure imposed by Canova and Ciccarelli (2009) has three advantages. First, opposed to the factors in a Stock and Watson (2002)-type model, the constructed regressors (i.e. indices) by Canova and Ciccarelli (2009) are observable and do not need to be estimated using a data-driven framework. Second, in contrast to factors, indices entail a direct economic interpretation. Finally, it is pretty difficult to estimate the factor loadings in a time-varying fashion. Finally, the panel VAR structure used in our study shares the general idea of global VAR models introduced by Pesaran *et al.* (2004), but it has also two advantages compared to the latter. First, global VARs do neither allow for time-variations in the coefficients nor account for potential lagged interdependencies between the cross-sectional units. Second, N is assumed to be large for global VARs.

The reminder of this paper is organized as follows. A review of the literature and a descriptive analysis of capital flows are provided in the subsequent section. Section 3 describes our dataset and Section 4 our empirical methodology. Section 5 presents our empirical findings and Section 6 concludes.

2 Capital flows and previous literature

Several studies deal with the macroeconomic effects of financial integration via capital, focusing on different aspects. When analyzing capital flows, net and gross capital flows should both be taken into account since gross capital flows are larger and more volatile relative to net capital flows and also act more procyclical (Broner *et al.*, 2011). This could result in different GDP effects. Figures I and II display the capital flows for the emerging markets under investigation. Figure I shows gross and net flows for all economies while Figure II provides a direct comparison of the gross and net flows for each emerging economy. A look at these figures is useful for understanding cycles and developments on capital flows.

*** Insert Figures I to II about here ***

The well-known increase in size and volatility in capital flows over time is fairly obvious for both gross and net flows, in particular when comparing the beginning and the end of the sample period. While the increase in terms of volatility and level is moderate until the end of the nineties, the increase after the Millennium until the beginning of the subprime crisis is striking. Inspecting the specific country levels, Korea, Thailand and the Philippines have all experienced a temporary blip in capital flows during the Asian crisis in the nineties while capital flows of India and South Africa have increased continuously throughout the sample period. The gross flows suggest that the recent crisis has also resulted in a huge temporarily shift rather than a permanent change in capital flows, which resembled level and volatility prior to the crisis. In contrast, an inspection of the net flows shows that the underlying structure has been subject to changes in some cases with Korea experiencing reversed inflows after the crisis. The upcoming years will show whether a changing pattern in the spirit of long-run financial decoupling will materialize for some economies over the long-run.

The literature on the effects of capital flows is enormous and only some main patterns are described in the following. When it comes to the effects of capital flows on GDP, our quarterly panel VAR approach differs from previous studies which rely on annual estimates and often focus on correlation rather than causality (Bluedorn *et al.*, 2013). A consequent causality analysis of capital flow impacts on GDP which also addresses international spillovers in a fully endogenous and time-varying framework still presents a gap in the literature.

Exchange rates offer a possible transmission for capital flow effects on GDP. Net capital inflows should, in theory, appreciate the domestic currency which might negatively affect domestic exports. Some studies indeed have provided evidence of forecasting power of net foreign asset positions and capital flows on bilateral exchange rates (Della Corte *et al.*, 2012). Another strand of the literature considers the opposite causality, for example by analyzing the effect of exchange rate uncertainty on different components of net portfolio flows (Caporale *et al.*, 2015).

In this context, currency reserve accumulation is often considered to have a positive effect on economic growth by preventing an appreciation through interventions. Interventions are also considered as a general policy tool for dealing with capital flows (Blanchard *et al.*, 2015). However, a positive effect on growth through a domestic depreciation or a delayed appreciation depends on several factors such as the degree of exchange rate pass-through and the reaction of other countries which might result in a competitive hoarding, sometimes referred to as a currency war scenario (Aizenman and Lee, 2008). Steiner (2014) argues that reserve accumulation has the potential to introduce systemic risk and to delay economic reforms required to achieve a domestic driven growth path while Dominguez (2012) finds that higher reserve accumulation prior to the recent crisis is associated with higher post-crisis GDP growth.

3 Data

The main source of our capital flow data is the International Monetary Fund's Balance of Payments Statistics database. In order to obtain a broad coverage on both the cross-sectional dimension as well as on the time dimension, we have extended the capital flow dataset by Forbes and Warnock (2012). Forbes and Warnock (2012) have compiled this dataset based on IMF data and modified it adequately for the use in empirical analysis. Since their dataset ends in 2010, we have extended and updated the time series using growth rates of the respective time series taken from the most recent IMF BOP data or, if not available from the IMF data taken from national sources. For most countries, we calculate extrapolated values based on the growth rates starting in 2008Q1.

Following Forbes and Warnock (2012), we use standard terminology and define gross capital inflows as the sum of inflows of direct investment, portfolio and other inflows, and gross outflows as the sum of direct investment, portfolio and other outflows. Gross capital flows are defined as the sum of gross outflows and gross inflows, while net capital flows are defined as gross inflows minus gross outflows. The resulting dataset provides quarterly time series of gross and net capital flows for up to 37 countries (OECD countries and emerging economies) from 1981Q1 to 2013Q4. However, our country choices as well as our sample period are restricted by data availability for other endogenous variables under observation. Therefore, we consider a sample period running from 1988Q1 to 2013Q4 including $T = 104$ time series observations for a set of 24 economies (i.e. $N = 24$) which include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the UK, and the US (classified as industrialized economies) as well as India, Korea, Mexico, the Philippines, South Africa, and Thailand (classified as emerging markets). We are aware that several additional emerging economies could be taken into account. However, all emerging economies under observation have experienced capital flows for a sufficient degree of time and have undergone a transformation of their financial system. In addition, Mexico and the three Asian economies (i.e. Korea, the Philippines, and Thailand) have also been subject to currency crises during the nineties.

Besides net capital flows (or gross capital flows, respectively), we include nominal effective exchange rates defined as quarterly averages, currency reserves, and the gross domestic product (GDP) as endogenous variables into our VAR model (i.e. $G = 4$). The corresponding data has been collected from Thomson Reuters Datastream and all endogenous variables are taken as growth rates normalized to a mean of zero and a variance of unity.

4 Empirical methodology

4.1 Panel vector autoregression

We apply a panel vector autoregression (VAR) in the tradition of Canova and Ciccarelli (2009). In order to illustrate the approach, we start with the formulation of the VAR model in the following

$$y_{it} = \sum_{j=1}^{p_1} D_{it,j} Y_{t-j} + \sum_{j=1}^{p_2} C_{it,j} W_{t-j} + e_{it}, \tag{1}$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T$ are the indices for the cross-section units and the time period, respectively. Therefore, the number of cross-section units (i.e. countries) is N and the length of each time series is T. y_{it} denotes a $G \times 1$ vector of variables for each i and is compressed to a $NG \times 1$ vector $Y_t = (y'_{1t}, \ldots, y'_{Nt})'$ in the following. W_t represents a $q \times 1$ vector of exogenous variables that also include a constant term and e_{it} stands for a $G \times 1$ vector of random errors. In addition, $D_{it,j}$ and $C_{it,j}$ are coefficient matrices of order $G \times GN$ and $G \times q$ for each lag j, where p_1 is the lag length of the endogenous and p_2 of the exogenous variables.

The benefit of this specification is that it allows for cross-unit lagged interdependencies and time-variation in the coefficients. However, this high degree of flexibility does not come without costs.

Without imposing any restriction there are more coefficients to estimate that observations available ($k = NGp_1 + qp_2$ per equation and per t). To avoid that we impose a factor structure on the model given in Eq. (1). For this it is necessary to stack the G rows of the matrices $D_{it,j}$ and $C_{it,j}$ in the $k \times 1$ vector δ_{it}^{g}. Then, we define $\delta_{it} = (\delta_{it}^{1\prime}, \ldots, \delta_{it}^{G\prime})'$ to be an $Gk \times 1$ vector and $\delta_t = (\delta_{1t}', \ldots, \delta_{Nt}')'$ to be an $NGk \times 1$ vector, which will be factored as follows

$$\delta_t = \sum_{f=1}^{F} \Xi_f \theta_{ft} + u_t \quad \text{with} \quad u_t \sim \mathcal{N}(0, \Omega \otimes V). \tag{2}$$

θ_{ft} is a low-dimensional vector describing the factor and Ξ_f is its corresponding matrix for each factor f. u_t is an $NGk \times 1$ vector of unmodeled and idiosyncratic error terms present in δ_t. The covariance matrix of u_t consists of the $NG \times NG$ matrix Ω and the $k \times k$ matrix $V = \sigma^2 I_k$. In our empirical model we choose a factorization with $F = 3$ factors of the following form

$$\delta_t = \Xi_1 \theta_{1t} + \Xi_2 \theta_{2t} + \Xi_3 \theta_{3t} + u_t, \tag{3}$$

where θ_{1t} is a 2×1 vector of common factors, one for industrialized economies (IE) and one for emerging markets (EM), θ_{2t} is a $N \times 1$ vector of country-specific factors and θ_{3t} is a $G \times 1$ vector of variable-specific factors. Therefore, the corresponding indices are constructed as follows: $\chi_{11t} = \sum_{\text{IE}} \sum_g \sum_j y_{ig,t-j}$, $\chi_{12t} = \sum_{\text{EM}} \sum_g \sum_j y_{ig,t-j}$, $\chi_{2it} = \sum_g \sum_j y_{ig,t-j}$, $i = 1, \ldots, N$, and $\chi_{3gt} = \sum_i \sum_j y_{ig,t-j}$, $g = 1, \ldots, G$. As a result $\theta_t = (\theta_{1t}', \theta_{2t}', \theta_{3t}')'$ is a vector of order $(2 + N + G) \times 1$. In the following we define $\mathbf{X_t} = (Y_{t-1}', \ldots, Y_{t-p_1}', W_{t-1}', \ldots, W_{t-p_2}')'$, $X_t = I_{NG} \otimes \mathbf{X_t}'$, and $\Xi = (\Xi_1, \Xi_2, \Xi_3)$. Then, Eq. (1) can be rewritten as

$$Y_t = X_t \delta_t + E_t = X_t(\Xi \theta_t + u_t) + E_t \equiv \chi_t \theta_t + \zeta_t, \tag{4}$$

where E_t is an $NG \times 1$ vector of normally distributed error terms with zero mean and variance-covariance matrix Ω, $\chi_t \equiv X_t \Xi$ is a matrix of constructed regressors (i.e. indices) that are also observable, and $\zeta_t \equiv X_t u_t + E_t$ is a vector of the reparameterized error terms.[4] In this reparameterized version the panel VAR model includes a substantially smaller number of regressors and the factors θ_{it} load on these. This solves the overparameterization problem of the original VAR.

[4] It is worth to note that the χ_{it}'s are non-orthogonal linear combinations of the regressors of the original VAR given in Eq. (1). However, the existing correlation between the χ_{it}'s decreases with G, N, and the number of lags included in the VAR.

In order to allow for time-variation in the factors, we apply the law of motion given by

$$\theta_t = \theta_{t-1} + \eta_t, \quad \text{with} \quad \eta_t \sim \mathcal{N}(0, B_t), \tag{5}$$

where η_t is independent of E_t and u_t, and $B_t = \text{diag}(B_1, \dots, B_F) = \gamma_1 B_{t-1} + \gamma_2 B_0$.

4.2 Inference

Markov Chain Monte Carlo (MCMC) methods can be applied to obtain the posterior distributions of the time-varying factors θ_{it} (see Canova and Ciccarelli (2009) for details). To illustrate the MCMC routine followed in our study, consider the likelihood of the reparameterized model given in Eq. (4)

$$L(\theta, \Upsilon|Y) \propto \prod_t |\Upsilon_t|^{-1/2} \exp\left[-\frac{1}{2}\sum_t (Y_t - \chi_t\theta_t)'\Upsilon_t^{-1}(Y_t - \chi_t\theta_t)\right], \tag{6}$$

with

$$\Upsilon_t = (1 + \sigma^2 \mathbf{X_t'X_t})\Omega \equiv \sigma_t\Omega \tag{7}$$

and the prior distribution for $(\Omega^{-1}, \sigma^{-2}, B^{-1})$ is as follows

$$p(\Omega^{-1}, \sigma^{-2}, B^{-1}) = p(\Omega^{-1})p(\sigma^{-2})\prod_f p(B_f^{-1}), \quad f = 1, \dots, F, \tag{8}$$

with

$$p(\Omega^{-1}) = \mathcal{W}(z_1, Q_1), \quad p(\sigma^{-2}) = \mathcal{G}(a_1/2, a_2/2), \quad p(B_f^{-1}) = \mathcal{W}(z_{2f}, Q_{2f}). \tag{9}$$

We apply a Gibbs sampler to approximate the posterior distribution, since an analytical computation is infeasible. In order to illustrate this, the notation is simplified as follows. $Y^T = (Y_1, \dots, Y_T)$ denotes the data and $\psi = (\Omega^{-1}, \sigma^{-2}, B^{-1}, \{\theta_t\})$ the parameters, where $\psi_{-\alpha}$ is ψ excluding the parameter α. The conditional posteriors are given by

$$\Omega^{-1}|Y^T, \psi_{-\Omega} \sim \mathcal{W}(z_1 + T, \hat{Q}_1), \quad B_f^{-1}|Y^T, \psi_{-B_f} \sim \mathcal{W}(T \cdot \dim(\theta_t^f) + z_{2f}, \hat{Q}_{2f}), \tag{10}$$

$$\sigma^{-2}|Y^T, \psi_{-\sigma^2} \propto (\sigma^{-2})^{a_1/2-1} \exp\left[-\frac{a_2\sigma^{-2}}{2}\right] \cdot L(\theta, \Upsilon|Y^T), \tag{11}$$

with

$$\hat{Q}_1 = \left[Q_1^{-1} + \sum_t (Y_t - \chi_t\theta_t)\sigma_t^{-1}(Y_t - \chi_t\theta_t)'\right]^{-1}, \tag{12}$$

and

$$\hat{Q}_{2f} = \left[Q_{2f}^{-1} + \sum_t (\theta_t^f - \theta_{t-1}^f)(\theta_t^f - \theta_{t-1}^f)' \right]^{-1}. \tag{13}$$

The conditional posterior for σ^{-2} is non-standard. Therefore, we run a Metropolis-Hastings step within the Gibbs to achieve draws for this parameter. This is done using a random walk kernel $(\sigma^2)^n = (\sigma^2)^c + v$ with $v \sim \mathcal{N}(0, d^2)$. The candidate's acceptance probability is equal to the ratio of the kernel of the density of $(\sigma^2)^n$ to the one of $(\sigma^2)^c$.

Finally, the conditional posterior of $(\theta_1, \ldots, \theta_T | Y^T, \psi_{-\theta})$ is computed by the following Kalman filter recursions

$$\theta_{t|t} = \theta_{t-1|t-1} + (R_{t|t-1}\chi_t F_{t|t-1}^{-1})(Y_t - \chi_t \theta_{t-1|t-1}), \tag{14}$$

$$R_{t|t} = [I - (R_{t|t-1}\chi_t F_{t|t-1}^{-1})\chi_t](R_{t-1|t-1} + B), \tag{15}$$

$$F_{t|t-1} = \chi_t R_{t|t-1} \chi_t' + \Upsilon_t. \tag{16}$$

The output of the Kalman filter is used to obtain the sample $\{\theta_t\}$ as follows. θ_T is simulated from $\mathcal{N}(\theta_{T|T}, R_{T|T})$, θ_{T-1} from $\mathcal{N}(\theta_{T-1}, R_{T-1})$, ..., θ_1 from $\mathcal{N}(\theta_1, R_1)$ with

$$\theta_t = \theta_{t|t} + R_{t|t} R_{t+1|t}^{-1}(\theta_{t+1} - \theta_{t|t}), \quad \text{and} \quad R_t = R_{t|t} - R_{t|t} R_{t+1|t}^{-1} R_{t|t}. \tag{17}$$

The starting values $\theta_{0|0}$ and $R_{0|0}$ can be obtained from a training sample or by choosing small values.

We have run the MCMC 30 times with 2,100 draws and a burn-in of 100. Furthermore, we set $a_1 = 10$ and $a_2 = 1$. $p(\Omega^{-1}) = \mathcal{W}(z_1, (z_1 \Omega_{OLS})^{-1})$ with $z_1 = NG + 47$ and Ω_{OLS} as the covariance matrix of the residuals derived from univariate autoregressions.[5]

4.3 Impulse response analysis

Generally, it is possible to compute an impulse response as the difference between two realizations of $y_{t+\tau}$, where one assumes a one-time shock in the jth component of $e_{t+\tau}$ at time $t+1$ and the other no shock. However, this proceeding is inadequate in our case since we allow the structural coefficients to change over time. Hence, in this case impulse responses can be computed as the difference between two conditional expectations of $y_{t+\tau}$ conditional on the data (Y^t), the factors (θ_t), the parameters that determine the law of motion of the coefficients as well as all future shocks (Koop *et al.*, 1996;

[5] The degrees of freedom z_1 haven been chosen to approximately match the sample size T.

Canova and Ciccarelli, 2009). The only distinction between this two conditional expectations is that one is also conditional on a random draw for the current shocks, whereas the other conditioned on the unconditional value of the current shocks.

To formalize this, $\mathcal{U}_t = (\zeta_t', \eta_t')'$ denotes the vector of reduced-form shocks while $\mathcal{Z}_t = (H_t^{-1}\zeta_t', H_t^{-1}\eta_t')'$ is the vector of structural shocks with $E_t = H_t v_t$, $H_t H_t' = \Omega$ so that $\text{var}(v_t) = I$. $H_t = J \cdot K_t$ with $K_t K_t' = I$, J is a lower triangular matrix that orthogonalizes the shocks, and $\mathcal{V}_t = (\Omega, \sigma^2, B_t)$. $\bar{\mathcal{Z}}_{j,t}$ denotes a particular realization of $\mathcal{Z}_{j,t}$ and $\mathcal{Z}_{-j,t}$ represents structural shocks excluding the one to the jth component of $\mathcal{Z}_t$. Finally, we define $\mathcal{F}_t^1 = (Y^{t-1}, \theta^t, \mathcal{V}_t, H_t, \mathcal{Z}_{j,t} = \bar{\mathcal{Z}}_{j,t}, \mathcal{Z}_{-j,t}, \mathcal{U}_{t+1}^{t+\tau})$ and $\mathcal{F}_t^2 = (Y^{t-1}, \theta^t, \mathcal{V}_t, H_t, \mathcal{Z}_{j,t} = E(\mathcal{Z}_{j,t}), \mathcal{Z}_{-j,t}, \mathcal{U}_{t+1}^{t+\tau})$. Then responses to an impulse in the jth component of $\mathcal{Z}_t$ at period t are given as

$$IR(t, t+\tau) = E(Y_{t+\tau}|\mathcal{F}_t^1) - E(Y_{t+\tau}|\mathcal{F}_t^2), \quad \tau = 1, 2, \ldots. \tag{18}$$

Given that, the responses can be obtained as follows:

(1) Choose t, τ, and J and draw $\Omega^l = H_t^l(H_t^l)'$ as well as $(\sigma^2)^l$ from their posterior distributions and u_t^l from $\mathcal{N}(0, (\sigma^2)^l I \otimes H_t^l(H_t^l)')$. Then, calculate $y_t^l = \chi_t\theta_t + H_t v_t + X_t u_t^l$.

(2) Draw $\Omega^l = H_{t+1}^l(H_{t+1}^l)'$, $(\sigma^2)^l$, B_{t+1}^l, and η_{t+1}^l from their posterior distributions. Then, use this to compute the factors θ_{t+1}^l and the indices χ_{t+1}. Draw u_{t+1}^l from $\mathcal{N}(0, (\sigma^2)^l I \otimes H_{t+1}^l(H_{t+1}^l)')$ and calculate $y_{t+1}^l = \chi_{t+1}\theta_{t+1}^l + H_{t+1}v_{t+1} + X_{t+1}u_{t+1}^l$, $l = 1, \ldots, L$.

(3) Repeat step 2 and compute θ_{t+k}^l, y_{t+k}^l, $k = 2, \ldots, \tau$.

(4) Repeat steps 1-3 setting $v_{t+k} = E(v_{t+k})$, $k = 0, \ldots, m$ using the draws for the shocks obtained in steps 1-3.

5 Empirical results

Owing to the fact that we consider a rich set of both cross-section and country specific dynamics, our following interpretation relies on selected impulse response functions which are related to effects on GDP for emerging economies as our main questions of interest. We distinguish between shocks from industrial and emerging markets through considering separate impulse response functions for shocks to both groups. Figures V to IX provide the corresponding impulse response functions.

*** Insert Figures III to IX about here ***

Causalities between capital flows and GDP

Figures V and VI provide impulse functions for a response of GDP to capital flows. For all emerging economies, domestic net capital flows have a positive impact on GDP at the 68% significance level with significance for India, Thailand, and the Philippines also emerging at the 95% level. In all cases, the positive effect diminishes after around 2 quarters. The same pattern holds for gross capital flows although the significance is less pronounced in some cases with a positive and significant effect at a 95% confidence interval only observed for Thailand. Interestingly, the pattern is partly different compared to a shock on capital flows in industrial economies. Net capital flows only have a positive impact on GDP for India and the Philippines at the 95% level while the effect is even negative for Korea at the 68% level. However, the effects are more significant if gross capital flows are considered so that the overall results are only different for Korea.

This finding offers interesting implications. Firstly, the result that increasing capital flows in the considered emerging economies have a clear positive effect on GDP is possibly due to the consideration of a comparable long period of investigation. Sudden stop losses in case of a reversal in capital flows mostly occur for comparable short periods and are less relevant if a longer sample is considered. The finding that the positive effect of capital flows is more pronounced for shocks in emerging markets is also plausible since capital flows between industrial economies do not necessarily affect emerging economies. A somehow surprising result is that the differences between net and gross flows essentially display a similar impact. Although gross capital flows tend to be more procyclical and more volatile than net inflows (Bluedorn *et al.*, 2013), the similar impact on GDP suggests that volatility of capital flows does not transmit into significant GDP effects.

Figures VIII and IX put the reversed causality from GDP on capital flows under closer scrutiny. Previous evidence has suggested that fundamentals such as interest rate differentials and output growth are important determinants of net private capital inflows in emerging markets (Ahmed and Zlate, 2014). Strictly, procyclical capital flows might for example occur if growth and capital flows are bilaterally linked. Except for Korea, the effect of GDP in emerging economies is significant for at least two quarters at the 95% level. Once again, the picture for net capital flows is less pronounced with only India and the Philippines experiencing a positive effect in case of an increase of GDP in emerging markets. Overall, the different results for Korea are in line with the graphical evidence in Section 2 which suggests persistent changes to Koreas capital flows after the recent crisis. Although South Korea was the first OECD country to escape the negative economic growth zone after the crisis in 2008, it still has limited capacity to stabilize the financial market and to control capital flows (Yoon, 2011).

Linkages between effective exchange rates and GDP

Figure VII considers the exchange rate effect on GDP. Analyzing the link between effective exchange rates and GDP is important in the present context since exchange rates offer a possible transmission channel stemming from capital flows. However, the relationship between capital flows and effective exchange rates potentially displays different patterns. Even if the bilateral exchange rate, for example against the dollar, is fixed, effective exchange rates might still fluctuate to a significant degree due to third country effects. In general, exchange rates have resulted in several controversies when it comes to policy recommendations. A frequent line of reasoning is that emerging economies rely on fixed exchange rates and an export-led growth strategy. Exchange rate adjustment is also among the candidates considered for a correction of global current account balances.

The findings display ambiguous and surprising patterns. Effects are mostly insignificant at the 95% confidence level. At the 68% level, an effective appreciation in emerging markets leads to an increase in domestic GDP for Korea, Mexico and South Africa while the opposite is observed for India, Thailand and the Philippines. Although previous research of di Mauro *et al.* (2008) also finds a hardly significant response of GDP to effective exchange rates for a sample period running from 1980 to 2007, the positive linkage between appreciation and GDP for Korea, Mexico and South Africa is still remarkable. Direct theoretical explanations are not embedded in our framework but there is for example plenty of evidence that an incomplete pass-through mechanism might offer an explanation for a weak link between international trade and exchange rate depreciations.

Several additional estimations have been considered. The growth effect of reserve accumulation has for example turned out to be insignificant for emerging economies. Results of capital flows shocks for industrial economies are not presented here for the sake of clarity. All other country specific impulse response functions are available upon request.

6 Conclusion

This paper has shed some light on the inter-linkages between capital flows, currency reserves and exchange rates and their impact on GDP for emerging economies. In contrast to previous studies, we focus on shocks to capital flows in either industrial or emerging markets as a whole to address spillover and contagion effects. Relying on a Bayesian panel VAR approach which allows for cross-section lagged interdependencies and time-varying coefficients; we establish a robust positive effect of capital flows on GDP. Except for Korea, both gross and net flows display a positive impact for around two quarters. Effective exchange rate changes on GDP hardly offer an explanation for a possible transmission of capital flow effects with effective depreciations both positively and negatively linked to GDP. Currency reserves also do not constitute a significant effect on GDP.

The reversed pattern of Korean capital flows clearly demonstrates the need to account for country specific dynamics with capital flows. While negative GDP effects of capital flows mostly occur in the short-run which are reversed, Korea has experienced a negative effect if the whole sample period is taken into account. Unsurprisingly, Korea is currently considering capital controls to stabilize financial markets in cases of sudden capital outflows. However, similar to exchange rates, the history of the international monetary system has shown that a successful control of international capital markets is hard to achieve. Despite their positive effect on GDP, dealing with short-run unwinding capital flows remains one of the challenges on global financial markets. The unpredictability of such flows represents a major task in this context. Recent research suggests that certain capital controls and macroprudential measures can be effective in reducing financial fragility but that such actions are frequently not capable of achieving their stated aims (Forbes *et al.*, 2015).

While the focus of the present study is an aggregated analysis, a disaggregated perspective on different kinds of capital flow types is surely an interesting avenue for further research. Case studies for individual economies might be able to shed some light on the GDP effect of capital flows. However, even when individual economies are analyzed, the consideration of global dependencies is of crucial importance.

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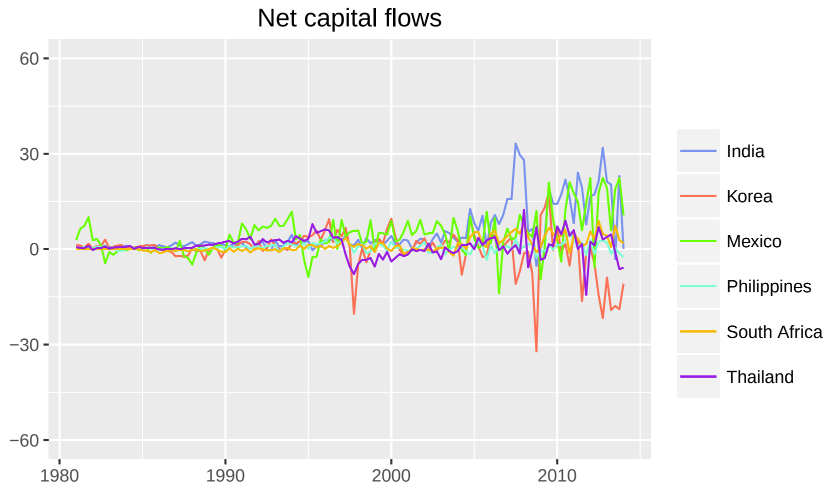
Figures

Figure I **Capital flows of emerging economies**

The plots show the net and gross capital flows of six emerging economies under consideration (i.e. India, Korea, Mexico, the Philippines, South Africa, and Thailand) for a sample period running from 1981Q1 to 2013Q4.

(a) Net capital flows:



(b) Gross capital flows:

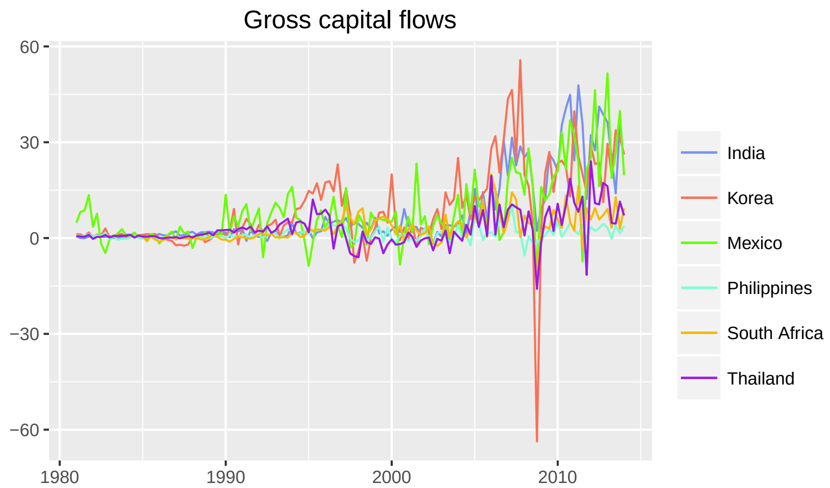


Figure II **Capital flows of emerging economies**

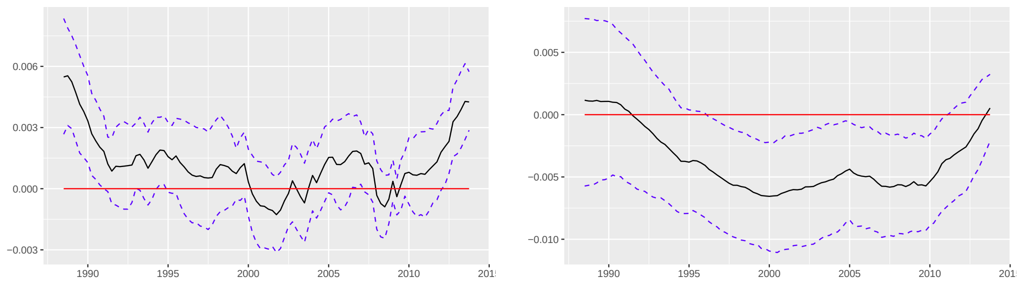
The plots show the individual net and gross capital flows of six emerging economies under consideration (i.e. India, Korea, Mexico, the Philippines, South Africa, and Thailand) for a sample period running from 1981Q1 to 2013Q4.

FIGURE III **Time-varying coefficients of common factors**

The plots show the time-varying coefficient estimates of both common factors included in θ_{1t} for a sample period running from 1981Q3 to 2013Q4. The coefficient estimates are represented by the median of the posterior distribution at each point in time (the blue dashed lines report the corresponding 10 and 90% quantiles). Panel (a) gives the coefficients for the panel VAR model including net capital flows and panel (b) for the panel VAR model including gross capital flows.

(a) Net capital flows:

Industrialized economies Emerging markets



(b) Gross capital flows:

Industrialized economies Emerging markets

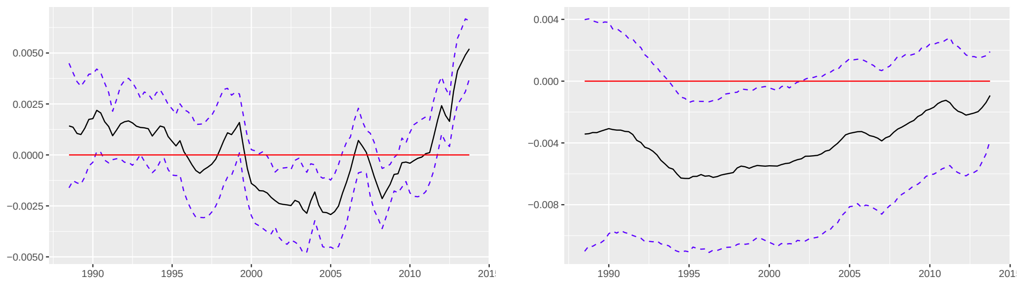


Figure IV **Time-varying coefficients of country-specific factors**

The plots show the time-varying coefficient estimates of the country-specific factors for the six emerging economies and the US as the major industrialized economy included in θ_{2t} for a sample period running from 1981Q3 to 2013Q4. The coefficient estimates are represented by the median of the posterior distribution at each point in time (the blue dashed lines report the corresponding 10 and 90% quantiles).

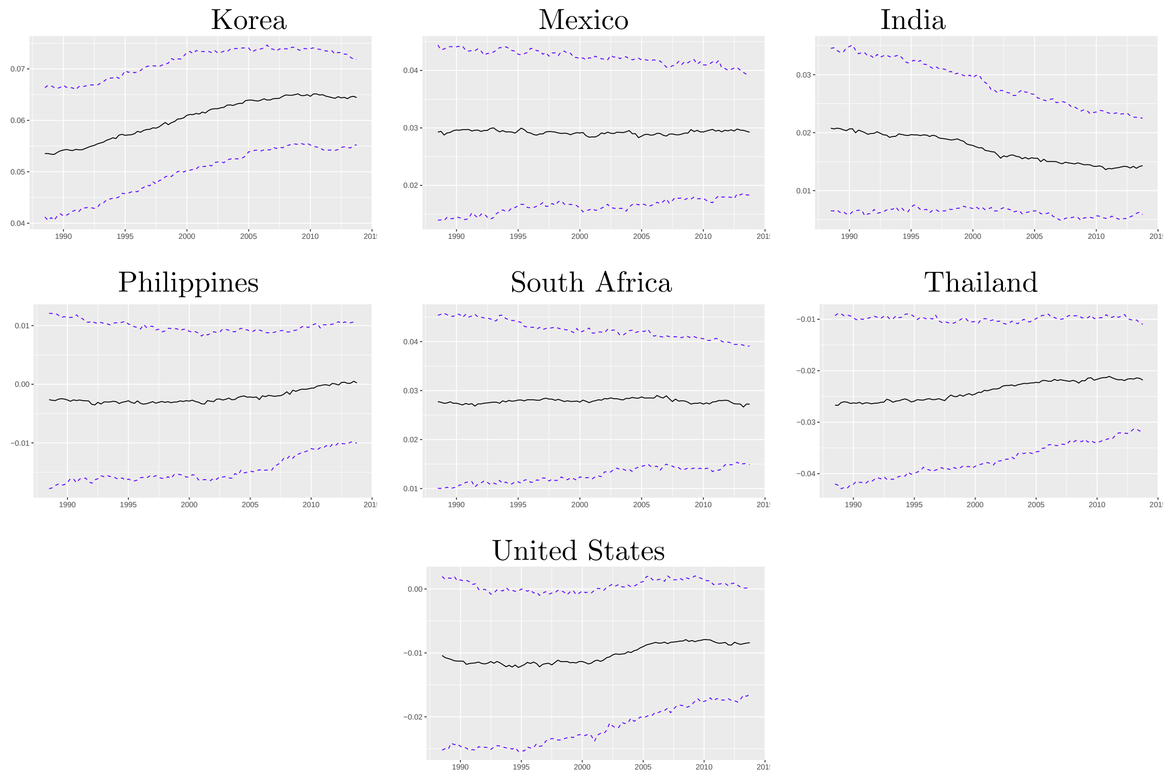
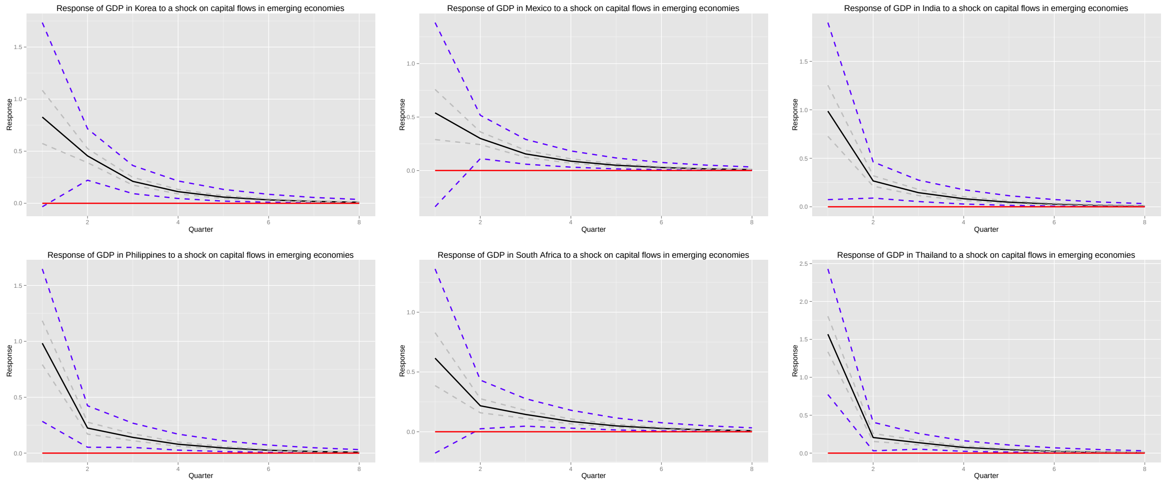


Figure V **Response of GDP in emerging economies to a shock on capital flows in emerging economies**

The plots show the reaction of the emerging economies individual GDPs to a common shock on capital flows in emerging economies. This response is shown for Korea, Mexico, India, the Philippines, South Africa, and Thailand as the emerging economies included in our study. Panel (a) gives the corresponding reation to a shock on net capital flows and panel (b) to a shock on gross capital flows. The reaction is represented by the solid black line and the corresponding confidence bands by dashed lines (the 95% level in blue and the 68% in grey). The solid red line displays the zero line.

(a) Net capital flows:



(b) Gross capital flows:

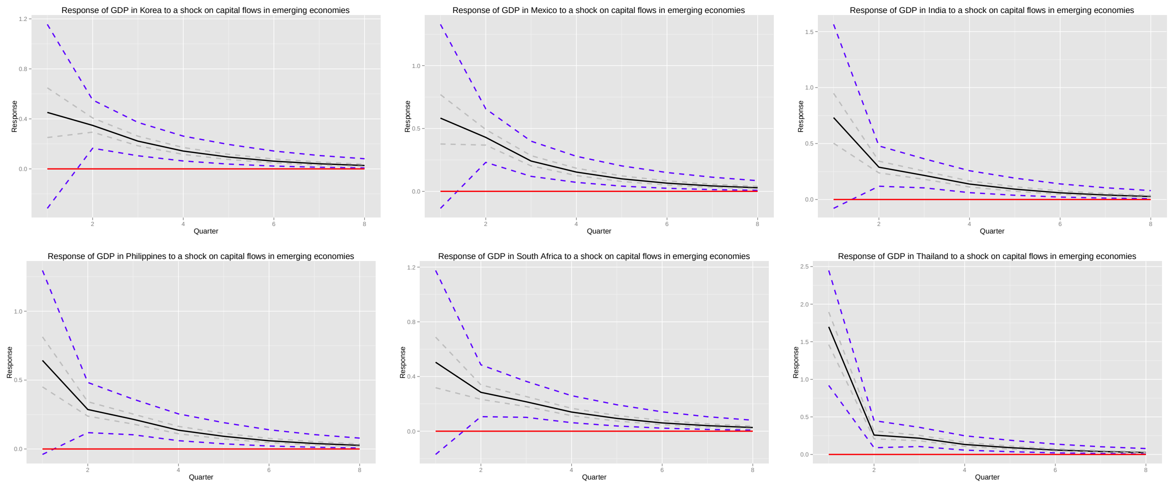
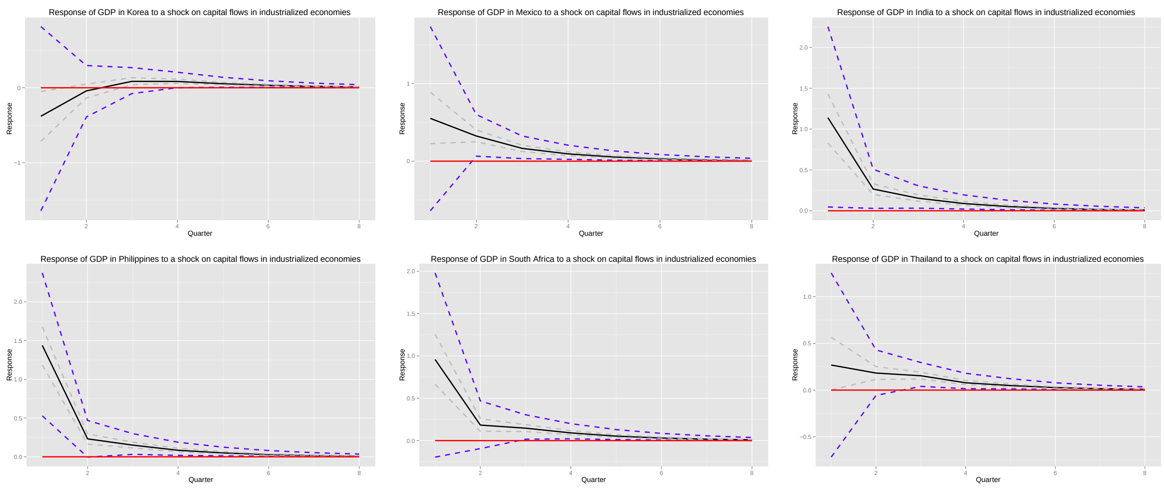


Figure VI **Response of GDP in emerging economies to a shock on capital flows in industrialized economies**

The plots show the reaction of the emerging economies individual GDPs to a common shock on capital flows in industrialized economies. This response is shown for Korea, Mexico, India, the Philippines, South Africa, and Thailand as the emerging economies included in our study. Panel (a) gives the corresponding reation to a shock on net capital flows and panel (b) to a shock on gross capital flows. The reaction is represented by the solid black line and the corresponding confidence bands by dashed lines (the 95% level in blue and the 68% in grey). The solid red line displays the zero line.

(a) Net capital flows:



(b) Gross capital flows:

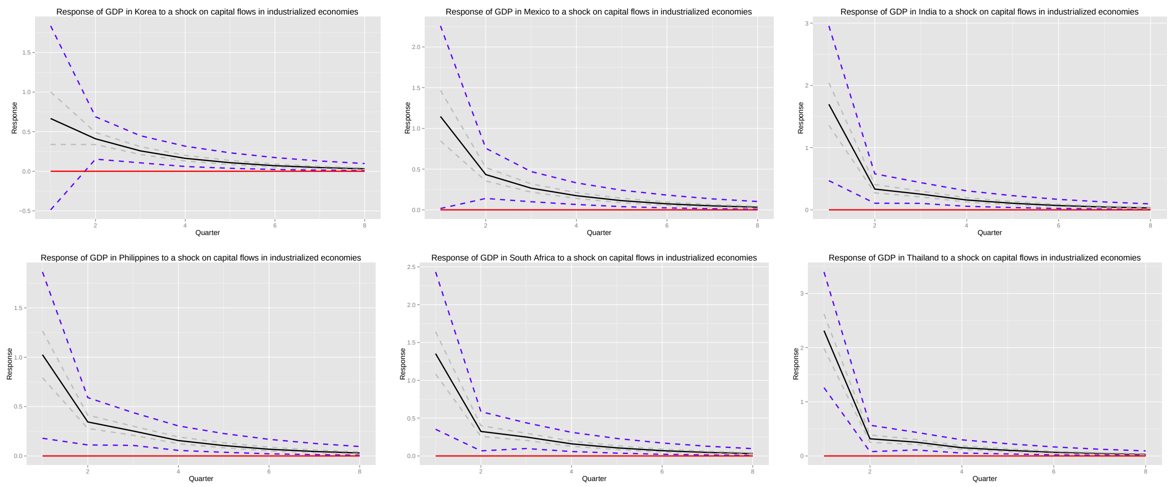
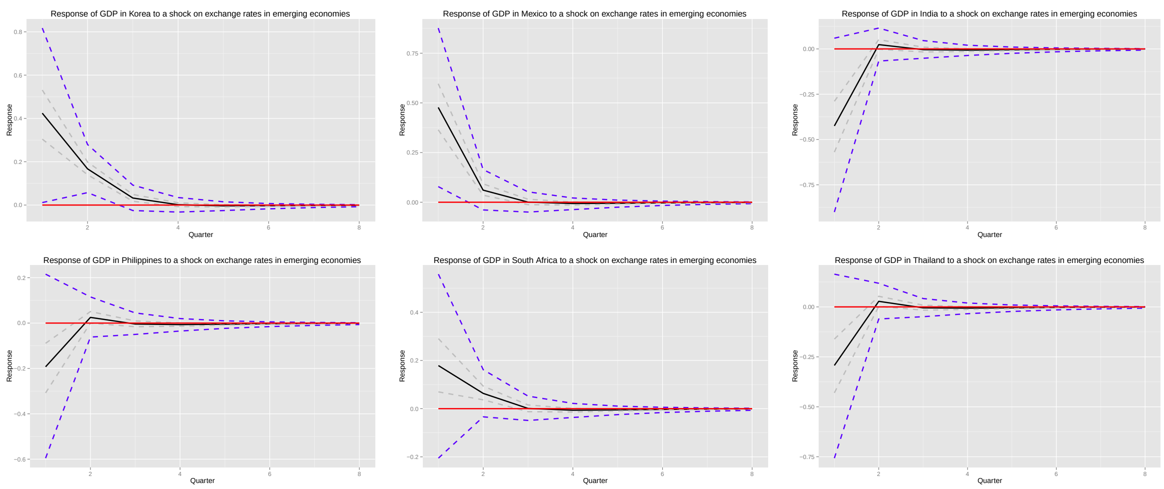


Figure VII **Response of GDP in emerging economies to a shock on exchange rates in emerging economies**

The plots show the reaction of the emerging economies individual GDPs to a common shock on exchange rates in emerging economies. This response is shown for Korea, Mexico, India, the Philippines, South Africa, and Thailand as the emerging economies included in our study. Panel (a) gives the corresponding reation to a shock on net capital flows and panel (b) to a shock on gross capital flows. The reaction is represented by the solid black line and the corresponding confidence bands by dashed lines (the 95% level in blue and the 68% in grey). The solid red line displays the zero line.

(a) Net capital flows:



(b) Gross capital flows:

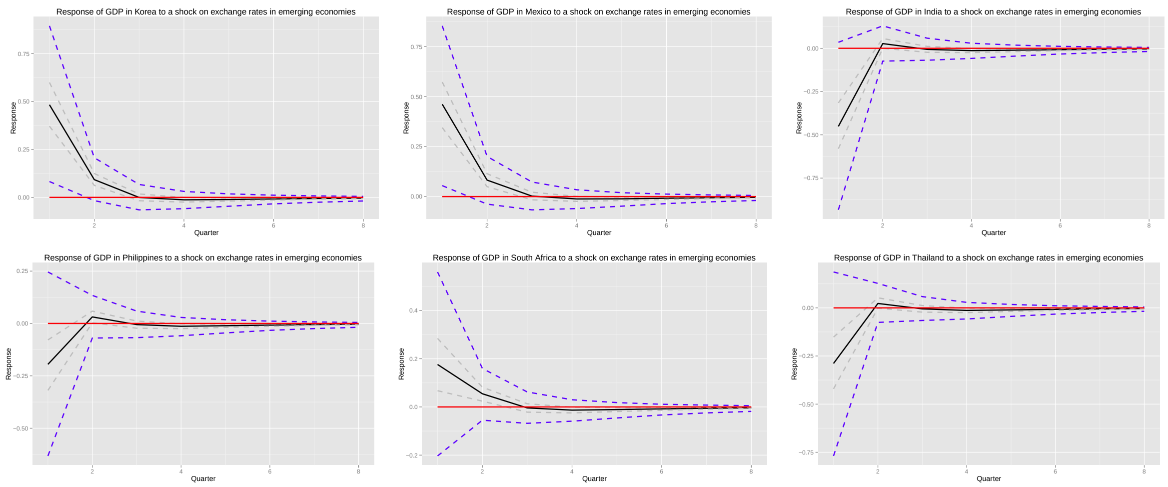
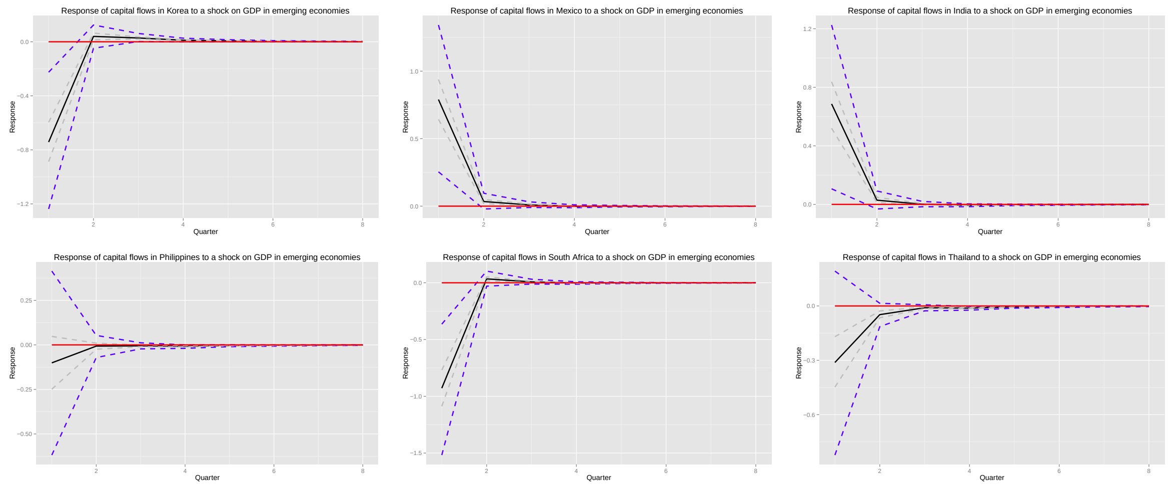


FIGURE VIII **Response of capital flows in emerging economies to a shock on GDP in emerging economies**

The plots show the reaction of the emerging economies individual capital flows to a common shock on GDP in emerging economies. This response is shown for Korea, Mexico, India, the Philippines, South Africa, and Thailand as the emerging economies included in our study. Panel (a) gives the corresponding reation to a shock on net capital flows and panel (b) to a shock on gross capital flows. The reaction is represented by the solid black line and the corresponding confidence bands by dashed lines (the 95% level in blue and the 68% in grey). The solid red line displays the zero line.

(a) Net capital flows:



(b) Gross capital flows:

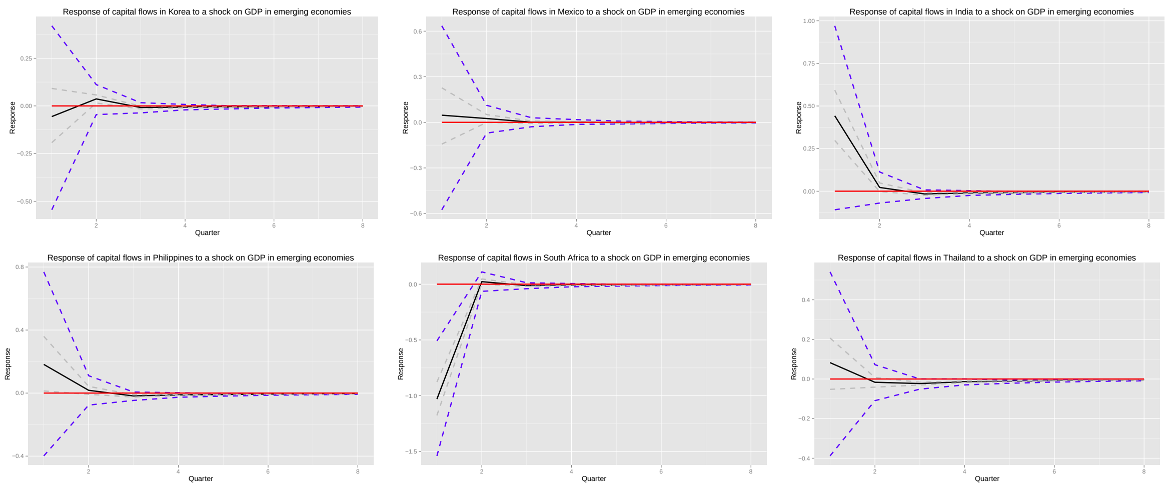
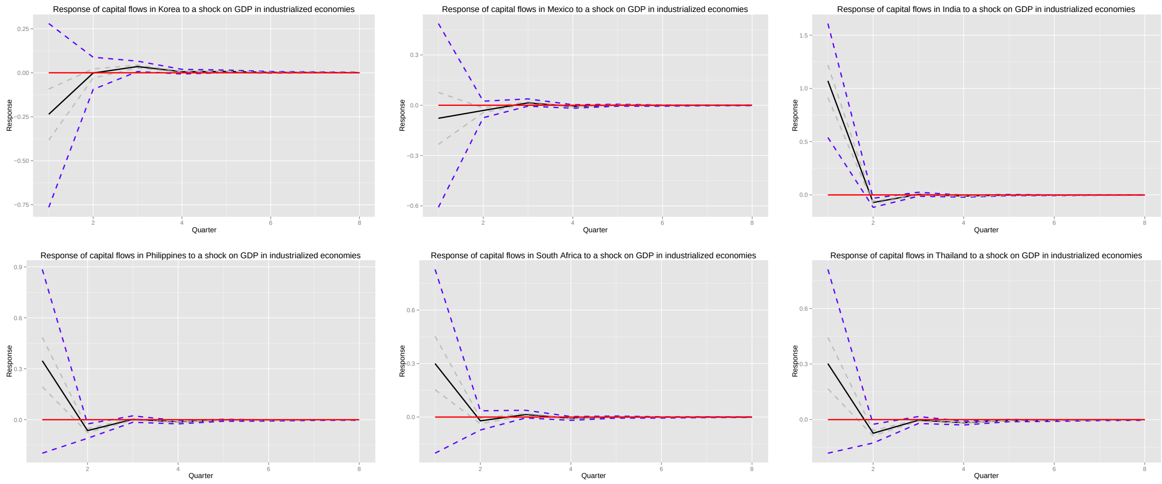


Figure IX **Response of capital flows in emerging economies to a shock on GDP in industrialized economies**

The plots show the reaction of the emerging economies individual capital flows to a common shock on GDP in industrialized economies. This response is shown for Korea, Mexico, India, the Philippines, South Africa, and Thailand as the emerging economies included in our study. Panel (a) gives the corresponding reation to a shock on net capital flows and panel (b) to a shock on gross capital flows. The reaction is represented by the solid black line and the corresponding confidence bands by dashed lines (the 95% level in blue and the 68% in grey). The solid red line displays the zero line.

(a) Net capital flows:



(b) Gross capital flows: