Global liquidity and house prices around the world

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Abstract

The paper investigates the impact of global liquidity, proxied by funding liquidity, on house prices around the world. Focusing on the repo markets in US, Europe, UK and Japan, we document that liquidity is related to cross-border bank flows and affect house prices. Highlighting the importance of looking beyond the US, we find that the liquidity effect depends on where liquidity has originated. Moreover, there is evidence of important banking channels for liquidity shocks to house prices in emerging markets. Finally, the exposure of house prices to global liquidity may be contained by certain country characteristics and policies.

Keywords: global liquidity, house prices, repos.
JEL classification: G15.

1 Introduction

In the last decade, house prices around the world have registered a sustained upward trend, increasing on aggregate by around 25% from 1999 until the recent financial crisis. This pattern has been rather similar to that of cross-border bank flows that increased steadily (Figure 1, Panel a). During this period, the correlation between changes in house prices and bank flows has been on average 23%, with coefficients over 27% in some countries, such as Brazil and Hong Kong. The

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increasing trend inverted during the recent financial crisis, when key financial markets experienced severe liquidity dry-ups and credit conditions worsened across the world. The responses of monetary authorities to the subsequent economic downturn have unleashed unprecedented amounts of liquidity. During this period, both house prices and bank flows resumed their upward trend. This is highlighted in Figure 1 (Panel b), which presents the annual growth rates of both cross bank flows and house prices for both advanced and emerging markets. While it is noticeable for both groups, the drop and subsequent recovery is more pronounced in advanced economies. This paper aims at investigating these dynamics and identifying the relationship between house prices and global liquidity, that is the liquidity that crosses the border and affects directly, or indirectly financing conditions abroad. In order to capture the global liquidity dynamics relevant for house prices around the world, we focus on the private component of liquidity on the major wholesale funding markets for financial intermediaries, that is the repurchase agreement (repo) market not only in the US, but also in the UK, Europe, and Japan. Changes in the availability of financing in the main financial systems may affect house prices via the funding channel that transmits global conditions into the local banking sector through bank flows. Moreover, funding conditions may also affect local house prices via their effect on the portfolio allocation of major investors in the real estate, such as hedge funds and real estate investment trusts (Baklanova, Copeland, and Mccaughrin, 2015). Thus, after establishing the link between funding conditions and bank flows, we study the impact of changes in funding availability in the main financial centers on house prices around the world over the period 1999 to 2012 for a representative group of advanced and emerging markets. We then extend our analysis to consider potential policies, which might mitigate the impact of global liquidity, proxied by funding conditions on house prices.

We are making the following contributions to the literature. First, we introduce a new proxy for global liquidity that captures shifts in funding availability to financial intermediaries measured by the aggregate amount of repos.[1] The impact of funding on the real economy has also been investigated by Chudik and Fratzscher (2011) and Cesa-Bianchi, Cespedes, and Rebucci (2015), but they use financing costs and proxy it by the US TED spread. Chudik and Fratzscher (2011) concentrate on the impact of financing costs on stock market prices during the global financial crisis, while Cesa-Bianchi et al. (2015) use a longer time framework and focus on the macroeconomy and on house prices. However, as Figure 2 shows, funding costs have been extraordinarily high during

[1]Funding liquidity has been measured by repos in other works in different contexts e.g Banti and Phylaktis (2015); Mancini Griffoli and Ranaldo (2011); Adrian, Etula, and Shin (2010); Coffey and Hrung (2009).

the recent financial crisis, making the variable more a proxy for the crisis episode than a measure of funding liquidity over time. In this respect, we consider the pattern of funding aggregates to capture more closely the evolution of funding availability through time. We do however explore the impact of funding costs in our analysis, by introducing it as an interactive variable with funding aggregates. Moreover, the amount outstanding of repos is a comprehensive measure of funding conditions that captures also developments in market conditions, given the presence of collateral. Our proxy is related to the bank leverage measure proposed by Bruno and Shin (2015), as it measures one of the main sources of financing by financial institutions. However, it is specific to the availability of funding for investments to the key players in the markets. In addition to an important source of wholesale funding for banks (IMF, 2015), other important financial institutions, such as hedge funds and real estate investment trusts, rely on repos to finance their operations (Baklanova et al., 2015). Furthemore, our proxy is exogenous to our sample of countries and thus does not present endogeneity issues in our modelling. In fact, the dynamics of funding markets in the main financial systems are unaffected by changes in the economic and financial conditions of local economies. Secondly, we extend previous work by focusing on the international aspect of global liquidity and consider changes in funding conditions not only in the US, but in other major financial systems, UK, Europe, and Japan (Cerutti, Claessens, and Ratnovski, 2014). By taking this international perspective, we establish not only the effects of global liquidity, but also where this liquidity has originated. Thirdly, we do not treat the emerging markets as one homogeneous group. As Kuttner (2015) notes in his discussion of the Cesa-Bianchi et al. (2015) study there are differences in the relationship between global liquidity and house prices amongst emerging markets. The relationship appears to be much tighter for the transition economies of Eastern and Central Europe compared to Asia and Latin America during the 2000-2012 period. Thus, the results of Cesa-Bianchi et al. (2015) on emerging markets might have been driven by what was going on in the Eastern and Central European economies. Forth, we compare the relative importance of global liquidity versus domestic monetary policy through variations in domestic short-term interest rates on house price developments. Although we have found global liquidity to impact on house prices, the question arises whether it is sufficiently large to weaken the effectiveness of domestic monetary policy in the presence of increased global liquidity. Finally, we consider the characteristics of countries to identify potential policies that can make them less vulnerable to the transmission of global liquidity shocks.

To determine that the funding liquidity variable provides a good representation of global liquid-

ity, we first document that it is positively related to cross-border bank flows. Using panel modelling on a sample of 26 countries, which includes both advanced and emerging economies and focusing on the period 1999 to 2012 due to data availability, we show that the impact of funding conditions on different regions depends greatly on where it came from. While bank flows to advanced economies are affected by global liquidity irrespective of their origin, emerging markets present stronger regional linkages. Importantly, this is reflected in the exposure of local house prices to global liquidity. Employing a panel vector autoregression (PVAR), we document that global liquidity triggers house price movements around the world, in line with previous findings (Darius and Radde, 2010; Tillmann, 2013; Cesa-Bianchi et al., 2015). Our analysis adds insights on this linkage. Indeed, we find that house prices in advanced economies react to liquidity shocks irrespective of its origin. Emerging markets present more regional linkages, with emerging American and European house prices affected by liquidity shocks from the US and Europe (including UK), and Asian house prices affected by liquidity shocks from Japan. Using impulse response analysis we explore whether the local banking sector channels these shifts on to the local housing market. We find evidence that bank flows are a transmission mechanism when shocks are transmitted to emerging markets. Conversely, the impact on house prices of liquidity shocks in advanced economies does not appear to be generally related to banks. We find evidence however that major investors in real estate, such as real estate investment trusts act as a channel of liquidity shocks to the housing market of these advanced economies.

Moreover, local governments can use monetary policy, in the form of interest rate changes to offset the global liquidity impact on house prices in advanced economies, whereas they attenuate the impact in emerging markets. This liquidity effect on house prices is also associated to other policies and country characteristics, such as bank regulation and supervision, and institution quality. Indeed, greater bank regulation, as well as exchange rate flexibility reduce the impact of liquidity shocks on local house prices, but better institution quality increases it. Also, we find that restrictions to non-resident investments in the local real estate sector are successful in mitigating the reactions of house prices to liquidity shocks. These findings have policy implications for countries, which would like to limit their exposure to global liquidity.

In the next section we review the related literature. In section 3, we describe the data and provide some preliminary analysis. We present the empirical analysis of the relationship between funding liquidity and cross-border bank flows in section 4. The empirical analysis of the impact of changes in funding liquidity on house prices is reported in section 5. Section 6 investigates the

impact of domestic monetary policy on house prices and compares its impact to global liquidity, while section 7 investigates the role of country characteristics and policies, which make a country more vulnerable to global liquidity. Section 8 reports some robustness tests. Finally, section 9 concludes and reports some policy implications.

2 Literature Review

Our work draws from two strands of literature, the measurement of global liquidity and its transmission, and the impact of global liquidity on house prices.[2]

Starting with Baks and Kramer (1999), global liquidity has been measured by money created in the main financial centers. The rationale is that money created in excess of the GDP growth, will flow abroad to other financial systems and affect credit conditions in the recipient countries.

The recent interest in global liquidity led to the development of a more precise definition and global liquidity has been associated with banks' financing conditions across borders (Domanski, Fender, and McGuire, 2011; Eickmeier, Gambacorta, and Hofmann, 2014). Given that monetary aggregates fail to capture this cross-country bank flows, several works measure global liquidity by employing credit aggregates. For instance, the BIS recently proposed its own indicators based on cross-border bank debt flows (BIS, 2013).

Shin (2012) shows that permissive financing conditions are transmitted globally via cross-border banking and global banks leverage. In their model of the international banking system, Bruno and Shin (2015) contend that bank flows are affected by changes in the leverage of global banks. This implies that financing conditions in the main financial systems are transmitted across borders to the local banking sector. In particular, changes in the size and leverage of systemically important banks are the key push factors of bank flows. In the empirical application, Bruno and Shin (2015) measure the changes in financing conditions by the leverage of US dealers. Departing from a US-based approach, Cerutti et al. (2014) show that financing conditions originating in Europe, UK, and Japan in addition to the US are determinants of cross-border bank debt. They consider global factors and include a measure of uncertainty in the global financial markets, such as the VIX, and the US TED spread in addition to bank leverage as measures of financing conditions. They also document a role for local country factors on the extent to which global conditions affect cross-

[2]The literature on house prices is vast. In this review we focus on the strand of the literature that studies house price dynamics in the context of global liquidity, which is relevant for our work. See Agnello and Schuknecht (2009), Duca, Muellbauer, and Murphy (2010) and Favilukis, Kohn, Ludvigson, and Van Nieuwerburgh (2011) for more general recent reviews on the determinants of house prices.

border bank flows. Finally, the importance of funding considerations is documented in Cetorelli and Goldberg (2011). Employing a difference-in-difference approach, they study the shock transmission mechanism from banks in advanced to banks in emerging countries. They find the main transmission mechanism to be the funding channel to the banks in emerging countries as opposed to the cross-border direct lending or local lending by foreign banks' subsidiaries. Investigating the effect on Peruvian banks of Russia's 1998 default, Schnabl (2012) document that foreign lending amplifies external shocks while foreign ownership mitigates them. In the light of this literature, we focus on funding aggregate measures in the main financial centers to capture the global liquidity conditions impact on cross-border bank flows.

The literature on the impact of global liquidity on the housing market is very limited. Focusing on a panel of Asian countries, Tillmann (2013) find an overall positive effect of capital flows on house prices, which is however different across countries. Empirical work on the relationship between monetary liquidity and house prices provide mixed evidence. While Darius and Radde (2010) and Belke, Orth, and Setzer (2010) document for the G7 and the OECD countries respectively a positive impact of liquidity on house prices, only a limited effect is found in Brana, Djigbenou, and Prat (2012) for a group of emerging markets.

Using a broader sample of countries, which includes both advanced and emerging economies, and focusing on funding costs, such as the US TED spread, Cesa-Bianchi et al. (2015) investigate the effect of global liquidity on the macroeconomy and the housing market. Applying a panel VAR framework for the period 1990-2012, they document a stronger impact of cross-border bank flows on house prices in emerging compared to advanced markets. To identify the effect of global liquidity, they employ a US-based set of instruments related to global factors, including the TED spread and VIX. Similarly to the above works, we investigate the reaction of house prices to liquidity in a panel VAR setting of 26 countries, which includes both advanced and emerging economies, but extend the work in several dimensions as explained earlier.

3 Data

In this section, we introduce the data used to measure our key variables, such as global liquidity, bank flows and house prices.

3.1 Measuring global liquidity with repurchase agreements

Global liquidity is generally defined as the easing of financing conditions across borders (BIS, 2013). To abstract from the demand-side considerations of credit creation, global liquidity has

been identified as shifts in the supply of financing and measured with supply-side factors, such as the VIX, the US TED spread and bank leverage measures (Chudik and Fratzscher, 2011; Shin, 2012; Cerutti et al., 2014; Bruno and Shin, 2015; Cesa-Bianchi et al., 2015). In line with this literature, we focus on supply factors and introduce a new measure to capture the availabiliy of funding to financial institutions to measure global liquidity. Differently to previous work on liquidity and asset prices, we measure liquidity created not only in the US, but in the UK, Europe and Japan as well, and we consider each system independently to determine where global liquidity has originated (Cerutti et al., 2014). Moreover, we employ funding aggregates in addition to costs to consider funding liquidity evolution. In fact, funding costs may be low but funding may be generally rationed and only available to most creditworthy parties (Figure 2). Thus, we consider funding aggregates to capture more accurately the evolution of funding availability through time. To gather information on both aspects of funding conditions, we do include funding costs in our analysis, as an interactive variable with funding aggregates.[3] Finally, among the sources of financing, we focus on repos, which are a major source of wholesale financing for financial institutions (IMF, 2015). In addition to its relative importance, this measure is able to capture the complexity of funding. Indeed, repos are collateralized debt instruments. As such, their availability is not only affected by conditions on the funding markets, but also by the market conditions that influence the evaluation and riskiness of collateral assets.

During the recent financial crisis, funding markets have experienced severe distress. While unsecured interbank financing halted after Lehman Brothers bankruptcy and returned to be available only to the most creditworthy counterparties after AIG bailout, severe uncertainty in the future value of collateral led to a near collapse of the repo market in the US (Krishnamurthy, 2010; Afonso, Kovner, and Schoar, 2011; Gorton and Metrick, 2012). As future expected volatility of the collateral value increased, Gorton and Metrick (2012) show that haircuts raised and the range of assets accepted as collateral was limited to the safest ones. In addition, after Lehman Brothers collapse, transaction volume fell sharply, as agents engaged in large deleveraging and reduced their demand for funding (Adrian and Shin, 2010; Krishnamurthy, 2010). Most recently, the IMF's Global Financial Stability Report has highlighted the vulnerabilities to financial stability posed by the current developments in the bond markets and their impact on collateralized lending (IMF, 2015). By

[3] An additional piece of information would be represented by the maturity of funding available (Banti and Phylaktis, 2015). In time of distress longer term financing is the most affected. However, we do not include this in our analysis as data on maturity is only available for the US.

employing the amount outstanding of repos, we aim to consider both the funding and market components of global liquidity. Given the presence of collateral our measure captures developments in market conditions as well as financing.

Data on repos is available from the relevant Central Banks' websites in domestic currency and converted in USD with the IFS monthly exchange rates. In detail, US data on bilateral repos is reported weekly by primary dealers to the Federal Reserve Bank of New York. Data on the repo positions of monetary and financial institutions in the UK is reported monthly by the Bank of England. Monthly data on repos of credit institutions in the Euro Area is available from the European Central Bank. Finally, Japanese monthly payables under repos in the balance sheet of domestically licensed banks are available from the Bank of Japan. Furthermore, we employ the Libor-OIS spread as a proxy for the cost of funding, as it is highly correlated with the repo rate with Treasuries as collateral in the US (Gorton and Metrick, 2012). The spread is the difference between 3-month Libor rate and the Overnight Interest Swap for the US dollar, Euro, British pound and Japanese yen. Data is collected from Datastream. The sample period starts in January 1999.

Table 1 (Panel a) reports the descriptive statistics of the repo data. The US repo market is the largest, with an average amount outstanding of over $2tn, followed by the European repo market with $1.3tn. The amount outstanding in the UK market is around $200bn, while the Japanese one is $78bn. The repo markets in the US, EU, and UK exhibit very strong comovement, with correlation coefficients between amounts outstanding of over 70%. The Japanese repo market is highly correlated to the EU and UK markets, at over 50%. Conversely, the correlation between Japanese and US repos is low at 2%.

3.2 Cross-border bank flows

To measure bank flows, we employ the BIS locational banking statistics that report the quarterly cross-border bank debt positions. These are bank foreign claims in all currencies from all reporting countries versus bank counterparties in the local economies. The sample includes both advanced and emerging countries and the choice is determined by the availability of data for both bank flows and house prices. Following Chudik and Fratzscher (2011), advanced countries include Denmark, Norway, Sweden, Switzerland, New Zealand, Australia and Canada. The emerging market subsample comprises countries from Asia, Europe and the Americas. For Asia, the sample includes Hong Kong, Indonesia, Philippines, Singapore, Thailand, Malaysia and China. Emerging Europe includes Czech Republic, Hungary, Poland, Russia, together with South Africa and Israel. Finally,

the Americas include Chile, Argentina, Mexico, Colombia, Peru, and Brazil. All series are deflated with the US CPI.

Graphical analysis in Figure 3 shows that cross-border bank flows share a common trend with funding liquidity, especially in the drop following the recent financial crisis. Moreover, Table 1 (Panel b) reports the descriptive statistics of the data. The largest bank's cross-border claims are in advanced economies, with a quarterly average of $10.8bn over the sample period, whereas emerging markets have average quarterly claims of $8.8bn. Similarly, average changes in cross-border bank claims are around 1.6% in advanced economies. While nearly half than in advanced economies, changes in cross-border claims of emerging markets exhibit marginally less variability.

In a preliminary exercise, we test whether changes to our repo measures affect cross-border bank flows. This exercise is conducted at monthly frequency to better capture the dynamics of global liquidity. As a proxy for bank flows at this higher frequency, we employ the monthly changes in local banks' foreign liabilities from the International Financial Statistics (IFS). Comparing these series with the BIS measures at quarterly frequency, we find them to be highly correlated. However, we check the robustness of our main results relating to the impact of funding liquidity on house prices using this alternative series of bank flows in section 8.

3.3 House price data

To measure house prices for the sample of countries described above we employ the dataset by Cesa-Bianchi et al. (2015). Residential house price data is available at quarterly frequency until 2012 and collected from a variety of sources, such as local Statistics Offices, Central Banks, and the BIS.

Table 1 (Panel c) reports some descriptive statistics of house prices. The average quarterly change in house prices for the period is around 0.6%. In contrast to bank flows, house prices in emerging markets exhibit stronger variation than in advanced ones.

4 Are funding liquidity conditions relevant for cross-border flows?

In the first step of our empirical analysis, we consider whether our funding liquidity measure captures global liquidity and we estimate the effect of shifts in liquidity conditions in the main financial systems on cross-border bank flows.

We estimate a panel model of monthly bank flows in each country on changes in funding liquidity conditions. We consider each main financial system independently to determine whether

global liquidity originating in different centers impacts differently, and run the following models:

$$\Delta Bank_{i,t} = \beta \Delta Fund_t^s + \delta Vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t \qquad s = [US, UK, EU, JP], \tag{1}$$

where $Bank_{i,t}$ are banks' foreign liabilities in country i in month t in logs, $Fund_t$ is the outstanding amount of repurchase agreements in the US, UK, EU and JP respectively in month t in logs, Vix_t is a measure of financial market uncertainty (to account for the strong real effect of risk appetite documented in Chudik and Fratzscher (2011)), M_t is broad money in the US, UK, EU and JP respectively in month t in logs (to account for the role of money creation on liquidity), and γ_i are country fixed effects. Δ indicates changes. Standard errors are clustered at the country level.

Furthermore, we allow for an asymmetric impact of increases and decreases in funding liquidity:

$$\begin{aligned}\Delta Bank_{i,t} = \beta_1(\Delta Fund_t^s * d_t^{s,+}) + \beta_2(\Delta Fund_t^s * d_t^{s,-}) + \delta Vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t \\ s = [US, UK, EU, JP],\end{aligned} \tag{2}$$

where $d^{s,+}$ is a dummy that takes the value of 1 when funding availability in the US, UK, EU and JP respectively increases, and 0 otherwise and $d^{s,-}$ takes the value of 1 when funding decreases, and 0 otherwise. Moreover, to capture the full extent of funding liquidity moves, we consider funding costs and interact our funding variable with a dummy for increases and decreases in the cost of financing. To do so, we estimate the above model (2), where $d^{s,+}$ is a dummy that takes the value of 1 when funding costs in US, UK, EU and JP respectively increase, and 0 otherwise and $d^{s,-}$ takes the value of 1 when funding costs decrease, and 0 otherwise.

Table 2 reports the results for the whole sample of countries in Panel a. Bank flows are positively related to changes in funding liquidity conditions in the US, EU and marginally in the UK. Thus, when liquidity conditions in the main nancial systems improve, which represent increases in global liquidity, enables local banks to increase their foreign debt. Investigating the relationship further, we find that while US and EU are significant when liquidity increases, JP and UK funding are relevant when it is declining. Moreover, the impact of US liquidity conditions is associated with periods of increasing funding costs. The VIX is negative and significant in all the models, as increasing uncertainty in the main financial centers is associated with lower bank flows. For the monetary aggregates, EU monetary aggregates exhibit a negative relationship with bank flows. These findings confirm the evidence provided in Cerutti et al. (2014) that other financial systems in addition to the US are responsible for the creation of global liquidity.

Our sample contains a variety of countries at different stages of economic and financial development. For this reason, we further investigate the impact of global liquidity by dividing our sample

into advanced and emerging countries and estimating equations (1) and (2) for the two subsamples separately.

Table 2 reports the results for advanced and emerging markets in Panels b and c respectively. The findings confirm the role of US and EU funding liquidity conditions, whose changes strongly affect bank flows in both advanced and emerging countries. Changes in liquidity conditions in other financial systems affect banks differently in different sub-samples. Indeed, bank flows in advanced economies are positively related to UK funding availability, whereas bank flows in emerging economies decline with increasing UK liquidity. Also, declines and increases in Japanese liquidity are related to decreasing bank flows. This effect is stronger when funding costs decline. In emerging markets, declines in JP funding are associated with less bank flows.

To offer further insights on the role of global liquidity on emerging markets, we look at individual regions and conduct the analysis for countries in Asia, Europe and the Americas separately. The evidence presented in Table 3 is rather diverse. In Panel a, Asian bank flows are strongly related to Japanese funding liquidity, especially when declining and in periods of increasing funding costs. Also, we find that liquidity in the US affects Asian banks in periods of increasing costs. In Panel b, banks in emerging Europe are affected by EU and Japanese funding available when funding costs increase. Finally, in Panel c, emerging American banks are affected by changes in liquidity conditions in the US, EU and marginally the UK.

In conclusion, there is evidence of a strong impact of liquidity, proxied by funding aggregates and generated in systemically important financial systems on the banking sector of all sub-samples of countries. Overall, we find that banking flows in advanced countries are related to liquidity generated across the main financial systems, while in emerging markets they have more specific linkages.

5 Do funding liquidity conditions affect house prices?

In this section, we investigate whether shocks in funding conditions in the major financial centers have an impact on house prices. Having documented that shifts in funding conditions abroad affect flows into the local banking sectors, we now explore whether the local banking sector channels these shifts on to the local housing market.

Thus, we estimate a PVAR model of funding liquidity and house prices, including domestic variables such as bank flows, real GDP growth, and short term interest rates as proxies for local

demand factors for housing, and global variables such as the VIX, as follows:

$$X^s_{i,q} = \sum_{n=1}^{N} \beta_i X^s_{i,q-n} + \epsilon_{i,q} \qquad s = [US, UK, EU, JP], \tag{3}$$

where $X^s_{i,q} = [Fund^s_q, Vix_q, Bank_{i,q}, Gdp_{i,q}, Sr_{i,q}, Price_{i,q}]$, $Price$ are house prices in country i, Sr is the short term interest rate in country i, and Gdp is real GDP growth in country i. All variables except for Gdp and Sr are in logs. We determine the number of lags n with the Schwarz criterion and it ranges between 1 to 2 lags.

We focus separately on the impact of one standard deviation shock on funding liquidity in each of the main financial centers on the local house prices across the main regional groups of our sample of countries. To avoid imposing restrictions on the slope coefficients of house prices across various countries, we employ the mean group estimator of Pesaran and Smith (1995). In essence, this is a dynamic panel estimation approach that allows for full country heterogeneity. Thus, we estimate a VAR for each country individually via OLS and estimate the impulse response functions by employing the Cholesky decomposition of the covariance matrix of the VAR residuals. Since we consider funding conditions in the main financial systems to be exogenous to domestic conditions and local house prices, we order our funding variables first in all the VARs. Moreover, we put house prices last in the order to allow for bank flows, short-term interest rates and GDP growth to impact house prices. We measure the average effect of the shock across countries by averaging cross-country responses at each forecasting horizon, excluding the top and bottom 1%. The standard errors of such measures are calculated as the cross-country variance of the responses at each forecasting horizon, divided by the number of countries minus one (Pesaran and Smith, 1995).

Figure 4 (Panel a) reports the impulse response functions (IRFs) of house prices to shocks in funding liquidity. Focusing on US liquidity conditions in the first row, the reactions in house prices to liquidity shocks are stronger for the advanced economies. This confirms the results of (Cesa-Bianchi et al., 2015), who employ US based set of instruments related to global liquidity. Among the emerging markets, house prices in emerging Europe and the Americas react positively to US liquidity shocks. If one looks at the impact of EU and UK liquidity we find that liquidity impacts much less in advanced economies than emerging markets. This brings out the differential impact of global liquidity originating in other financial centers and the importance of considering the origin of global liquidity. UK and EU liquidity shocks affect house prices in both advanced and emerging housing markets, especially in emerging Europe and the Americas. Finally, Japanese liquidity

shocks result in higher house prices in emerging Asia in the short-run. In general, the liquidity impact is not immediate for the advanced economies, whereas it is instantaneous for emerging markets. Moreover, the impact of liquidity shocks on emerging markets is relatively less persistent and lasts generally around 16 quarters before turning insignificant.

In conclusion, we document a strong impact of liquidity shocks on house prices in advanced economies irrespective of its origin. For emerging markets, the origin is instead very important. Regional linkages are evident in our results, as European and Asian housing markets are affected by liquidity originating in Europe (including the UK) and Japan, respectively. Nevertheless, we do also find some more global impact. Indeed, liquidity shocks in the US affect house prices in both emerging Europe and the Americas.

5.1 The role of transmission channels

In this section, we explore the role of banks and other financial institutions in the exposure of local housing markets to unexpected shifts in global liquidity conditions.

Bank channel:

In order to identify the role of the banking sector on the transmission of shocks from funding abroad on local house prices, we estimate the PVAR in equation (3) above with muted bank flows in the house price equation. That is, we first estimate the PVAR and we then impose null coefficient of bank flows in the house price equation to estimate the impulse responses. We then compare the responses of house prices to liquidity shocks in the baseline model and in the model with muted bank flows. If banks do mediate the impact of liquidity shocks on house prices, the impact should be reduced, or cancelled, when bank flows do not affect house prices.

In Figure 4 Panel (b), we report the responses of house prices to funding liquidity shocks when bank flows are muted in the house price equation of the PVAR. Looking first at US liquidity shocks and comparing these responses with the ones of the baseline model in Panel (a), we find evidence of a bank channel in emerging markets, but not in advanced economies, as the responses in the latter are still positive and significant while in the former turn insignificant in Panel (b). Among emerging markets, the bank channel is evident in the Americas, as the positive and significant reactions in Panel a turn insignificant in Panel b. Moreover, we find that banks channel part of the impact of liquidity from Europe (including UK) and Japan on house prices in emerging Europe and Asia, respectively. In fact, while still significant, the impacts are reduced when bank flows are muted in Panel b. Indeed, the differences between the responses in the two panels are statistically

significant.

In conclusion, we show that bank flows are relevant channels for the transmission of liquidity shocks to house prices in emerging markets.

Financial channel:

Banks are not the only potential channel. In fact, institutional investors that are important international players, such as hedge funds and real estate investment trusts (reits) are affected by shifts in funding liquidity in the main financial systems (Baklanova et al., 2015). If these international investors participate in local real estate sectors by investing in stocks of firms operating in the property sectors, then funding shocks abroad may be transmitted to local house prices via the financial market. We measure the impact of these investors on house prices by employing the General Index from Global Property Research (GPR) that is the stock price index of all listed real estate companies with a market capitalization in excess of 50 mil$ and over 75% of operations in the property sector. The data coverage is not complete for our full sample, and it excludes Hungary, Poland and Chile. Moreover, due to the limited number of time-series observations, we drop Brazil, China, Czech Republic, Denmark, Israel, Mexico, and Russia. Thus, as a result of the limited cross-sectional dimension, we cannot estimate reliable responses and confidence bands for the emerging market subsamples and for this reason, we limit the analysis in this section to the advanced and emerging groups. We build our quarterly series by taking the average in the quarter.

To identify this transmission channel, we include the real estate index ($Index_{i,q}$) in country i into our model and estimate equation (3) above with $X^s_{i,q} = [Fund^s_q, vix_q, Index_{i,q}, Gdp_{i,q}, Sr_{i,q}, Price_{i,q}]$. Similarly to the analysis for the bank channel, we then compare the responses of house prices to liquidity shocks in the baseline model and in the model with muted financial market in the house price equation.

As shown in Figure 5, the financial market is an important transmission channel for liquidity shocks to house prices in advanced economies.[4] In fact, the positive and significant responses in the baseline model (Panel a) turn insignificant when the financial market channel is muted (Panel

[4]The insignificant impact of liquidity on the house prices in EMs could be due to the absence of bank flows in the model and to the fact that many of our emerging markets could not be included in this exercise due to the unavailability of data. As the countries comprising the advanced group has not changed between the examinations of the two transmission channels the impact of funding liquidity on house prices in advanced economies remains the same, as expected. Also, the absence of bank flows does not alter the results since bank flows are not a channel for funding shocks on house prices in advanced economies.

b). This is true for all funding liquidity shocks, with the exception of the UK.

6 Impact of domestic monetary policy on house prices

Having found that global liquidity proxied by funding liquidity affects house prices, we go on to investigate whether the monetary authorities can use monetary policy by changing short-term interest rates to offset its impact.[5] In the first instance, we investigate the impact of shocks to domestic monetary policy on local housing markets, and consider the effect of a shock on domestic short-term interest rates on house prices. Thus, using the VAR estimation of equation (3) we focus on the impact of one standard deviation shock of the domestic short-term interest rates on local house prices.

As expected irrespective of the origin of global liquidity, there is a general negative reaction of house prices in advanced and emerging markets to shocks in domestic monetary policy. Results are not presented but can be made available by the authors on request.

6.1 Forecast error variance decomposition

Having documented that domestic monetary policy through variations in domestic interest rates has a negative impact on house prices, we perform forecast error variance decomposition to assess the relative role of global liquidity versus domestic monetary policy on house price developments. In particular, we compute the contribution of shocks to global liquidity and domestic short-term rates to the forecast error variance of house prices for VAR models estimated for each country in the sample as reported in equation (3). We employ recursive re-formulation of the VAR model and use the Cholesky decomposition to achieve orthogonal structural shocks.

Although we have found global liquidity to impact on house prices, the question arises whether it is sufficiently large to weaken the effectiveness of domestic monetary policy in the presence of increased global liquidity. An unanticipated increase in short term domestic interest rates constitutes a contractionary monetary policy, which has been found as expected to have a dampening effect on house prices. On the other hand an increase in global liquidity has a positive impact on house prices.

In this exercise we present results in a more aggregated form. We present results for aggregated liquidity, without distinguishing where liquidity has originated. We do not present results for each country separately, we average the country results for each group. Table 4 shows the percentage of the total forecast error variance of house prices at horizons of n={1,4,8,16,20} quarters that can

[5]For a detailed analysis of the impact of monetary policy on house prices see Sa, Towbin, and Wieladek (2011).

be ascribed to global funding and to domestic interest rate shocks. The variance decomposition reveals a different pattern for advanced and emerging markets. For the advanced economies 14% of the forecast error variance 20 quarters ahead can be ascribed to global liquidity shocks and 21% to domestic monetary policy shocks. That implies that monetary policy is quite effective in advanced markets in moderating the impact on house prices arising from global liquidity. This finding is in line with the results of Darius and Radde (2010), who using a monetary aggregate definition of global liquidity find that liquidity lost completely predictive power of asset prices, including house prices in the G7 countries during the 2000s. Their explanation is that this is due to the expansionary monetary policies, which played a much greater role than global factors in house price developments.

Looking now at emerging markets 21% of the forecast error variance 20 quarters ahead can be ascribed to global liquidity shocks and 11% to domestic monetary policy shocks, that is monetary policy is effective, but less so than in advanced countries. This is more or less the same in all emerging market regional groups. Moreover, the impact of global liquidity shocks lingers on and in fact increases as time goes by in all groups.

7 The role of country characteristics and policies

Having found that global liquidity affects house prices, we investigate whether some countries are more vulnerable than others by looking at certain country characteristics and policies, which may affect the exposure of house prices to external funding liquidity shocks. Thus, we follow the insights in Cerutti et al. (2014), who investigated country characteristics. We divide the full sample of countries according to the following characteristics and policies: the regulatory environment of the local banking system, the general quality of the institutions, the flexibility of the exchange rate, capital account openness, and controls on real estate purchases and sales by foreign investors. For each characteristic we estimate the VAR model in (3) with funding liquidity and house prices as well as the other variables, as outlined in section 5. We then aggregate the responses of house prices to liquidity shocks across countries that have more or less of the characteristic than the cross-country median, individually. By examining the difference in the IRFs from those above to those below the characteristic, we can determine whether the characteristic is an important determinant of the exposure of the housing markets to global liquidity. The results are presented in Figure 6. We take each characteristic in turn below and we assess the impact by its size and persistence:

The regulatory environment of the local banking sector: Focusing on the regulatory environment

of the local banking sector, we assess how its strength affects the exposure of house prices to liquidity shocks. We measure the strength of bank regulation by the strength of capital adequacy requirements and by the strength of supervisory power as developed by Barth, Caprio, and Levine (2013) based on World Bank survey data. Relevant survey questions relate to information on capital requirements ($init\_cap\_strin$) and power of the supervisory agencies (Sup_Power). The results show that house prices in countries with more stringent capital requirements are less strongly affected by shocks in liquidity conditions. In more detail, the responses of countries with less stringent regulation (Panel b) are more persistent, and last over the 20 quarters, than the responses of countries with more stringent regulation (Panel a). This confirms the results of other studies, which have found that for Central and Eastern European economies, certain macro prudential policies including capital adequacy ratios influence house price inflation (Vandenbussche, Vogel, and Detragiache, 2015).

The general quality of the institutions in the countries: We measure the institutions quality with the index of economic freedom constructed by the Heritage Foundation.[6] The index takes into considerations several factors that affect the quality of countries' institutions including property rights, freedom from corruption, monetary freedom, trade freedom, investment freedom, and financial freedom. The results show that countries with better institutions, attract more capital and thus, are more exposed to liquidity shocks. In more detail, the responses of countries with better institutions (Panel a) are statistically significant and persistent, whereas the responses of countries with worst institutions (Panel b) are not.

Flexibility of the exchange rate arrangements: We focus on the flexibility of the exchange rate arrangements as a potential shield from external shocks on the local economies. Following Shambaugh (2004), we calculate a monthly dummy that takes the value of 1 if the exchange rate of the currency versus the reference base (US$ or EUR) stays within a +/-2% band in a year, and 0 otherwise. We find that more flexible exchange rates reduce the impact of global liquidity on house prices. In more detail, the responses of countries with less flexible exchange rates (Panel b) are statistically significant and persistent, whereas the responses of countries with more flexible exchange rates (Panel a) are not. Exchange rate flexibility induces a risk premium, which may discourage capital inflows.

Capital account openness: We turn to the openness of the capital account of the countries, measured by the KAOPEN index (Ito and Chinn, 2006). The index is normalized to take values between

[6]The Heritage Foundation data is available at http://www.heritage.org/index/.

0 and 1 and it is the first principal component of proxies for regulatory controls of both current and capital account transactions, for the existence of multiple exchange rates, and for requirements on export proceeds. Higher values indicate greater openness. The results are inconclusive. This could be due to the fact that the index is too general covering restrictions on both the current and capital accounts. Thus we next investigated the impact of controls more specific to the housing market and focused on the restrictions to the purchase and sale of real estate by non-residents.

Controls on real estate purchases and sales by foreign investors: This is measured by a dummy that takes the value of 1 if restrictions are present and 0 otherwise, as developed by Fernández, Klein, Rebucci, Schindler, and Uribe (2015). The results show that only house prices in countries with less restrictions are affected by global liquidity. In more detail, the responses of countries with less controls (Panel b) are statistically significant and persistent, whereas the responses of countries with more controls (Panel a) are not.

Bearing in mind that the various policies may be correlated, and in order to provide further support to our inferences above, we estimate a cross-sectional regression of the cumulated impact of funding liquidity on house prices from equation (3) on the country characteristics above, and run the following regression:

$$Impact_i^s = \beta X_i + \epsilon_i \qquad s = [US, UK, EU, JP], \tag{4}$$

where $Impact_i$ is the 20-quarter cumulated impact of funding liquidity on house prices for country i from equation (3), and X_i is a vector containing the strength of capital regulation, quality of institutions, exchange rate flexibility, capital account openness, and controls on real estate investment for country i, averaged across the sample period.

The results are reported in Table 5 for the aggregated liquidity as well as for liquidity in each financial centre separately and generally confirm the findings above. In particular, stronger capital regulation in the form of more stringent capital adequacy ratios reduces the impact of global liquidity on house prices in the case of US liquidity, whereas the impact is greater for countries with better institution quality. The effect of exchange rate flexibility documented above is reduced when other country characteristics are taken into account. House prices in countries with less open capital account are more affected by global liquidity, which is contrary to our expectations. This could be the case because when countries open their capital account, capital flows if institutional quality is high (Ito and Chinn, 2006).[7] Finally, controls to real estate investment by foreigners

[7]This is confirmed when we divide the sample into two groups, those above the median for institutional quality

reduce this exposure significantly, as documented above.

In conclusion, we document that in addition to the banking and financial channels explored in section 5, country characteristics and policies are important determinants of the exposure of housing markets to global liquidity. In particular, we show that stronger bank regulation and more restricted foreign investment in the local real estate sector reduce the impact of liquidity shocks on house prices.

8 Robustness tests

8.1 The role of banking channel with an alternative measure of bank flows

In the main analysis we measure bank flows as the claims of banks versus foreign banks from the BIS. In this section we conduct a robustness test of the analysis of the role of banking channel on the transmission of liquidity shocks to house prices by employing the foreign liabilities of local banks from the IMF.[8]

The results of the analysis of the banking channels are presented in Figure 7. We confirm the main results in section 5. Indeed, we find that banks transmit the liquidity shock in emerging markets.

8.2 The recent financial crisis

As the crisis period may have affected several behavioral relationships, we investigate whether the our VAR estimation is robust to the crisis episode, and check for breaks in the VAR during the crisis. To do so, we conduct the Chow F-test for the significance of a dummy variable for the crisis episode that takes the value of 1 for the period from 2007Q1 to 2008Q4, and 0 otherwise. We estimate the VAR model in equation (3) for each country in our sample under two alternative specifications: an unrestricted model including the dummy for the crisis period and a restricted model where all coefficients of the dummy are set to zero. We test the null hypothesis that the dummy variable coefficients are zero in all VAR equations, so that the restricted model is better than the unrestricted model. We find that we cannot reject the null for the majority of countries (over 60% of the sample, and within this 40% are advanced and 60% are emerging countries) at the 5% significance level. Thus, we conclude that the crisis did not cause a structural break in our VAR model.

and those below and run equation (4) with the capital account openness as an independent variable. We find a positive impact in the first group and an insignificant impact in the second group.

[8] We find that the IFS data at quarterly frequency and the BIS data are highly correlated.

9 Conclusion

The paper investigates the impact of global liquidity on house prices around the world. We introduce a new measure of global liquidity, which focuses on the private component of liquidity on the major wholesale funding markets for financial intermediaries, that is the repurchase agreement (repo) market not only in the US, but also in the UK, Europe and Japan. Changes in the availability of financing in the main financial systems may affect house prices via the funding channel that transmits global conditions into the local banking sector through bank flows. Thus, after establishing the link between funding conditions and bank flows, we study the impact of changes in funding availability in the main financial centers on house prices around the world from 1999 to 2012 for a representative group of advanced and emerging markets.

In line with previous findings we document that global liquidity triggers house price movements around the world (Darius and Radde, 2010; Tillmann, 2013; Cesa-Bianchi et al., 2015). However, our analysis adds insights on this linkage. Indeed, we find that the effect does not only originate from the US, but also from the other systematically important financial systems. We find that house prices in advanced countries react to liquidity shocks irrespective of their origin. Emerging markets present however more regional linkages, with house prices in emerging Americas and Europe affected by liquidity shocks in the US and Europe (including UK), and Asian house prices affected by liquidity shocks in Japan. Furthermore, we find evidence that bank flows are a transmission mechanism for liquidity shocks to the local housing markets, when shocks are transmitted to emerging markets. Conversely, the impact on house prices of liquidity shocks in advanced countries does not appear to be generally related to banks. Since other important financial market players, such as hedge funds and real estate investment trusts, rely on repos to finance their operations, we show that investment trusts are an important transmission channel for liquidity shocks to house prices in advanced economies.

Although we have found global liquidity to impact house prices, we have also established, that governments in both advanced and emerging markets can use monetary policy to offset part of that impact. Furthermore, governments can implement more stringent bank regulation and more flexible exchange rates to reduce the impact of liquidity shocks on local house prices. They can also adopt focused restrictions to non-resident investments in the local real estate sector, which have been found to be effective in limiting the liquidity impact on house prices.

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Appendix

Table 1A: Description of the variables included in the analysis

Variables	Data source
Amount outstanding of repos in the US	Federal Reserve Bank of New York
Amount outstanding of repos in the UK	Bank of England
Amount outstanding of repos in EU	European Central Bank
Amount outstanding of repos in Japan.	Bank of Japan
VIX	CBOE
M3 in the US, UK, EU and JP	OECD
House prices	Cesa-Bianchi et al. (2015)
Real Estate Investment Trust (REIT) and property company price index	Global Property Research (GPR)
External claims (deposits and loans) of reporting banks vis-à-vis banks of each country	BIS Locational statistics
Foreign liabilities of local banks	IMF
Domestic short-term interest rates	IMF
Real GDP growth rate	IMF
Strength of capital adequacy	World Bank survey data from Barth et al. (2013)
Strength of bank supervision	World Bank survey data from Barth et al. (2013)
Institution quality	Heritage Foundation
Exchange rate flexibility	Own elaboration of Thomson Reuters spot rate data
Capital account openness	Data from Ito and Chinn (2006)
Capital controls on real estate purchase and sale by nonresidents	Data from Fernández et al. (2015)

Table 1: Descriptive statistics

	a. Repo amount outstanding			
	US	UK	EU	JP
Levels ($mil)				
mean	2,662,258	241,557	1,323,496	77,564
median	2,679,457	245,023	1,473,637	72,533
st dev	806,829	108,470	587,204	31,970
max	4,433,581	421,795	2,464,076	144,303
min	1,136,616	63,188	440,076	16,811
Changes (%)				
mean	0.4	0.9	0.6	1.4
median	0.8	1.5	0.9	0.7
st dev	6.3	8.8	5.2	16.3
max	19.9	30.3	11.4	116.6
min	-28.7	-41.3	-18.3	-62.0

	b. Bank data		
	Whole sample	Advanced Economies	Emerging Markets
Cross-border claims ($mil)			
mean	19,609	10,821	8,788
median	18,237	11,340	7,821
st dev	5,149	3,158	2,781
max	29,066	18,027	14,824
min	13,137	5,642	5,527
Changes (%)			
mean	1.1	1.6	0.8
median	0.8	0.1	0.9
st dev	4.8	6.1	5.5
max	16.1	21.8	10.7
min	-8.8	-9.9	-12.5

	c. Changes in house prices (%)		
	Whole sample	Advanced Economies	Emerging Markets
mean	0.6	0.9	0.5
median	0.7	1.2	0.7
st dev	1.1	1.1	1.4
max	2.6	2.6	2.9
min	-4.0	-2.5	-6.6

Notes: Descriptive statistics are reported for the funding liquidity measures for each financial system in Panel a. These systems are US, UK, EU and Japan (JP). Panel b reports descriptive statistics for the aggregated and quarterly changes of bank cross-border claims of the whole sample, advanced, and emerging subsamples. The whole sample includes countries from both the advanced and emerging subsamples. The advanced sample comprises Denmark, Norway, Sweden, Switzerland, New Zealand, Australia and Canada. The emerging market subsample consists of Hong Kong, Indonesia, Philippines, Singapore, Thailand, Malaysia, China, Czech Republic, Hungary, Poland, Russia, South Africa, Israel, Chile, Argentina, Mexico, Brazil, Colombia, and Peru. Panel c reports the descriptive statistics of quarterly changes in house prices for the same groups of countries. All data in levels is in millions of US$.

Table 2: The impact of funding liquidity on cross-border bank flows

	a. Whole sample											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.041***			0.038*			0.115***			0.007		
Funding available:												
Δ Fund * d^+		0.051*			-0.015			0.144***			-0.014*	
Δ Fund * d^-		0.032			0.084**			0.087			0.05***	
Funding cost:												
Δ Fund * d^+			0.119***			0.004			0.092***			0.041**
Δ Fund * d^-			0.017			0.07*			0.138***			0.069***
vix	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	0.000***	-0.001***	-0.001***	-0.001***
ΔM	0.46*	0.452*	0.157	0.196	0.128	0.253*	-0.691**	-0.667**	-0.611**	0.784	0.736	0.944
R_{bar}	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01
	b. Advanced economies											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.076***			0.103***			0.225***			-0.00		
Funding available:												
Δ Fund * d^+		0.039			0.101***			0.263***			-0.045***	
Δ Fund * d^-		0.111***			0.105*			0.186**			0.067***	
Funding cost:												
Δ Fund * d^+			0.205***			0.095***			0.157***			-0.008
Δ Fund * d^-			0.065			0.128***			0.286***			0.064**
vix	-0.00***	-0.00***	-0.00***	-0.001***	-0.001***	-0.001***	-0.00***	-0.00***	-0.00***	-0.001***	-0.001***	-0.001***
ΔM	-0.318	-0.288	-0.498**	-0.099	-0.102	-0.055	-0.97**	-0.942**	-0.904**	-0.028	-0.059	0.967
R_{bar}	0.02	0.02	0.04	0.04	0.04	0.04	0.06	0.06	0.07	0.01	0.03	0.02
	c. Emerging markets											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.029**			0.015			0.079**			0.013*		
Funding available:												
Δ Fund * d^+		0.054			-0.054**			0.103**			-0.003	
Δ Fund * d^-		0.006			0.075			0.056			0.044***	
Funding cost:												
Δ Fund * d^+			0.092***			-0.026			0.071***			0.058***
Δ Fund * d^-			0.001			0.051			0.091*			0.071***
vix	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
ΔM	0.698**	0.679**	0.355	0.292*	0.201	0.354**	-0.586	-0.565	-0.496	1.05*	1.007*	0.927
R_{bar}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Notes: The table reports the results of the different specifications of regressions (1) and (2) for the whole sample (Panel a), advanced countries (Panel b) and emerging markets (Panel c):

$$\Delta Bank_{i,t} = \beta \Delta Fund_t^s + \delta vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t$$
$$\Delta Bank_{i,t} = \beta_1(\Delta Fund_t^s * d_t^{s,+}) + \beta_2(\Delta Fund_t^s * d_t^{s,-}) + \delta vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t$$
$$s = [US, UK, EU, JP],$$

where $Bank$ are banks' foreign liabilities, $Fund$ is the outstanding amount of repurchase agreements in the US, UK, EU and JP. For the model of funding available, d^+ is a dummy that takes the value of 1 when the amount of repurchase agreement outstanding of the US, UK, EU and JP increases, and 0 otherwise, d^- takes the value of 1 when it decreases, and 0 otherwise. In model for funding costs, d^+ is a dummy that takes the value of 1 when the LIBOR-OIS spread of the US, UK, EU and JP increases, and 0 otherwise, d^- takes the value of 1 when it decreases, and 0 otherwise. M is the monetary aggregate M3 in the US, UK, EU and JP, vix is a measure of uncertainty in financial markets, and γ_i are country fixed effects. Δ indicates changes. Standard errors are adjusted for country clustering. ***, **, * indicate significance at 1%, 5% and 10%. R^2 are reported in the last row. The sample period is from January 1999 to December 2012, except for JP that starts in April 2000 due to data availability.

Table 3: The impact of funding liquidity on cross-border bank flows in emerging markets

	a. Emerging Asia											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.009			-0.004			0.018			0.031**		
Funding available:												
Δ Fund * d^+		-0.021			-0.05			0.063*			0.002	
Δ Fund * d^-		0.036			0.036			-0.026			0.089***	
Funding cost:												
Δ Fund * d^+			0.126***			-0.048			0.042			0.106***
Δ Fund * d^-			-0.013			-0.012			0.001			0.078*
vix	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001***	-0.001**	-0.001**	-0.001**	-0.001***	-0.001**	-0.001***
ΔM	1.489***	1.512***	0.992***	0.466*	0.406*	0.405	-0.517	-0.476	-0.458	0.114	0.038	-0.804
R_{bar}	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04
	b. Emerging Europe											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.025			-0.033			0.049			0.004		
Funding available:												
Δ Fund * d^+		0.036			-0.064*			0.17			-0.002	
Δ Fund * d^-		0.016			-0.006			-0.069			0.019	
Funding cost:												
Δ Fund * d^+			0.028			-0.022			0.079***			0.064***
Δ Fund * d^-			-0.006			0.003			0.029			0.067
vix	-0.001**	-0.001**	-0.001**	-0.001*	-0.001*	-0.001	-0.001	-0.001*	-0.001	-0.001	-0.001	-0.001*
ΔM	-0.594	-0.602	-0.621*	0.01	-0.03	0.164	-1.239**	-1.127*	-1.157*	2.81***	2.791***	3.721***
R_{bar}	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.03
	c. Emerging Americas											
	US			*UK*			*EU*			*JP*		
Δ Fund	0.07***			0.118			0.231***			-0.00		
Funding available:												
Δ Fund * d^+		0.211**			-0.044			0.072			-0.012	
Δ Fund * d^-		-0.06			0.258*			0.385**			0.005	
Funding cost:												
Δ Fund * d^+			0.129***			0.008			0.109***			-0.034
Δ Fund * d^-			0.035			0.234*			0.338**			0.066
vix	-0.001***	-0.001***	-0.001**	-0.001**	0.00	-0.001	-0.001*	0.00	-0.001*	-0.001***	-0.001***	-0.001**
ΔM	1.212***	1.107***	0.675	0.4	0.187	0.55	0.208	0.075	0.372	0.064	0.05	-0.187
R_{bar}	0.00	0.01	0.00	0.01	0.02	0.01	0.01	0.02	0.02	0.00	0.00	0.00

Notes: The table reports the results of the different specifications of regressions (1) and (2) for Asia (Panel a), emerging Europe (Panel b) and Latin America (Panel c):

$$\Delta Bank_{i,t} = \beta \Delta Fund_t^s + \delta vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t$$
$$\Delta Bank_{i,t} = \beta_1(\Delta Fund_t^s * d_t^{s,+}) + \beta_2(\Delta Fund_t^s * d_t^{s,-}) + \delta vix_t + \theta \Delta M_t^s + \gamma_i + \epsilon_t$$
$$s = [US, UK, EU, JP],$$

where $Bank$ are banks' foreign liabilities, $Fund$ is the outstanding amount of repurchase agreements in the US, UK, EU and JP. For the model of funding available, d^+ is a dummy that takes the value of 1 when the amount of repurchase agreement outstanding of the US, UK, EU and JP increases, and 0 otherwise, d^- takes the value of 1 when it decreases, and 0 otherwise. In model for funding costs, d^+ is a dummy that takes the value of 1 when the LIBOR-OIS spread of the US, UK, EU and JP increases, and 0 otherwise, d^- takes the value of 1 when it decreases, and 0 otherwise. M is the monetary aggregate M3 in the US, UK, EU and JP, vix is a measure of uncertainty in financial markets, and γ_i are country fixed effects. Δ indicates changes. Standard errors are adjusted for country clustering. ***, **, * indicate significance at 1%, 5% and 10%. R^2 are reported in the last row. The sample period is from January 1999 to December 2012, except for JP that starts in April 2000 due to data availability.

Table 4: Forecast error variance decomposition

	Advanced economies		*Emerging markets*	
quarters	Liquidity shock	Rate shock	Liquidity shock	Rate shock
1	6.13	5.69	7.63	3.82
4	5.43	18.85	12.13	7.77
8	7.26	22.03	16.13	8.98
16	12.35	21.33	20.17	10.15
20	14.08	21.11	20.80	10.59

	Emerging Asia		*Emerging Europe*		*Emerging Americas*	
quarters	Liquidity shock	Rate shock	Liquidity shock	Rate shock	Liquidity shock	Rate shock
1	7.20	3.84	5.02	5.46	6.53	5.10
4	11.14	7.69	8.75	10.89	10.03	8.20
8	14.50	8.71	12.27	11.39	13.16	8.45
16	17.89	9.70	16.73	11.63	17.22	8.66
20	18.49	9.98	17.33	12.05	18.13	8.87

Notes: The table reports the forecast error variance decomposition of house prices of to shocks in funding liquidity and short-term interest rates. All VARs include funding liquidity, the VIX, bank flows, real GDP growth, short-term interest rates, and house prices. All variables except short-term rates and GDP are in logs. The sample period is from January 1999 to December 2012.

Table 5: The role of country characteristics

	Aggregated	*US*	*UK*	*EU*	*JP*
Strength of capital regulation	-0.62	-1.63***	-0.46	-0.88	-0.04
Quality of institutions	0.13***	0.13***	0.12***	0.17***	0.01
Exchange rate flexibility	-0.23	0.61	-0.73	1.43	-0.87*
Capital account openness	-5.36***	-4.39*	-5.74***	-7.96***	-0.49
Controls to real estate	-3.08***	-1.84	-3.19***	-2.99**	-0.71
Rbar	0.24	0.26	0.23	0.30	0.04

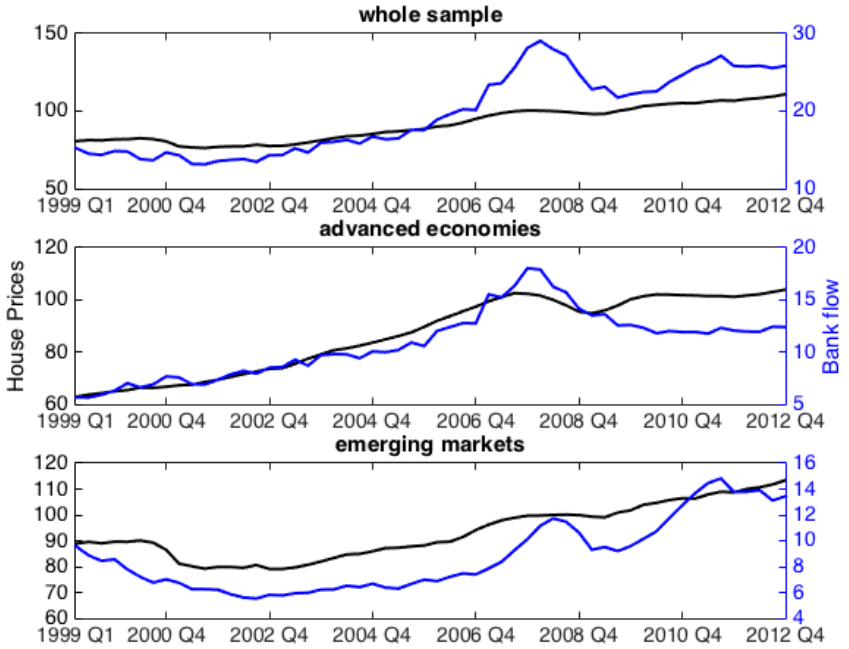
Notes: The table reports the results of the different specifications of regressions (4):

$$Impact_i^s = \beta X_i + \epsilon_i \qquad s = [US, UK, EU, JP],$$

where $Impact_i$ is the 20-quarter cumulated impact of funding liquidity on house prices for country i, and X_i is a vector containing a set of country characteristics, such as the strength of capital regulation, quality of institutions, exchange rate flexibility, capital account openness, and controls on real estate investment for country i. ***, **, * indicate significance at 1%, 5% and 10%. *Rbar* are reported in the last row.

Figure 1: **House prices and cross-border bank flows.** The figure reports the quarterly series of house prices (plotted on the left axis - black line) and cross-border bank flows (plotted on the right axis - blue line). House prices are the average across countries in the groups and are indexed to 100 in the second quarter of 2008. Bank flows are aggregated across countries and measured in billions of US$. Panel a reports the levels for the whole sample, advanced, and emerging subsamples, whereas Panel b depicts the annualized growth rates.

a) Levels



b) Annual growth rates

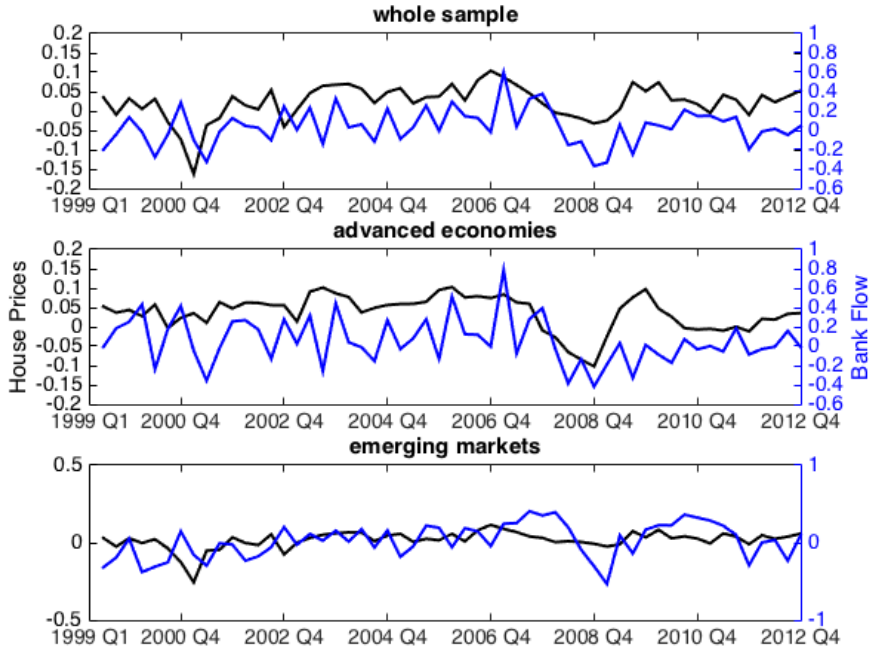


Figure 2: **Funding aggregate and cost.** Monthly series of the amount outstanding of repurchase agreements in the US (plotted on the left axis - solid line) and the US Libor-OIS spread (plotted on the right axis - dashed line). Repos are in million of US$, while the spread is in percentage.

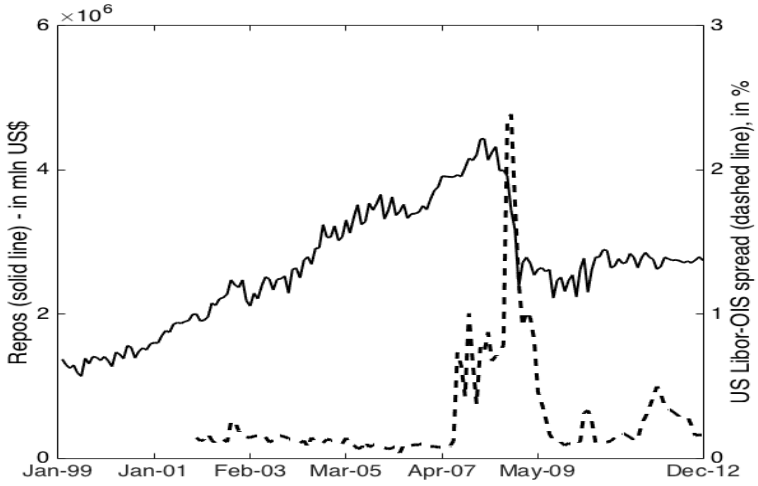
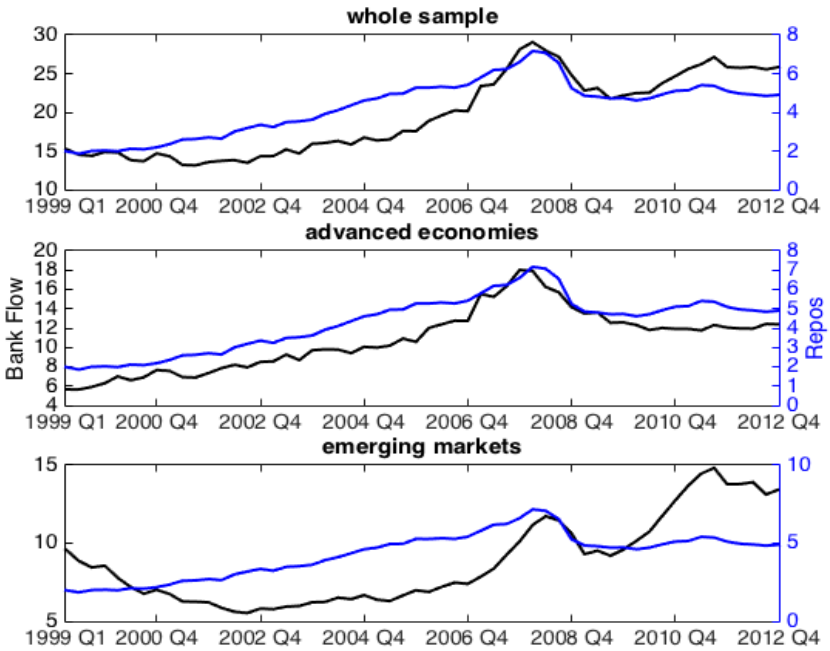


Figure 3: **Cross-border bank flows and funding liquidity.** The figure reports the quarterly series of cross-border bank flows (plotted on the left axis - black line) and the outstanding amount of repos in the main financial centers (plotted on the right axis - blue line). Bank flows are aggregated across countries and measured in billions of US$. Repos are aggregated across US, UK, EU, and JP and are in trillion of US$. Panel a shows the levels for the whole sample, advanced, and emerging subsamples, whereas Panel b depicts the annualized growth rates.

a) Levels



b) Annual growth rates

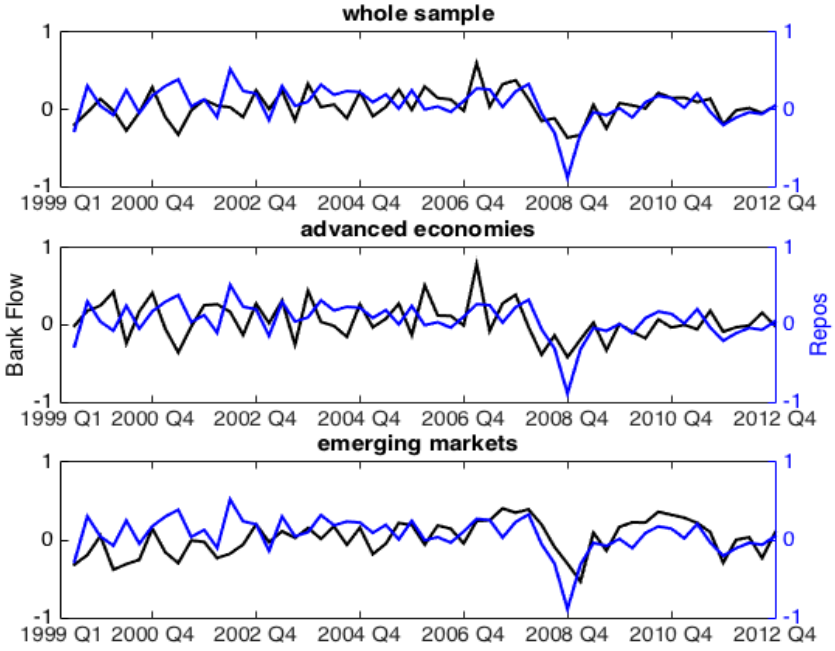
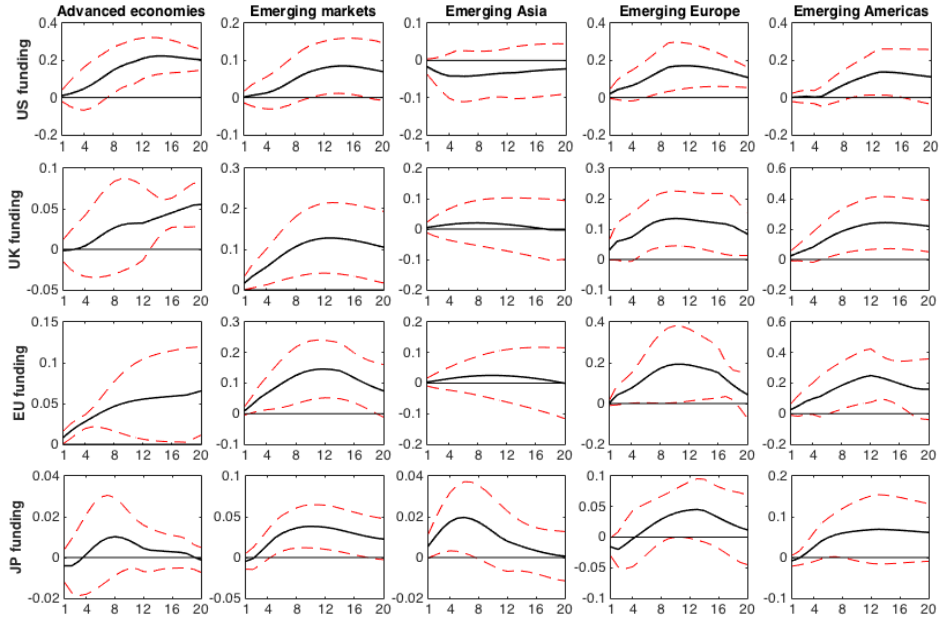


Figure 4: **Responses of house prices to a liquidity shock - bank channel.** The solid black lines are IRFs of house prices to a one-time shock of one standard deviation in funding liquidity. The red lines are two standard error confidence bands. Panel a reports the responses for the VAR models with funding liquidity, VIX, bank flows, real GDP growth, short term interest rates, and house prices. Panel b reports the responses with muted bank flows in the house price equation. Lags are determined according to the Schwarz criterion and are between 1 and 2.

a) Funding liquidity impact on prices



b) The relevance of bank channel - Funding liquidity impact on prices with muted channel

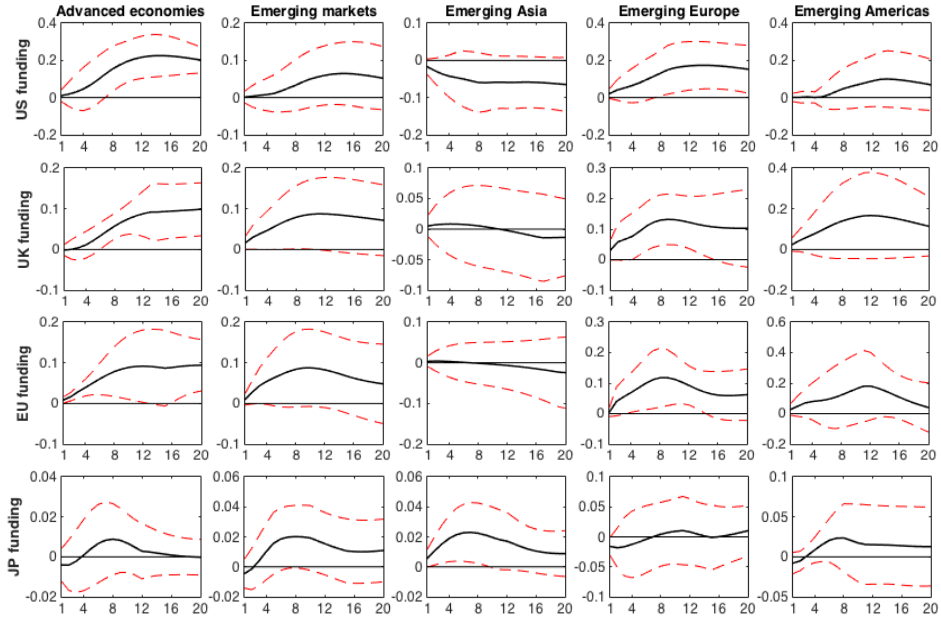
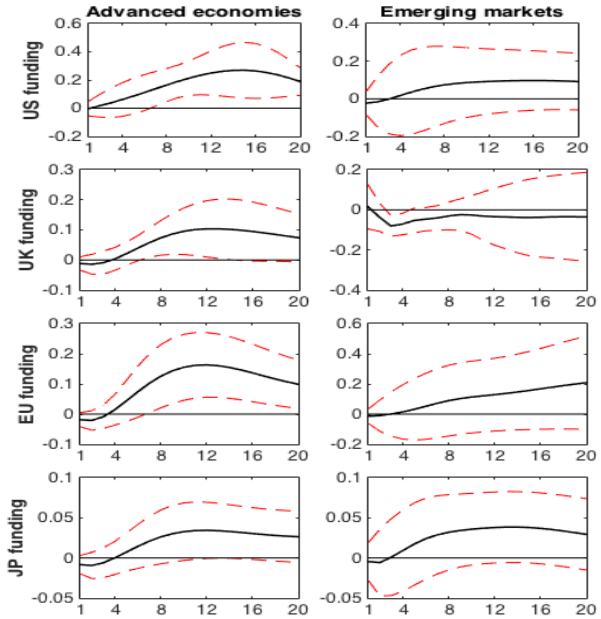


Figure 5: **Responses of house prices to a liquidity shock - financial market channel.** The solid black lines are IRFs of house prices to a one-time shock of one standard deviation in funding liquidity. The red lines are two standard error confidence bands. Panel a reports the responses for the VAR models with funding liquidity, VIX, real estate stock index, real GDP growth, short term interest rates, and house prices. Panel b reports the responses with muted real estate stock index in the house price equation. Lags are determined according to the Schwarz criterion and are between 1 and 2.

a) Funding liquidity impact on prices



b) The relevance of financial market channel - Funding liquidity impact on prices with muted channel

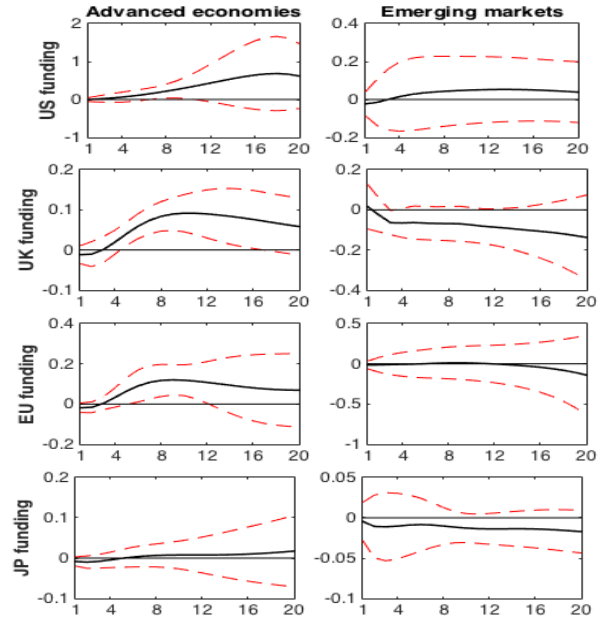
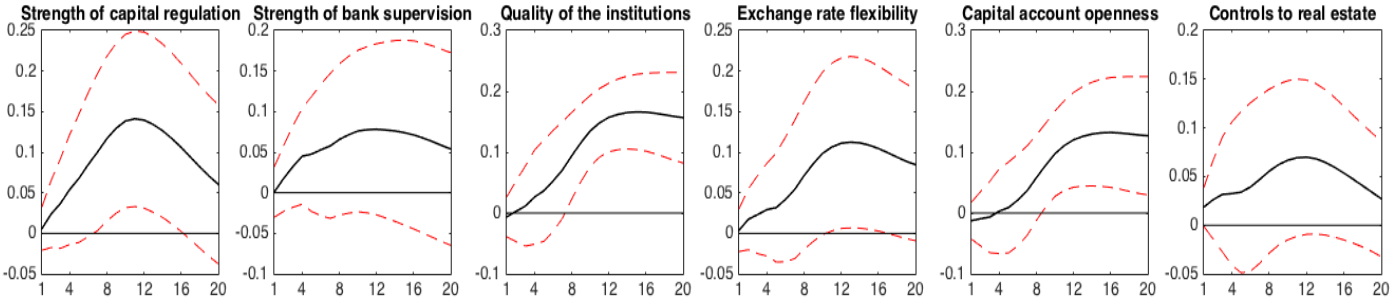


Figure 6: **Responses of house prices to a funding shock depending on country characteristics.** The solid line represents the IRFs of house prices to a one time shock of one standard deviation in funding liquidity. The red lines are two standard error confidence bands. Country characteristics are described in the titles of the plots. They include the strength of capital regulation, bank supervision, institution quality, FX flexibility, capital openness, and controls on real estate investments by nonresidents. The blue responses are averaged across the sample of countries with higher country characteristics than median. In Panel a the responses are averaged across the sample of countries with higher country characteristics than median. In Panel b the responses are averaged across the sample of countries with lower country characteristics than median. All VAR models have funding liquidity, the VIX, bank flows, real GDP growth, short-term interest rates, and house prices. Funding liquidity is the average repo amount outstanding across US, UK, EU, and JP. Lags are determined according to the Schwarz criterion and are between 1 and 2.

a) Responses averaged across countries with characteristics above median



b) Responses averaged across countries with characteristics below median

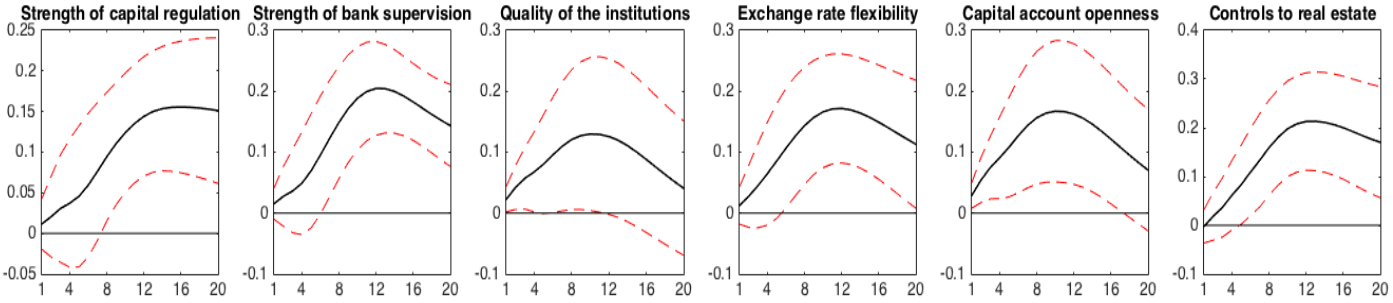
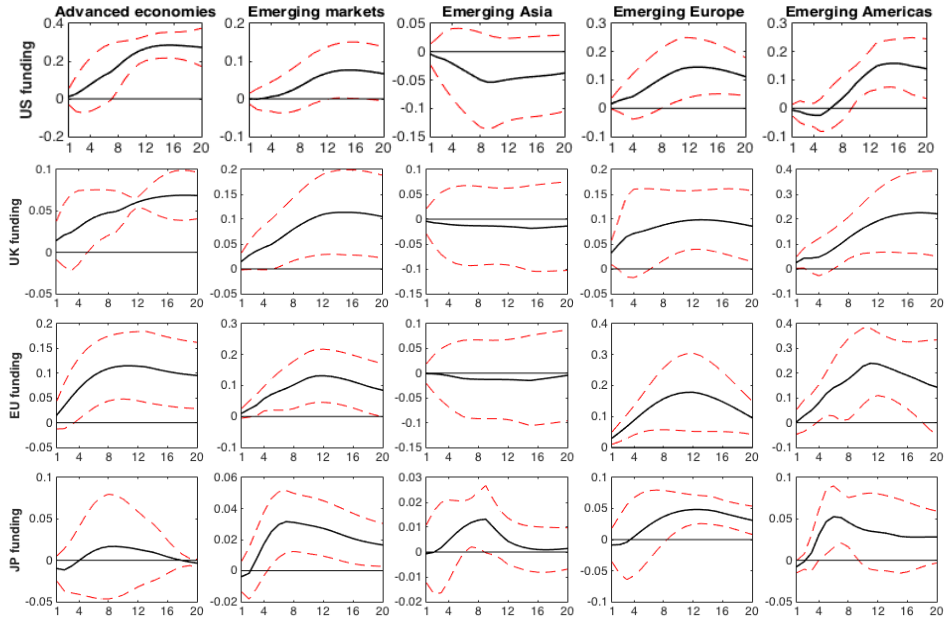


Figure 7: **Responses of house prices to a liquidity shock - bank channel with IFS data.** The solid black lines are IRFs of house prices to a one-time shock of one standard deviation in funding liquidity. The red lines are two standard error confidence bands. Panel a reports the responses for the VAR models with funding liquidity, VIX, bank flows, real GDP growth, short term interest rates, and house prices. Bank flows are the end of the quarter IFS banks' foreign liabilities. Panel b reports the responses with muted bank flows in the house price equation. Lags are determined according to the Schwarz criterion and are between 1 and 2.

a) Funding liquidity impact on prices



b) The relevance of bank channel - Funding liquidity impact on prices with muted channel