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# Capital Inflows and Asset Prices: Evidence from Emerging Asia

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# Capital Inflows and Asset Prices: Evidence from Emerging Asia

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**Abstract:** The withdrawal of foreign capital from emerging countries at the height of the recent financial crisis and its quick return sparked a debate about the impact of capital flow surges on asset markets. This paper addresses the response of property prices to an inflow of foreign capital. For that purpose we estimate a panel VAR on a set of Asian emerging market economies, for which the waves of inflows were particularly pronounced, and identify capital inflow shocks based on sign restrictions. Our results suggest that capital inflow shocks have a significant effect on the appreciation of house prices and equity prices. Capital inflow shocks account for - roughly - twice the portion of overall house price changes they explain in OECD countries. We also address cross-country differences in the house price responses to shocks, which are most likely due to differences in the monetary policy response to capital inflows.

**Keywords:** Capital Inflows, House Prices, Monetary Policy, Sign Restrictions, Panel VAR

**JEL classification:** F32, F41, E32

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# 1 Introduction

Over the recent years emerging market economies experienced large swings in net capital inflows. While net capital inflows peaked in early 2008 at about 4% of emerging markets' GDP, they dropped to -2.5% following the collapse of Lehman Brothers at the height of the financial crisis. Interestingly, however, capital flows quickly resumed in early 2009. In Asia, flows already exceeded the pre-crisis level in early 2010.[2]

Capital inflows are, in principle, highly welcome in emerging economies. They lower the costs of funding, help raise the standard of living and thus facilitate convergence with advanced economies. Likewise, cross-border flows, by offering investment opportunities and extending the set of available assets, contribute to economic efficiency and risk sharing also in the source countries. Nevertheless, capital inflows often have many unwarranted effects: First, they can lead to a real exchange rate appreciation that undermines competitiveness in the tradeable goods sector. Second, by preventing the central bank from tightening monetary policy, they can lead the economy to overheat, generating inflationary pressures. Third, they can trigger and prolong asset price bubbles and amplify financial fragility.

The latter impact is the focus of this paper. In light of the recent financial crisis that originated in a housing price bubble in the U.S., researchers and policymakers focus again on the housing market as a key indicator for financial imbalances and macroeconomic risks. Federal Reserve chairman Bernanke (2010) explicitly linked capital inflows to accelerating house price inflation and bubbly property prices. Although he focused on the U.S. case, the capital flow-house price nexus is arguably even more important for emerging countries.

This paper studies the response of property prices in emerging market economies to an inflow of foreign capital. Our contribution is threefold:

First, we estimate a panel vector autoregression (VAR) on a set of Asian emerging market economies for which the waves of inflows were particularly pronounced. A panel approach is best suited to summarize the data in light of the short sample period available after the disruptions of the Asian financial crisis. The paper focuses on Asia because capital quickly returned to this region after the 2008 financial crisis, inflows are more homogenous across countries in this region than compared to, say, Latin America and, finally, house prices experienced considerable upward pressure over the past years.

Second, we use sign restrictions following the work of Uhlig (2005) and, in particular, Sá, Towbin and Wieladek (2011) to identify capital inflow shocks and the responses of house prices and equity prices to these shocks. Our approach avoids an arbitrary ordering of the variables that often characterizes triangular identification schemes used

[2] The numbers are taken from IMF (2011a). See Tille (2011) a survey on capital flows to Asia during the crisis and IMF (2011b) and Balakrishnan et al. (2012) for discussions of policy responses.

in other VAR studies on asset price dynamics and monetary policy reviewed below. The shock we identify can best be interpreted as an unexpected increase in foreigner's demand for domestic assets. The driving forces behind international capital flows are often classified in terms of push and pull factors. Push factors, defined as financial and macroeconomic conditions in advanced economies, lead investors in advanced economies to send funds to emerging markets. In contrast, pull factors are given by conditions in the recipient countries attracting foreign investors. The capital inflow shock identified here is consistent with a shock to push factors.[3]

Third, we use the estimated panel VAR to shed light on cross-country differences in the responses of both types of asset prices, i.e. house prices and equity prices, to capital inflow shocks. For that purpose we exclude each country in turn from our panel VAR and estimate the VAR on the remaining set of countries. This gives us a set of impulse response functions from which the relative effect stemming from one country in the panel can be gauged.

Our results suggest that capital inflow shocks had a significant effect on real house price appreciation. A shock that increases net capital inflows relative to GDP by one percentage point leads to an increase in real house prices of 0.5%. Although capital inflow shocks account for only a moderate small portion of overall house price changes, about 10% to 15% depending on the specification, this fraction is about twice as large as what has been found for OECD countries.[4] The shocks we identify capture the capital flight in 2008 and the massive return of capital coinciding with the unconventional monetary policies in industrial countries since 2009. To corroborate these findings, we also estimate the responses of equity prices to capital inflow shocks and restrict capital flows to portfolio inflows only. Finally, we find important cross-country differences in the sensitivity to capital flow shocks, which cannot be explained by mortgage market characteristics or property market regulation. Instead, our results are consistent with the view that aggregate macro policies such as the monetary policy response to inflows are the main determinant of cross-country heterogeneity.

The remainder of the paper is organized as follows. The following section briefly summarizes the related literature. Section three introduces the panel VAR model, provides details on the data set, the construction of the main variables and explains the identifying restrictions. The main findings are discussed in section four. Section five presents results from alternative specifications to corroborate the robustness of the previous findings. Section six sheds light on the cross-country heterogeneity in the asset price responses to capital inflow shocks. Section seven summarizes the results and draws some conclusions.

[3] Milesi-Ferretti and Tille (2011) and Forbes and Warnock (2011) stress the role of push-factors for recent periods of massive capital inflows. See also Förster, Jorra and Tillmann (2012) for an analysis of the global comovement of capital flows.

[4] See Sá, Towbin and Wieladek (2011) for these findings for OECD countries.

## 2 Related literature

The present paper contributes to understanding the linkages between capital inflows and asset price surges with a particular focus on house price dynamics. Three strands of the literature are particularly relevant for this task. We briefly portray some key contributions to each strand with an eye on VAR studies and pay particular attention to papers addressing Asian economies.

First, a number of papers estimate reduced form relationships between asset prices and the current account.[5] Based on a large cross-section of countries Kole and Martin (2009) find a robust negative correlation between the growth rate of house prices and the change in a country's current account balance. Likewise, Aizenman and Jinjarak (2009) find a strong positive relationship between current account deficits and real estate prices. The causality between house prices and the current account is studied by Jinjarak and Sheffrin (2011). They argue that current account deficits were unlikely to directly drove real estate prices in the US, Spain and Ireland. As shown by Kannan, Rabanal and Scott (2011), after 1985 a deteriorating current account balance is shown to be a strong leading indicator for house price busts in OECD countries.

Second, some studies use VARs to estimate the dynamic interaction between asset price, capital flows and the macroeconomy and explicitly identify capital inflow shocks. Kim and Yang (2009) use a VAR model to analyze the effects of capital inflow shocks on asset prices in Korea. They find that capital inflow shocks have an effect on equity prices but not on property prices. These shocks are, however, identified by imposing a recursive ordering onto the variables. In light of the mutual interactions between asset prices, capital flows and the macroeconomic environment imposing this ordering requires a substantial amount on arbitrariness. Think of the relationship between asset price and monetary policy shocks. A triangular identification scheme forces the researcher to impose ex ante the direction of causality between asset prices and monetary policy within a quarter. In a related paper, Kim and Yang (2011) extend their work to a panel VAR estimated on five Asian economies between 1999-2006. Again, capital inflow shocks explain only a small fraction of asset price fluctuations. This paper suffers from the same weakness as the authors rely on an ad-hoc ordering of the variables to interpret the estimated shocks.

The relationship among asset markets and the current account is also studied by Fratzscher, Juvenal and Sarno (2010), although with a slightly different focus. The authors use a VAR with a sign-restriction identification scheme to assess the impact of

[5] In a recent theoretical contribution, Adam, Kuang and Marcet (2012) develop an open economy asset pricing model for the G7 economies in which households entertain subjective beliefs about price behavior that are potentially decoupled from fundamentals. A two-country two-sector model which illustrates the link between a property price boom and the current account is presented by Punzi (2012). Favilukis et al. (2011) argue that capital flows play only a limited role in boom-bust cycles in property prices. Instead, they point to the reversal of financial market liberalization as a key driver.

asset market shocks on the U.S. current account. While a few studies try to identify capital flows shocks, Helbling et al. (2011) instead use sign restrictions to identify a credit shock. According to their estimates, credit shocks, in particular those originating in the U.S. during the recent global financial crisis, are an important driver of fluctuations in the G7 economies.

The study by Sá, Towbin and Wieladek (2011) is closest the our paper and estimates a panel VAR for OECD countries. Capital inflow shocks derived from sign restrictions are shown to be important driving forces of house prices and other housing market variables. Moreover, the large panel dimension allows the authors to reveal cross-country differences and the relation to mortgage market characteristics. A better developed mortgage market leads to even stronger effects of capital inflow shocks. In the empirical analysis below we apply a similar identification scheme to a panel of Asian emerging market economies.

Third, recent studies focus on the response of property markets to monetary policy shocks. Assenmacher-Wesche and Gerlach (2008) and Goodhart and Hofmann (2008) estimate panel VARs on 17 OECD countries to show that monetary policy shocks have a significant effect on asset prices. A VAR for several Asian emerging economies is estimated by Bracke and Fidora (2008). The authors use sign restrictions to identify monetary policy shocks which are shown to explain a large part of asset price fluctuations. To improve the efficacy of the estimation, the authors aggregate individual economies using GDP weights.

Vargas-Silva (2008) uses sign restrictions to quantify the response of U.S. house prices to monetary policy shocks. He finds that housing starts and residential investment responds to a policy tightening, although the impact is affected by a large degree of uncertainty. Similarly, Mallick and Sousa (2011) provide evidence on the effects monetary policy shocks, again identified via sign restrictions, on real equity prices in large open economies such as Brazil, China, Russia and South Africa. Our method is also similar to the recent work of Carstensen, Hülsewig and Wollmershäuser (2009) and Hristov, Hülsewig and Wollmershäuser (2011), who estimate a panel VAR with shocks identified via sign restrictions. They are, however, interested in identifying loan supply shocks and monetary policy shocks, not capital inflow shocks.

# 3 The empirical model

## 3.1 A panel VAR approach

A panel structure allows us increase the degrees of freedom in the estimation process in light of the short sample period after the Asian crisis of 1997. This will lead to more efficient estimates than a country-by-country analysis. The estimated panel VAR of

order $l$ takes the following form

$$Y_{it} = B_{i0} + B_1 Y_{it-1} + B_2 Y_{it-2} + ... + B_l Y_{t-l} + u_{it} \tag{1}$$

with time index $t = 1-l, ..., T$ and country index $i = 1, ..., N$ where $Y_{it}$ is an $m \times 1$ vector of data for country $i$, $B_j$ are $m \times m$ coefficient matrices and $u_{it}$ is the vector of one-step ahead prediction errors with variance-covariance matrix $\Sigma$. The vector $B_{i0}$ consists of country-specific intercepts. We collect the coefficient matrices in $B = (B_1', ..., B_l')$. The matrix polynomial in the lag operator $L$ is $B(L)$.
In order to translate the reduced-form innovations $u_{it}$ into meaningful structural shocks $v_{it}$, we need a matrix $A$ such that

$$u_{it} = Av_{it} \tag{2}$$

with $\Sigma = E\left[u_{it}u_{it}'\right] = AE\left[v_{it}v_{it}'\right]A' = AA'$. There are $m\left(m-1\right)/2$ degrees of freedom in specifying $A$. The identifying restrictions needed to obtain that, besides those emerging from the covariance structure, are imposed following Uhlig's (2005) seminal (pure) sign-restrictions approach. One popular alternative would to let $A$ be a Cholesky factor of $\Sigma$ , which implies a recursive - but often arbitrary - ordering of the variables. The identification is achieved by imposing restrictions on the sign of the impulse responses of the endogenous variables.[6] Uhlig (2005) shows that any impulse vector $\alpha$ can be recovered if an $m$-dimensional vector $q$ of unit length is chosen such that $\alpha = \tilde{A}q$, where $\tilde{A}\tilde{A}' = \Sigma$, and $\tilde{A}$ is the lower triangular Cholesky factor of $\Sigma$.[7]
A Normal-Wishart prior in $(B(L), \Sigma)$ is formed for the reduced-form VAR. The posterior is the Normal-Wishart for $(B(L), \Sigma)$ times the indicator function that discriminates the draws on the basis of the imposed sign restrictions. For each $q$ draw, we compute the associated $\alpha$ vector and calculate the impulse responses as described before. If the resulting impulse response has the correct sign, i.e. the prespecified sign, the draw is kept. If not, the draw is discarded. We take $n_1$ draws from the VAR posterior and $n_2$ draws from an independent uniform prior. The impulse responses are calculated at horizon $k = 0, ..., K$ (in quarters). We stop after obtaining $n_3$ impulse response functions with the desired sign. The error bands are calculated using the draws kept. We set $n_1 = n_2 = 2000$ and $n_3 = 1000$.

The model is estimated by Ordinary Least Squares (OLS). This warrants some discussion as the OLS estimator with fixed-effects is known to be potentially biased in a dynamic panel setting if the coefficients on the endogenous variables differ across countries. As discussed in Assenmacher-Wesche and Gerlach (2008), restricting the coefficients to be the same across groups induces serial correlation in the residuals when the

[6] The following exposition follows Uhlig (2005) and Fratzscher, Juvenal and Sarno (2010).

[7] An alternative identifiction based on a combination of short and long run restrictions is proposed by Bjornland and Jacobsen (2010).

regressors are autocorrelated. A popular way to solve this problem is to apply Pesaran and Smith's (1995) mean-group estimator, which is used in Assenmacher-Wesche and Gerlach (2008) and Sá, Towbin and Wieladek (2011). To be a viable solution, however, the mean-group estimator requires the time dimension of the panel to be sufficiently large to estimate country-specific VARs whose coefficients can be averaged across countries. This requirement is clearly violated in our setup as the sample period covers one decade only. In fact, Rebucci (2003) finds that the mean-group estimator typically requires a time dimension that exceeds the length of a typical macroeconomic dataset. To address the issue of cross–country differences, besides the illustrative approach presented below, we also estimated the model using a random-coefficient approach in which the coefficients in the $B_j$ matrices are allowed to vary randomly around a common mean. This yields results that are virtually identical to those obtained with the fixed-effects estimator. In light of these difficulties, we therefore continue to use the fixed-effects estimator.

### 3.2 The data set

We estimate the model for Asian emerging economies using two alternative VAR specifications, each of which is estimated for two alternative capital inflow series and two alternative asset prices. Our estimation period and the set of countries is dictated by data availability. For many Asian economies, reliable house price indices are available only after the Asian crisis. This leaves us with five economies, for which data is available from 2000:1, i.e. Korea (KOR), Hong Kong (HKG), Malaysia (MAL), Thailand (THA) and Taiwan (TWN). The estimation period for this sample ends in 2011:1. Based on standard lag selection criteria the lag order for this panel VAR, henceforth referred to as VAR I, is set to $l = 4$. For Singapore house prices are available from 2003. Therefore, we set up a second VAR, henceforth VAR II, which also covers Singapore (SGP). The lag order of this VAR model, for which the estimation sample ends in 2010:4, is set to $l = 3$. Table (1) summarizes the alternative VAR specifications.

Table 1: VAR specifications

| | VAR I | VAR II |
|---|---|---|
| sample | 2000:1 - 2011:1 | 2003:1 - 2010:4 |
| lag order | 4 | 3 |
| countries | HKG, KOR, MAL, THA, TWN | HKG, KOR, MAL, SGP, THA, TWN |
| variables | $FLOWS_{it}$, $GDP_{it}$, $P_{it}$, $REER_{it}$, $ASSET_{it}$, $LONG_{it}$, $SHORT_{it}$ | |

Each VAR contains the following quarterly data series: net capital inflows in percent of GDP ($FLOWS_{it}$), log real GDP ($GDP_{it}$), the log consumer price index ($P_{it}$), the log

real effective exchange rate ($REER_{it}$), a log real asset price ($ASSET_{it}$), the long-term ($LONG_{it}$) and the short-term interest rate ($SHORT_{it}$). All variables enter the VAR in levels. Thus, the vector $Y_{it}$ consists of

$$Y_{it} = [FLOWS_{it} \quad GDP_{it} \quad P_{it} \quad REER_{it} \quad ASSET_{it} \quad LONG_{it} \quad SHORT_{it}]' \qquad (3)$$

To assess the role of different types of capital inflows, the $FLOWS_{it}$ variable represents either total net capital inflows defined as the sum of foreign direct investment, portfolio and other types of capital inflows or portfolio capital inflows only. We are also interested in contrasting the response of house prices to capital inflow shocks with that of other equity prices. For that purpose, the $ASSET_{it}$ variable represents either real house prices or real equity prices. A higher value of $REER_{it}$ means a real appreciation of the domestic exchange rate.

The macroeconomic data series are taken from the IMF's *International Financial Statistics* Database, while the real effective exchange rate series are obtained from the BIS's website. Data on house prices is taken from the *CEIC* database.

### 3.3 The identifying restrictions

In this paper a capital inflow shock is interpreted as an unexpected inflow of foreign capital unrelated to domestic fundamentals, thus resulting from global push-factors. This requires us to carefully distinguish a capital inflow shock from other sources of capital inflows, e.g. a shock to domestic productivity or demand, which would also attract foreign inflows of capital.

The set of restrictions imposed in this paper is summarized in table (2).

Table 2: Sign restrictions

| restriction on | VAR with total capital inflows | | VAR with portfolio inflows | |
|---|---|---|---|---|
| | sign | horizon | sign | horizon |
| capital inflows | + | $K = 2$ | + | $K = 1$ |
| GDP | + | $K = 2$ | + | $K = 1$ |
| price level | unrestricted | | unrestricted | |
| REER appreciation | + | $K = 2$ | + | $K = 1$ |
| asset prices | unrestricted | | unrestricted | |
| long rate | - | $K = 2$ | - | $K = 1$ |
| short rate | unrestricted | | unrestricted | |

These restrictions correspond to those imposed by Sá, Towbin and Wieladek (2011) extended by a constraint on the output response. An expansionary capital inflow

shock is supposed to increase capital inflows, leads to an increase in economic activity, puts appreciation pressure on the real effective exchange rate and lowers long term interest rates. The restrictions are imposed for a horizon of $K = 2$ quarters for the VAR model containing total capital inflows and $K = 1$ quarter for the portfolio-VAR. Given the volatility of net portfolio inflows, a restriction over two quarters might be too restrictive.

These effects are consistent with a broad range of empirical studies on capital inflows to emerging economies. Let us briefly sketch selected recent contributions. A complete survey is beyond the scope of this paper: Cardarelli, Elekdag and Kose (2010) analyse the implications of surges in private capital inflows in a large group of emerging and advanced economies. They conclude that capital inflow periods are associated with an acceleration of GDP growth and a real appreciation.[8] Likewise, Jongwanich (2010) estimates a dynamic panel model to understand the nexus between capital flows and real exchange rates for the period 2000-2009, which roughly corresponds to our sample. He shows that both portfolio and FDI inflows lead to a significant real appreciation.

Capital inflows also increase liquidity and depresse long-term interest rates. In the present setting, this constitutes an unwarranted monetary easing as many economies operate close to or even above potential and face strong inflationary pressure. The recent study by Pradhan et al. (2011) finds that an increase in nonresident participation in local bond markets by one percentage point reduces nominal long-term bond yields by about five basis points on average. As discussed in Sá, Towbin and Wieladek (2011), restricting the long-term interest rate is crucial in order to distinguish a capital inflow shock, i.e. an unexpected increase in foreign demand for domestic assets, from other shocks. A positive productivity shock or a demand shock, for example, would also result in capital inflows and a real appreciation, but would increase rather then decrease the (real) long-term interest rate. Since Sá, Towbin and Wieladek (2011) find that including the nominal or the real interest rate makes no difference for the results, we opt for the nominal interest rate for reasons of data availability.

Note that the response of the asset price, which is the central focus of this paper, is left unrestricted. The same is true for the monetary policy response, i.e. the short-term interest rate, and the price level.

# 4 Results

The resulting impulse response functions for both models i.e. the VAR I and VAR II, two alternative asset price series, i.e. house prices and equity prices, and two alternative capital inflow series are shown in figures (1) to (8). All figures show the response of the seven endogenous variables to a capital inflow shock one standard deviation in

[8] Kim and Kim (2011) study the role of capital inflows for the degree of business cycle synchronization in Asia and find an expansionary effect of capital inflow shocks on GDP.

size. In all figures the solid line represents the median response across all draws. The surrounding confidence bands are constructed using the 15th and 84th percentile of the accepted responses.

The core result is that a positive capital inflow shock leads to a significant and persistent appreciation of both house prices and equity prices. A shock of one standard deviation leads to capital inflows of one percent of GDP and an increase in real house prices of about 0.5 percent, see figure (1). The resulting increase in equity prices is almost four times as large, see figure (2). The impulse responses also reveal that consumer prices increase for a prolonged time period after an unexpected surge in capital inflows. Monetary policy tightens with some time lag of about three to four quarters. The VARs estimated with portfolio inflows instead of total capital inflows, see figures (3) and (4), yield very similar results.

The six-country VAR specification, our VAR II model, generates slightly stronger house price responses than the five-country model, see figure (5), when estimated on total capital inflows. This reflects the house price surge in Singapore, which is missing in the smaller VAR I model. For portfolio inflows, the results become insignificant. Another striking finding from the VAR II is the negative response of the short-term interest rate following a shock to capital inflows. This finding is also discussed in the following section.

Table (3) reports the fraction of the forecast error variance of asset prices explained by the capital inflow shock. Two findings stand out. First, the explained portion is larger when the model is estimated on portfolio flows only rather than on total inflows. Second, when compared to the findings of Sá, Towbin and Wieladek (2011), the fraction of house price variance explained by capital inflow shocks is roughly twice as large as in OECD countries. Although the overall effect appears moderate with a share of about 10% to 15% of house price dynamics accounted for by capital inflow shocks, two remarks are warranted. First, these numbers refer to real house prices. Given the persistent inflationary effect of capital inflows shocks, the eventual response of nominal house prices will be much larger. Second, the capital flow shocks reflect changes in global push-factors only. In addition to that, capital flows attracted by domestic conditions such as favorable growth prospects, would also contribute to asset price developments.

Figures (9) to (12) depict the identified capital inflow shocks for the recent crisis period, i.e. from the first quarter of 2007 to the last quarter of 2010. The shocks capture the boom-bust cycle observed in aggregate capital inflow data. Large negative shocks are observed for the second half of 2008, i.e. after the Lehman collapse, followed by exceptionally strong inflows in the first half of 2010.

# 5 Robustness

In this section we perform a number of robustness checks to corroborate the findings presented before. A first modification pertains to the treatment of the variables. Although some of the variables exhibit a trending behavior, the baseline specification includes a constant as the only deterministic variable. This is in line with the bulk of the literature. To nevertheless address that issue, we linearly detrend the GDP, the price level and the house price series before the estimation stage. For the remaining variables, i.e. capital inflows, interest rates and the real exchange rate, a time trend appears to be less plausible. The results of this specification based on the otherwise unchanged baseline VAR specification are presented in figure (13). While the size of the effect of capital inflow shocks on house prices remains roughly unchanged, the effect is no longer significant.

Second, a large fraction of the available observations stems from the recent financial crisis. To isolate the effect of the crisis, we estimate the model up to 2008:2, i.e. we close the estimation window before the Lehman collapse in the second half of 2008 and the resulting financial meltdown. We chose the VAR II model for that exercise to see whether the negative interest rate response following a capital inflow shock observed before is indeed due to aggressive policy measures to combat the crisis. The results are presented in figure (14). While the effect of shocks on house prices is smaller in the pre-crisis sample than in the complete sample presented before, the negative response of the short-term interest rate remains puzzling. This probably reflects the drastic interest rate cuts in Singapore starting in mid-2006. Singapore is not covered by the VAR I model which exhibits a positive interest rate response for the complete sample period.

Finally, all impulse response functions presented in this paper are constructed using the identification scheme shown before. Another set of restrictions, hence, could alter the dynamic responses. Additional results (which are available upon request) reveal that lifting the restriction on the real exchange rate appreciation has almost no effect on the results. Furthermore, dropping the restriction on the long-term interest rate leaves the results unchanged. The restriction of a positive impact response on GDP matters for the VAR II but not the VAR I. This probably reflects the increased focus on the financial crisis in the former VAR setup that would otherwise be dominated by the fallout from the global recession in 2008/2009.

To summarize, our results appear reasonably robust with respect to selected modifications of the empirical specification. In light of the short time span available for estimation, however, the empirical evidence remains tentative.

# 6 Cross-country heterogeneity

The choice of a panel model is likely to obscure important cross-country differences in the dynamic responses to shocks. We mainly resort to panel techniques to cope with the small sample size. In addition, the cross-sectional dimension is small due to data availability. Thus, the estimation of country-specific VAR models is no viable alternative.[9]

To address the extent of cross-country heterogeneity in the responses to capital inflow shocks despite the small dimension of the panel at hand, we estimate the VAR II model repeatedly and exclude each country in turn. This gives us six impulse response functions, each for a set of five out of the available six countries. Suppose we exclude country $j$ from the VAR. Comparing the impulse response functions of the overall model with that obtaining without country $j$ allows us to roughly assess country $j$'s contribution to the overall findings.

Figure (15) reveals that excluding Hong Kong, Korea or Singapore results in smaller effects of capital inflow shocks compared to the full model. The upper panel of the graph shows that the responses of the remaining five-country VAR model are all smaller than the impulse response of the full, i.e. six-country, VAR. Take the response four quarters after the shock. Excluding one of these three countries, the response is roughly half as strong as the benchmark impulse response including all countries. Excluding Malaysia, Thailand or Taiwan, in contrast, leads to stronger responses as shown in the lower panel of figure (15). This, in turn, implies that the response are exceptionally strong in Hong Kong, Korea and Singapore and relatively weak in the remaining set of countries. Since these findings reflect only the marginal impact on the panel of excluding one country, the cross-country differences documented here can be interpreted as conservative estimates of the true degree of heterogeneity.

Two factors could, in principle, be responsible for the observed differences in the responses to capital inflow shocks across countries: (1) mortgage market characteristics as surveyed in Zhu (2006), Glindro et al. (2011) and Sá, Towbin and Wieladek (2011) and (2) the monetary policy response to capital inflows. If different mortgage market characteristics across Asian economies are behind the different response patterns, the pattern should be different for equity price responses which are not affected by institutional details of the respective housing markets. If, however, monetary policy explains cross-country differences, the responses of equity prices should be similar as equity and house price responses are likely to be similarly affected by the monetary policy stance. In other words, the differences between the house price responses and equity price responses contain information about the underlying sources of heterogeneity.

Figure (16) reports the same exercise based on the VAR II model with equity prices.

[9] Carstensen, Hülsewig and Wollmershäuser (2009) use a data-driven approach to split a panel into two disjoint groups. Although appealing, this procedure is not feasible here due to the small number of countries.

The results are striking: the response of equity prices to capital inflows leads to the same grouping of countries than before. We clearly see that the exclusion of Hong Kong, Korea and Singapore leads to a much smaller response in the remaining five-country panel. Put differently, in the three countries the stock market responses are exceptionally strong. This exactly corresponds to the grouping of countries in the VAR on house prices discussed before. Hence, this points to monetary policy responses as the key factor determining the strength of the asset price responses and reflects the focus on maintaining the currency board in Hong Kong and the managed exchange rate in Singapore which prevents the monetary authorities to tighten policy. Moreover, many other Asian central banks, among them the Bank of Korea, are reluctant to tighten policy fearing that a wider return differential with respect to mature economies would attract even larger capital inflows.[10]

While the results corroborate the notion that macroeconomic policy explains cross-country differences, the findings not necessarily imply that macroprudential policies such as loan-to-value (LTV) limits, which were introduced in Hong Kong and Korea, were ineffective.[11] Given the bluntness of monetary policy as an instrument to contain asset price booms (see Crowe et al. (2011) for this point), the evidence presented here is consistent with the view that macroprudential measures haven not been used boldly enough to prevent bubbly house price developments.

# 7 Conclusions

This paper estimated the impact of capital inflow shocks on property prices and equity prices in Asian economies using a panel VAR with sign restrictions for a post-2000 sample. The key results are that, first, capital inflow shocks significantly push up housing prices and stock prices and, second, are twice as important for the development of asset prices than in OECD countries. A third finding revealed that cross-country differences in the responses to capital inflow shocks are not due to housing market characteristics or the use of macroprudential policies directed to contain property price bubbles. Instead, the evidence is consistent with the view that differences in macro policies, e.g. monetary policy, are the source of heterogeneity across countries.

The ebb and flow of capital inflows over the recent years did indeed contribute to the observed surge in house prices. This also implies that ongoing inflows of capital pushed to emerging economies by loose monetary conditions in advanced economies poses serious risks to financial stability in the recipient countries.

Here we quantify the impact of shocks to push-factors over which domestic policies have no control. While our evidence suggests that a monetary tightening could dampen

[10] See IMF (2011b) for a discussion of the remaining room of regional central banks to raise interest rates in light of capital inflows.

[11] The empirical case for macroprudential policies in Asia such as LTV ratios and other measures is discussed in Igan and Kang (2011), Wong et al. (2011) and Craig and Hua (2011).

the effect on asset markets, raising interest rates in order to dampen property prices increases is certainty too blunt an instrument to be applied in non-crisis periods. A deeper empirical analysis of the impact of macroprudential policy measures is needed, which have recently been employed throughout the region, to assess their effectiveness. It will also be informative to see how an unwinding of capital inflows, probably due to an eventual tightening of monetary conditions in mature economies, will affect emerging economies' asset prices.

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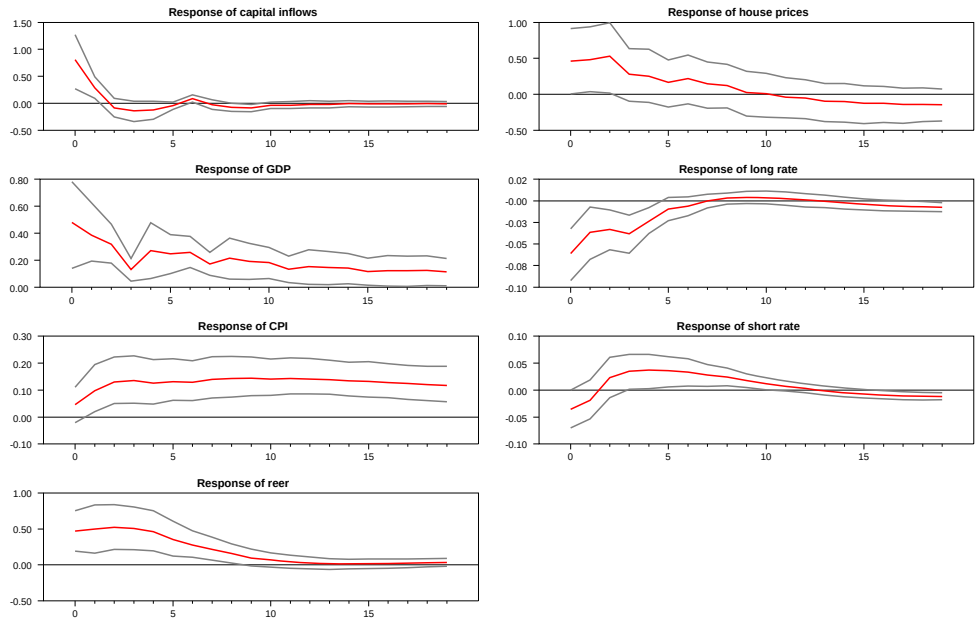


Figure 1: Impulse responses after a capital inflow shock obtained from a five-country VAR with total capital inflows and house prices

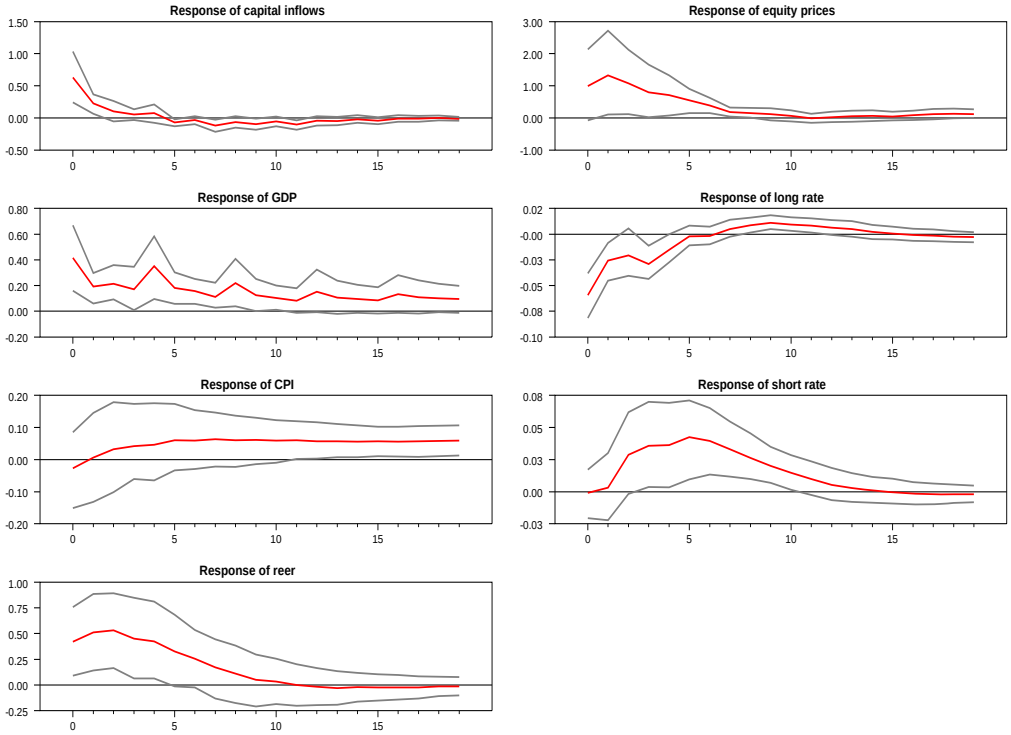


Figure 2: Impulse responses after a capital inflow shock obtained from a five-country VAR with total capital inflows and equity prices

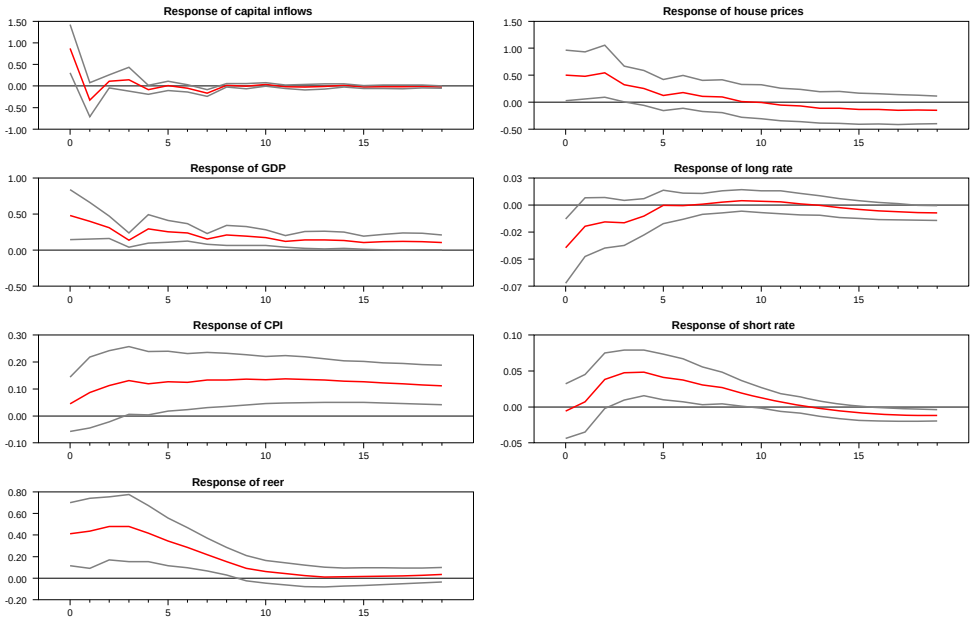


Figure 3: Impulse responses after a capital inflow shock obtained from a five-country VAR with portfolio inflows and house prices

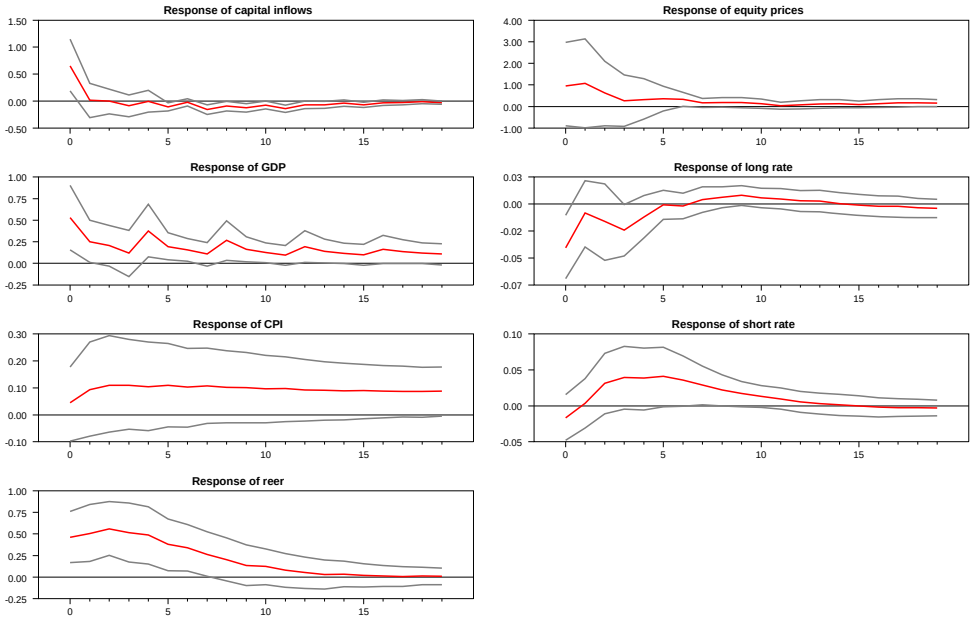


Figure 4: Impulse responses after a capital inflow shock obtained from a five-country VAR with portfolio inflows and equity prices

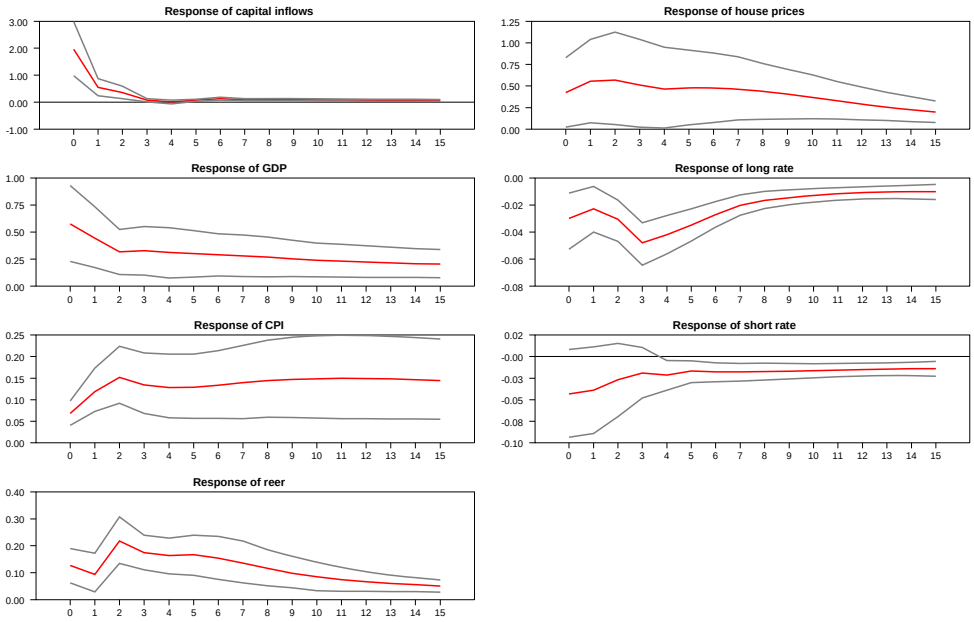


Figure 5: Impulse responses after a capital inflow shock obtained from a six-country VAR with total capital inflows and house prices

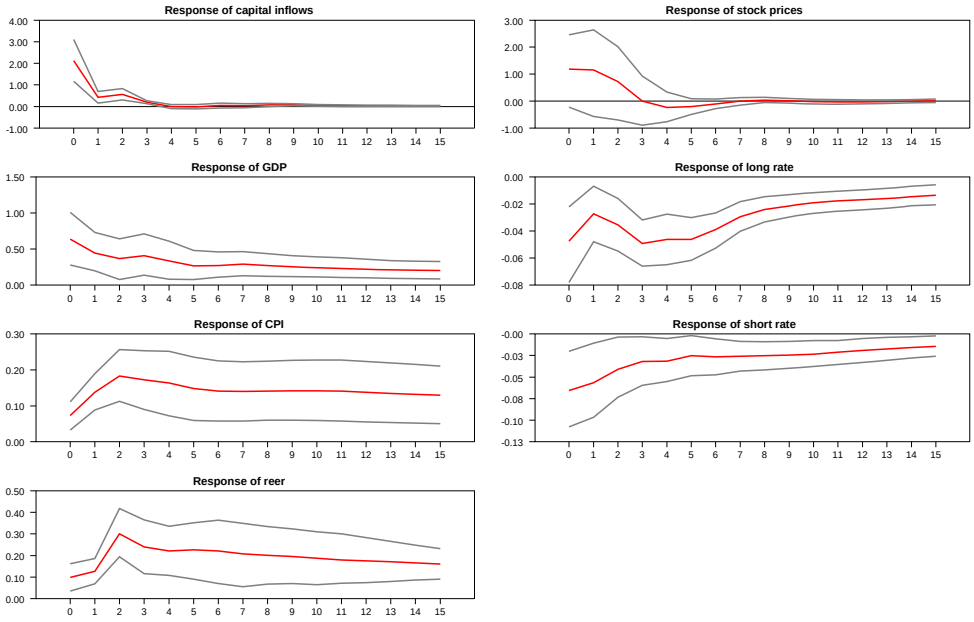


Figure 6: Impulse responses after a capital inflow shock obtained from a six-country VAR with total capital inflows and equity prices

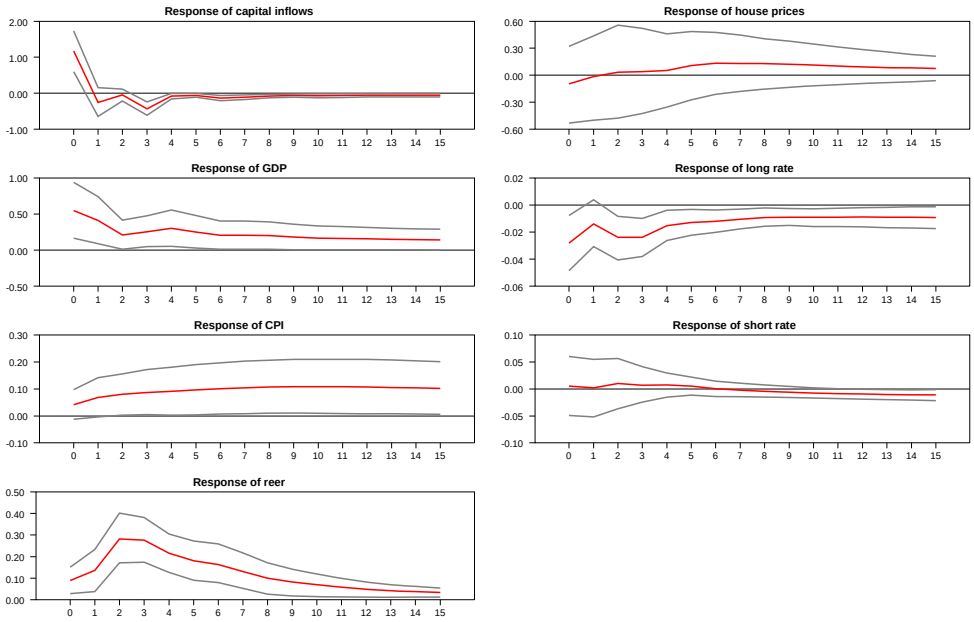


Figure 7: Impulse responses after a capital inflow shock obtained from a six-country VAR with portfolio inflows and house prices

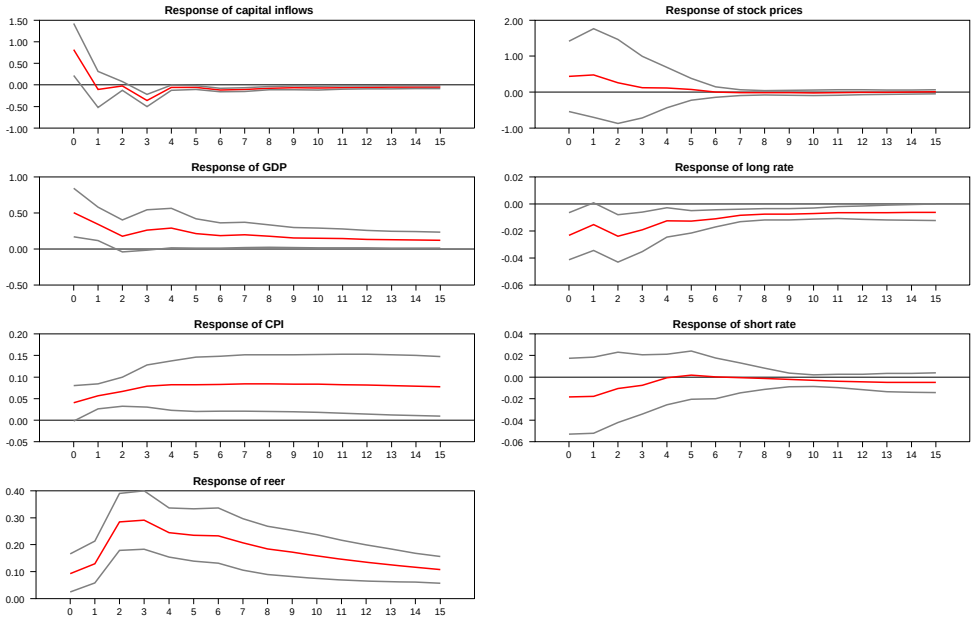


Figure 8: Impulse responses after a capital inflow shock obtained from a six-country VAR with portfolio inflows and equity prices

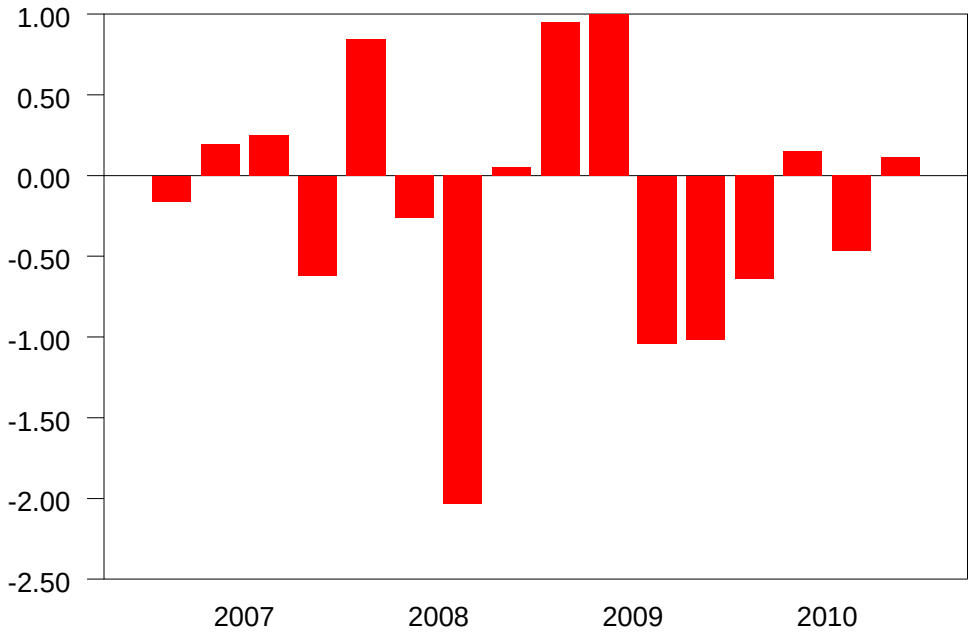


Figure 9: Capital inflow shocks obtained from a five-country VAR with total capital inflows and house price

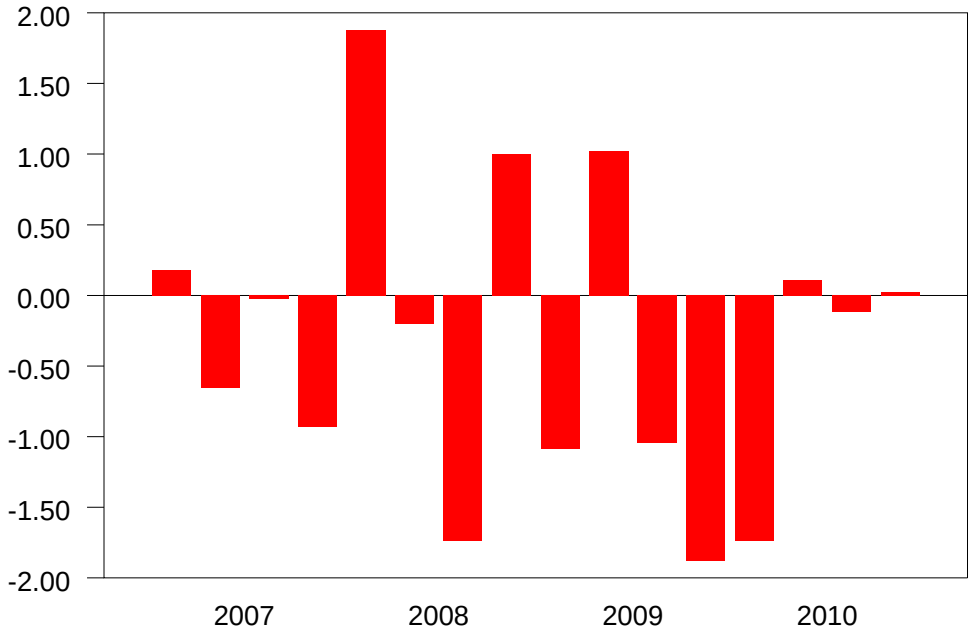


Figure 10: Capital inflow shocks obtained from a five-country VAR with total capital inflows and equity price

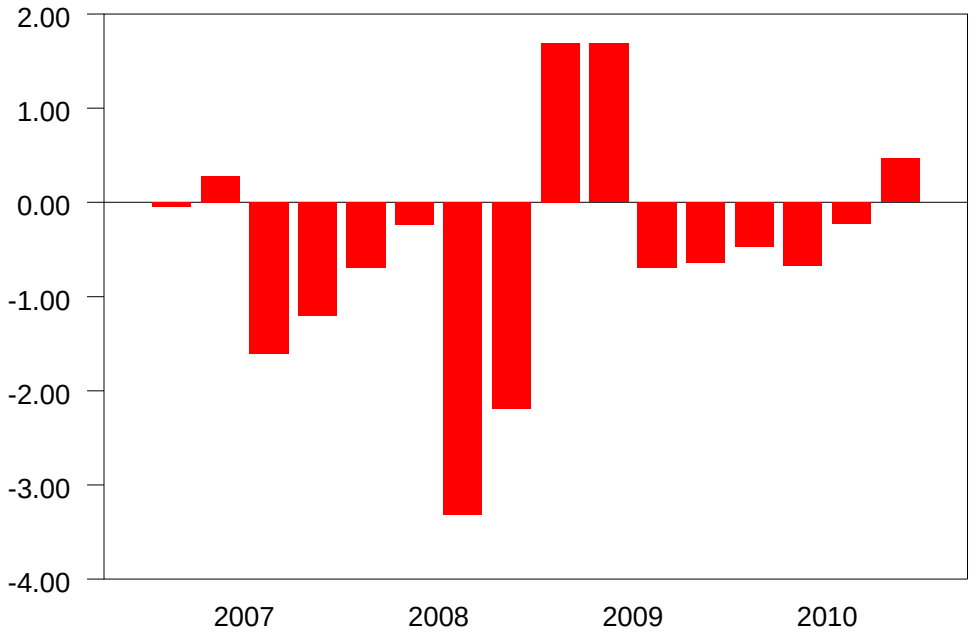


Figure 11: Capital inflow shocks obtained from a five-country VAR with portfolio inflows and house price

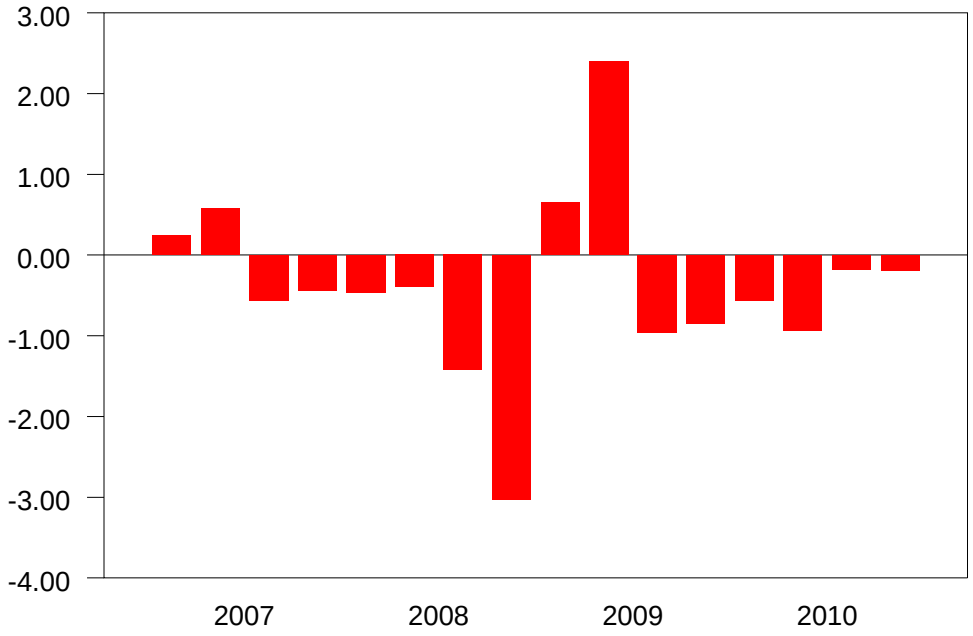


Figure 12: Capital inflow shocks obtained from a five-country VAR with portfolio inflows and equity price

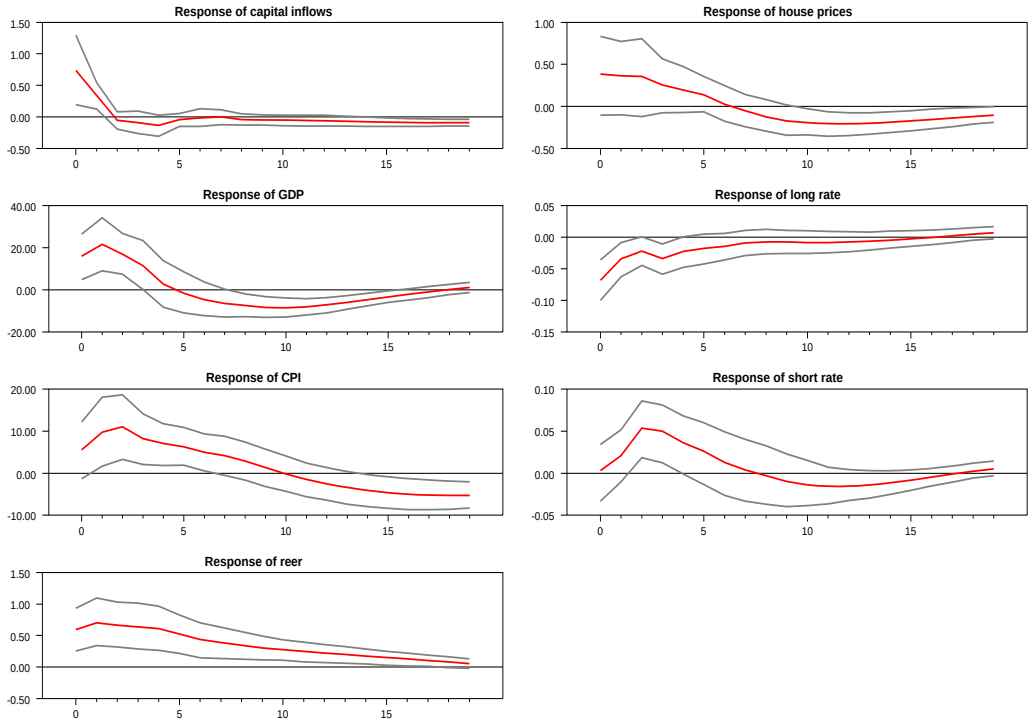


Figure 13: Impulse responses after a capital inflow shock obtained from a five-country VAR with total capital inflows and house prices and detrended GDP, price level and house price series

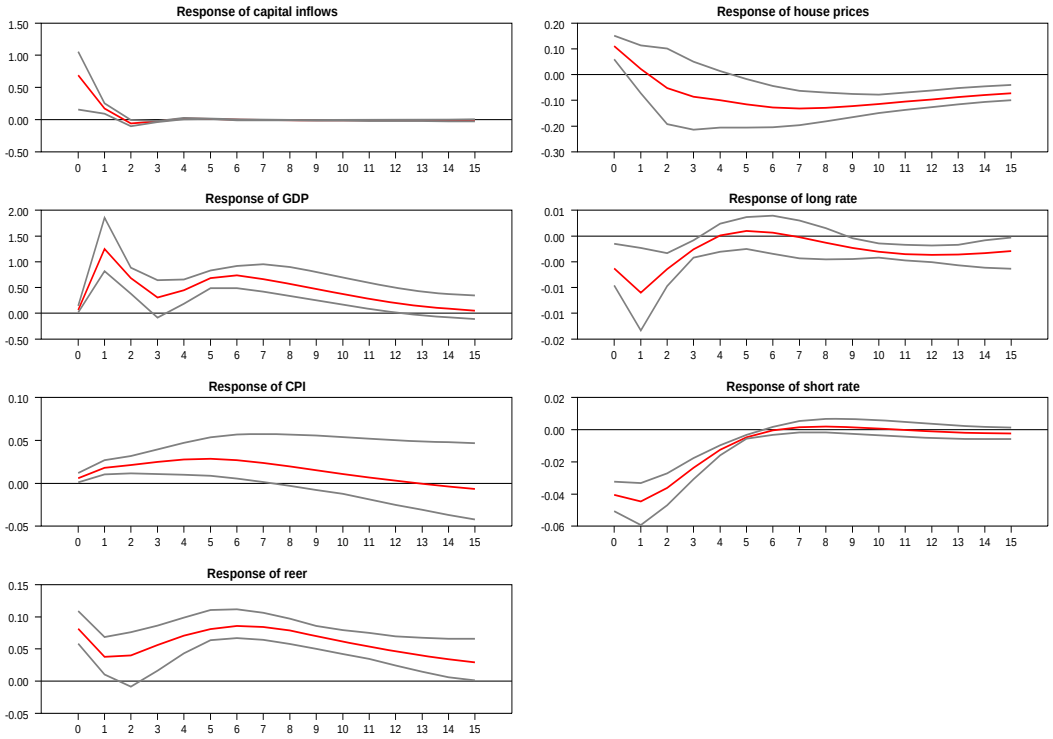


Figure 14: Impulse responses after a capital inflow shock obtained from a six-country VAR with total capital inflows and house prices excluding the financial crisis

Table 3: Forecast error variance decomposition

| model | forecast horizon (in quarters) | variance share explained by capital inflow shock | |
|---|---|---|---|
| | | with total capital inflows | with portfolio inflows |
| VAR I | 1 | 0.09 | 0.14 |
| with house prices | 4 | 0.08 | 0.15 |
| | 8 | 0.08 | 0.15 |
| | 12 | 0.10 | 0.14 |
| VAR I | 1 | 0.15 | 0.12 |
| with equity prices | 4 | 0.14 | 0.13 |
| | 8 | 0.15 | 0.13 |
| | 12 | 0.15 | 0.13 |
| VAR II | 1 | 0.11 | 0.15 |
| with house prices | 4 | 0.10 | 0.13 |
| | 8 | 0.11 | 0.12 |
| | 12 | 0.11 | 0.11 |
| VAR II | 1 | 0.12 | 0.14 |
| with equity prices | 4 | 0.11 | 0.14 |
| | 8 | 0.12 | 0.13 |
| | 12 | 0.12 | 0.13 |

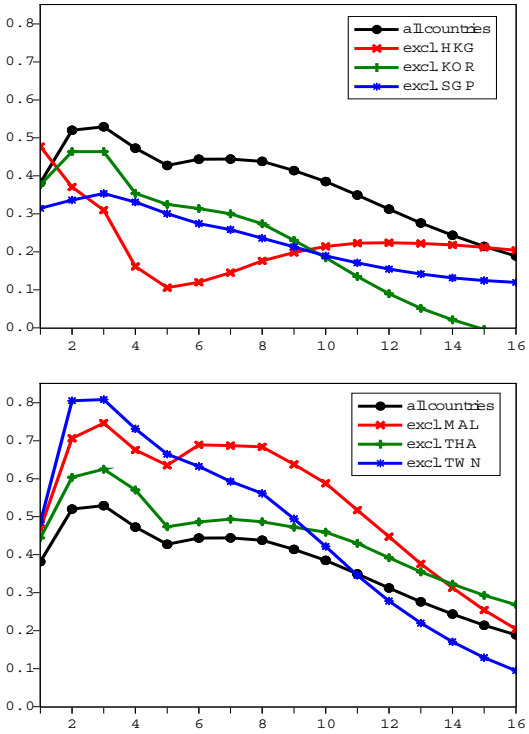


Figure 15: Impulse responses after a capital inflow shock obtained from a VAR with house prices in which a given country is excluded

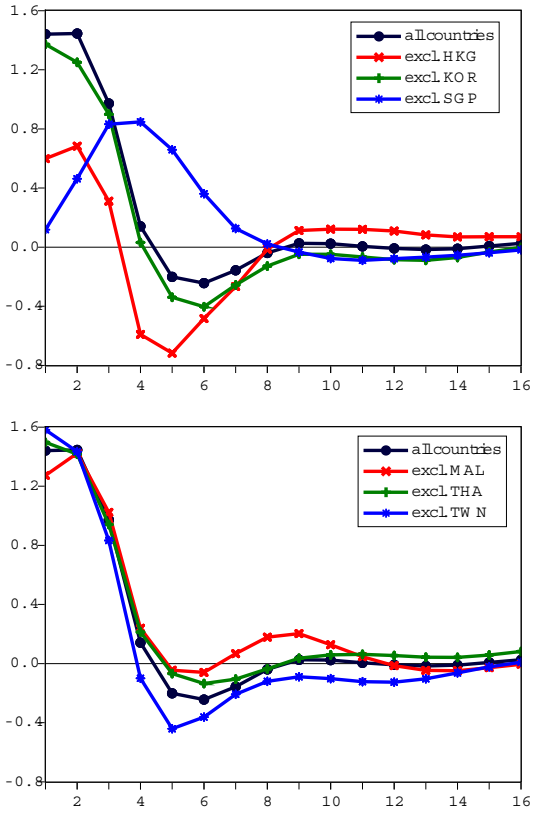


Figure 16: Impulse responses after a capital inflow shock obtained from a six-country VAR with equity prices in which a given country is excluded

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