KGRI Working Papers

No.9

House price and credit cycles: effects of global liquidity and risk perception

Version1.0

August 2017

Satoshi Tobe[1]

Keio University Global Research Institute

[1] Corresponding author. Graduate School of Economics, Keio University, 2-15-45, Mita, Minato-ku, Tokyo, 108–8345, Japan. E-mail address: stobe@keio.jp

House price and credit cycles: effects of global liquidity and risk perception

Satoshi Tobe[1]

KGRI project code: S17-06

This version: August 15, 2017

Abstract

This paper explores the determinants of house prices and bank credit. An empirical analysis of panel data of 22 developed countries during 1990–2015 reveals cross-border bank inflows and risk perception in global markets as the key drivers of house prices and bank credit. Moreover, it indicates that the effect of this risk perception on house prices is non-linear, depending on the leverage of local financial systems: it is stronger in economies with higher leveraged financial sectors. These results suggest that local financial cycles are exposed to spillover effects of U.S. monetary policy, and that local banking sectors play key roles in transmitting the effects to local house price cycles.

Keywords: House Price, Bank Credit, International capital flow, Global Liquidity, Risk perception

JEL classification: F3

---

[1] Corresponding author. Graduate School of Economics, Keio University, 2-15-45, Mita, Minato-ku, Tokyo, 108–8345, Japan. E-mail address: stobe@keio.jp.

1. Introduction

This paper empirically analyzes the dynamics of house prices and bank credit. In the past two decades or more, many developed countries have experienced several boom–bust cycles in these financial variables. Particularly, the cycles in the late 2000s are remarkable with regards to the persistence and size of downturns before and after the great financial crisis, respectively (Cesa-Bianchi et al., 2015; Hume and Sentance, 2009). This recent experience reminds both academics and policy makers that the dynamics of these financial variables have non-trivial effects on our real economies. Gourinchas and Obstfeld (2012), Jordà et al. (2015, 2016a) and Schularick and Taylor (2012) reveal that these dynamics contain valuable information on financial stability and macroeconomic performance after financial crises, even when based on longer historical perspectives.

In tandem with the cycles, international capital transactions—especially cross-border bank flows (lending)—have increased dramatically against a backdrop of financial integration. Especially in the 2000s, (1) declining federal funds rates and (2) adoption of a common European currency, both of which reduces cross-border banking costs, facilitated the upward trend (Bruno and Shin, 2015a, 2015b; Hale and Obstfeld, 2016; McGuire and Tarashev, 2007; Shin, 2012). Some literature often calls cross-border bank inflows "global liquidity." It has a highly pro-cyclical nature and can amplify local business and financial cycles through tightening or loosing financial conditions, sometimes impairing financial stability. Moreover, they play a key role in the international transmission of U.S. monetary policy (Bruno and Shin, 2015b; McCauley et al., 2015; Rey, 2013, 2016). In this sense, global liquidity increases the connectedness of local financial markets.

Recently, Miranda-Agrippino and Rey (2012, 2015), Rey (2013), and Passari and Rey (2015) argue that global financial cycles determine fluctuations in asset prices, credit growth, and international capital transactions, which could explain the global financial environment described above well. They find cyclical co-movements of these variables across a broad sample of countries, and reveal their close ties with a global common factor, such as risk perception in global financial markets as measured by the CBOE VIX index. Related literature (e.g., Hirata et al., 2012; Miranda-Agrippino and Rey, 2015; Cesa-Bianchi et al., 2017) shows that 20–40% of variation in global asset prices or credit is explained by a common global factor. Accordingly, it is essential to consider the effects of global liquidity and global common factors, as well as country-specific factors, to understand the dynamics of local financial cycles in recent decades.

This paper explores the interaction among house prices, bank credit, cross-border bank inflows, and risk perception in global markets. In addition to the effect of cross-border bank inflows on house prices and bank credit, risk perception in global markets can be associated with these local financial variables—the easing of risk perception (the increased risk appetite) in tranquil time produces expansionary effects on asset prices and operations of financial intermediaries. Moreover, countries may respond non-linearly to shocks in this risk perception, according to its time or country-specific nature. This study performs instrumental variable (IV) regressions by using quarterly panel data for 22 developed countries between 1990 and 2015. It enables the exploration of the effects of both country-specific and global common factors on house prices and bank credit. Moreover, the method reduces endogeneity concerns, so that the effects of exogenous (supply-push) change in cross-border bank inflows on house prices and bank credit can be estimated.

Empirical analysis reveals that increases in cross-border bank inflows and an easing of risk perception in global markets induce appreciation in house prices and expansion of bank credit. Moreover, it indicates that the effects of this risk perception on house prices are non-linear, depending on the leverage of local banking sectors: they are stronger in economies with higher leveraged financial systems. These results indicate that global liquidity and risk perception in global markets play key roles in explaining the cycles of house prices and bank credit in developed countries; interestingly, the effects of this risk perception can vary non-linearly with situations of local financial systems.

This paper makes three contributions. First, it provides a more complete picture of key factors inducing boom–bust cycles over the past two decades or more. For example, the vector autoregression (VAR) analysis of Rey (2013) focuses on a set of variables similar to that included here, but it has little concern for cross-country variations in domestic factors, which are expected to affect house prices, bank credit, and cross-border bank inflows. In addition, although Avdjiev et al. (2017), Bruno and Shin (2015a), Cerutti et al. (2015), and Cerutti et al. (2017) provide evidence that countries' capital inflows are tightly associated with global common factors (e.g., VIX or leverage of U.S. financial intermediaries), the ultimate effects of inflows on local economies are not explored.[1]

Moreover, Cesa-Bianchi et al.'s (2015) VAR analysis of the causal effects of cross-border bank inflows on house prices in both developed and emerging economies

[1] Calvo et al. (1993, 1996) are the first literature that find U.S. monetary and financial conditions play dominant roles in explaining capital inflows to emerging economies.

does not focus on factors determining inflows, or on the effects of the risk perception in global markets on house prices. Empirical studies on global imbalances (e.g., Bernanke, 2010; Sà et al., 2014; Sà and Wieladek, 2015) also explore the interaction between (net) inflows and house prices, but have the same shortcomings as Cesa-Bianchi et al. (2015). This research contributes by analyzing global financial cycles in more detail.

The second contribution is a reduction of the endogeneity concerns. The potential two-way causality between cross-border bank inflows (more generally, capital inflows) and local financial variables was insufficiently dealt with by Bernanke (2010) and Miranda-Agrippino and Rey (2013) in their exploration of the interaction between capital inflows and house prices. This study performs IV regressions to reduce the endogeneity concern. Moreover, the method enables the joint estimation of the determinants of cross-border bank inflows and house prices or bank credit, strengthening the first contribution.

Third, a novel finding is made on the non-linearity of the effects of risk perception in global markets measured by VIX. Previous literature provides little systematic evidence of non-linearity or heterogeneity in the responsiveness of local financial variables to VIX, focusing on the degree of exchange rate flexibility (Passari and Rey, 2015) or financial openness (Miranda-Agrippino and Rey, 2013; Rey, 2013) of local economies. In contrast, further analysis reveals a higher sensitivity of house prices to VIX in economies that experience faster bank credit growth compared to their real economies, or that have larger deviations of the bank credit to GDP ratio from its trend. This suggests that house price fluctuations are more strongly linked to the U.S. financial and monetary conditions in economies with larger leverage, because VIX is closely tied with federal funds rate shocks, as revealed in Bekaert et al. (2013) and Bruno and Shin

(2015b). Therefore, the finding contributes to existing literature (e.g., McCauley et al., 2015; Rey, 2013, 2016; Passari and Rey, 2015) by capturing non-linearity in an empirical model of international spillover of U.S. monetary policy.

The reminder of this paper is organized as follows: Section 2 describes data and methodology, Section 3 presents the estimation results and a discussion thereof, and Section 4 concludes.

2. Data and methodology

2.1 Key variables

This section describes data and methodology. First, visual characterizations are provided of key variables that are used in an empirical analysis performed later. A cross-country sample average of key variables is plotted, although the analysis that follows treats country-specific variables separately. These characterizations aid in the simplistic understanding of a whole sample trend of key variables. The sample comprises quarterly data spanning the first quarter of 1990 to the third quarter of 2015 for the 22 developed countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

Figure 1 plots the cross-country average of quarterly growth in house prices (solid line), with upper and lower bounds of a one standard deviation band (shaded area) and a one-year moving average (dashed line). The figure shows a persistent and steady growth of house prices before the great financial crisis. The one standard deviation band suggests that house prices appreciated strongly in many developed countries, especially in the 2000s. After the prolonged appreciation, house prices declined sharply during the great financial crisis and still showed anemic growth in recent years, compared to the pre-crisis period.

Similarly, Figure 2 plots the growth of bank credit. According to this figure, bank credit cycles are short-lived and highly volatile compared to house price cycles. However, their growth rate in the 2000s is relatively strong compared to that in the other period. It suggests that house price appreciation in the 2000s coincides with an increase in bank credit in average developed countries.

[Insert Figures 1 and 2 here]

To reveal the factors that contributed to the house price and bank credit cycles, described in Figure 1 and 2, this paper focuses on the roles of cross-border banking activity and risk perception in global markets. Figure 3 plots the quarterly growth of cross-border bank claims of all Bank for International Settlements (BIS) reporting countries on a country's banking sector, similar to Figures 1 and 2. This series is used as a standard measure for cross-border bank inflows in previous literature (e.g., Bruno and Shin, 2015a, 2015b). Such inflows are often called "global liquidity," because they are interpreted as the cross-border supply of bank loans. Their dynamics expect to affect each country's house prices and bank credit. For example, increases in the inflows can place upward pressure on house prices and bank credit by (1) lowering interest rates, (2) forming expected appreciation of house prices, and (3) directly or indirectly relaxing credit constraints by increasing the asset prices used as collateral for bank lending.

As shown in Figure 3, cross-border bank inflows indeed show similar dynamics to the bank credit described in Figure 2, because the two variables are on both sides of banks' balance sheet. Moreover, especially when we focus on the one-year moving average, the inflows also seem to be associated with the house price fluctuations described in Figure 1. To analyze the interaction between the inflows and house prices or bank credit formally, cross-border bank inflows are included in baseline empirical models as an endogenous right hand side variable.

[Insert Figure 3 here]

Figure 4 plots the CBOE VIX index (dashed black line, inverted scale). VIX may contain the following information: (1) uncertainty in global financial markets or risk appetite of global investors (banks) and (2) realized volatility of risky assets. Thus, recent literature uses VIX as a valuable proxy for key financial factors. For example, Forbes and Warnock (2012), Passari and Rey (2015), and Rey (2013) regard VIX as a proxy for risk perception in global markets or the global financial cycle. Moreover, Adrian and Shin (2014) show that VIX is closely associated with the Value-at-Risk (VaR) constraint. Considering these aspects, the dynamics of VIX are expected to be associated with the change in house prices and bank credit in each country.

According to Figure 4, VIX shows a cyclical behavior in the sampled period. Most interestingly, VIX started to decline from 2002, reaching a historically low level in the mid-2000s. Under this financially eased environment, global investors (banks) increased risk taking, which may have led to upward pressure on house prices and bank credit. The following empirical models contain the lagged level and current growth of VIX.[2]

[Insert Figure 4 here]

In reality, the responsiveness of house prices and bank credit to VIX can vary (non-linearly) with situations in each country. To analyze this phenomenon, this study also focuses on the leverage of banking sectors in each country (local leverage). It regards the bank credit to GDP ratio as a local leverage measure (proxy). For example,

---

[2] As discussed in Baskaya et al. (2017) and Cerutti et al. (2017), VIX is basically an exogenous variable for many countries. This is because VIX is originally an index of U.S. stock option markets that are unlikely to be affected by the dynamics in house prices and bank credit in the other countries.

assuming that local banks can raise their funds only by deposit under some capital constraints (e.g., VaR constraint), the dynamics of the bank credit to GDP ratio will be stable. This is because bank credit cannot grow faster than the growth of deposits, which is expected to be approximately equal to GDP growth. However, in reality, banks can extend their funds through non-core liability, such as short-term wholesale funding (Adrian and Shin, 2010; Brunnermeier et al., 2012; Hahm et al., 2013). Thus, local bank credit can change regardless of GDP growth. Considering these aspects, the bank credit to GDP ratio is expected to be a good proxy for local leverage, because the ratio tracks bank credit that is supported by non-core liability (i.e., leveraged credit).

Some previous literature also regards the ratio as leverage of local banking sectors. For example, Gourinchas and Obstfeld (2012) and Jordà et al. (2016b) treat the bank credit to GDP ratio as (internal) leverage. Moreover, Gourinchas and Obstfeld (2012) and Jordà et al. (2016a) show that the ratio works well as an early warning indicator (EWI), informing of excess leverage or risk taking by local agents. In general, economies with higher leverage may be sensitive to external shocks in financial conditions, such as VIX.

Figure 4 also plots a cross-country average of the change in bank credit to GDP ratio. Local leverage growth has increased since the mid-1990s, and remained at a relatively high level until occurrence of the great financial crisis. In particular, it recorded historically high growth rates in the late 2000s. These dynamics suggest that the local banking sectors in average developed countries aggressively managed their balance sheets before the recent crisis, after which local leverage growth became nearly zero. To test whether the responsiveness of house prices and bank credit to VIX is non-linear, depending on situations of local leverage, some empirical models include current and lagged interaction terms of change in VIX and local leverage growth.

2.2 Other controls

The empirical models discussed in this paper also include country-specific factors to control the effects of local financial conditions and fundamentals (domestic or demand pull factors). The following factors are included: local stock market volatility, change in interest rates (short- or long-term rates), GDP growth rate, inflation rate, and change in real effective exchange rates. All these controls are lagged by one quarter. Appendix provides further details and data sources on the variables used in the empirical analysis.

2.3 Identification strategy

One of the objectives of this study is to explore the interrelations between cross-border bank inflows and house prices or bank credit. However, there may be a two-way causality between the variables, which raises endogeneity concerns when we estimate the relationships with standard ordinary least squares (OLS) regressions. To reduce this concern, this study performs IV regressions with house prices or bank credit as dependent variable and cross-border bank inflows as an endogenous right hand side variable. This method requires the use of instruments that affect an endogenous variable but are not related to error terms (or variations in dependent variables). The baseline models contain one of the two instruments described below.[3]

The first instrument is U.S. broker-dealer leverage (lagged level and current growth), which is defined as the ratio of asset over equity of U.S. broker-dealers. Bruno and Shin (2015a) find that this leverage is the key driver of cross-border bank inflows. Cerutti et al. (2017) take a similar perspective, and reveal that leverage of U.S. financial

[3] The identification strategy described here is similar to Tobe (2017), who investigates the relationship between total credit and total capital inflows. This study applies this strategy to investigate the determinants of house prices and bank credit, focusing on cross-border bank inflows (i.e., global liquidity).

intermediaries, including U.S. broker-dealer leverage, performs well in explaining cross-border bank inflows to each country.

Bruno and Shin's (2015a) theoretical model partly explains the background to the tight relationship between inflows and leverages. They built a "double-decker model of global banking" that has two types of banks, global and regional, located in a financial core country (e.g., U.S.) and other countries, respectively. Global banks finance themselves using short-term wholesale funding as well as channel liquidity to regional banks through their international banking systems. Then, regional banks provide local loans using the liquidity from global banks. Given this structure, when the risk perception in global markets (measured by VIX) or short-term (dollar) interest rate is low, global banks increase their leverage by accumulating short-term funding, leading to an expansion in cross-border inflows (lending) to regional banks. This can ultimately increase regional bank credit, and is expected to lead to an appreciation in house prices.

In an empirical exploration of this model, Bruno and Shin (2015a) use U.S. broker-dealer leverage as a proxy for the leverage of global banks. This is because (1) the broker-dealer sector actively manages their balance sheet through short-term wholesale funding operations, and (2) data availability on European broker-dealers that might also work as global banks is limited.[4] According to their analysis, U.S. broker-dealer leverage explains a sizable part of the variation in cross-border bank inflows to developed and emerging economies.[5] If results are interpreted more

[4] Cerutti et al. (2017) provide evidence that the leverage of large (commercial) banks in the UK and Euro area also play a key role in explaining cross-border bank inflows. However, robustness of the results relies on the sampled period.

[5] The double-decker model of global banking explains the background of the cross-border bank inflows from global to regional banks. However, data on the inflows used in Bruno and Shin (2015a) include a broader range of the inflows than their model intend to explain, such as global-bank-to-global-bank flows, regional-bank-to-regional-bank flows, and

empirically, this leverage works as a time dummy that represents the risk-taking capacity of global banks, or the ease of short-term dollar funding.

Although U.S. broker-dealer leverage is a valuable measure to track the dynamics of cross-border bank inflows, this leverage may be irrelevant to dependent variables, at least directly. As for house prices, leverage of U.S. broker-dealers (or risk taking capacity of U.S. financial intermediaries) may not affect these in a particular country, because the broker-dealers are not direct participants in housing markets in each foreign (non-US) economy in many cases. Similarly, the leverage may also be irrelevant to bank credit in a particular country, because the ultimate suppliers (or decision makers) of bank credit are regional banks, as described in the double-decker model. Cesa-Bianchi et al. (2015) also use U.S. broker-dealer leverage as one of the instruments in their VAR analysis to explore the causal effects of inflows on house prices when they identify exogenous (supply-push) shocks to cross-border bank inflows. Thus, U.S. broker-dealer leverage is expected to be a valid instrument to identify supply-push effects of cross-border bank inflows on local financial variables.

Nevertheless, there is some concern that this leverage may not be irrelevant to variations in house prices and bank credit in the U.S. This paper reduces this concern by also using an alternative instrument.[6] This second instrument is global flow, defined as the change in the cross-sectional sample sum of cross-border bank claims of all BIS reporting countries on a given country's banking sector, excluding the claims on the country under consideration. This method follows Blanchard et al. (2015), who investigate the effects of gross capital inflows on GDP growth and the change in private

---

regional-bank-to-global-bank flows.

[6] Another method to deal with this problem is to exclude U.S. data from the sample. The author confirms that results hold true even when the U.S. data are excluded.

credit in emerging economies. Considering the findings in Rey (2013), global flow can be correlated with cross-border bank inflows to each country, because gross capital inflows—especially cross-border bank inflows—co-move at global level. However, global flow is clearly irrelevant to the variations within the country under consideration, because data on the country are excluded from the flow. Thus, global flow is also expected to satisfy the assumptions on valid instruments.

Empirically, the effects of these instruments on endogenous variables may vary across countries. To deal with this possibility, for half the specifications, the models contain interaction terms of the instruments with country-specific dummies as the alternative sets of instruments. These specifications may be less restrictive on the sensitivity of the endogenous variables to the instruments. However, the specifications include a large number of instruments, although they have only one endogenous variable (i.e., cross-border bank inflows). As a result, they do not tend to pass the test on over-identification compared to the other specifications, as shown in the next section. Nevertheless, results are similar across models, so over-identification does not cause a significant problem in this study.

3. Estimation results and discussion

3.1 Determinants of house prices

First, results on the determinants of house prices are presented. Table 1 presents results from panel regression models. Models 1A and 1C (Models 1B and 1D) use global leverage (global flow) as an instrument. Columns (1) and (2) show the results of the first- and second-stage regressions of Model 1, respectively.

In the first stage, global leverage (lagged level and current growth) is positively correlated with cross-border bank inflows, consistent with Bruno and Shin (2015a). As for controls, the coefficient for GDP growth is also positively significant, implying pro-cyclicality of cross-border bank inflows. In this model, VIX is positively correlated with the inflows. This is inconsistent with the findings for the global financial cycle, but the result is not robust as shown in the other models. A possible explanation is that some countries in the sample are regarded as safe havens. Other controls are insignificant at this stage, but the F-statistic is sufficiently high (larger than 10). Thus, there is little concern about weak instruments.[7]

In the second stage, cross-border bank inflows are positively correlated with house prices at the 1% significance level, indicating an inflow contribution toward house price appreciation. In this model, a 1% increase in cross-border bank inflows raises quarterly house price growth by 0.14%. Moreover, coefficients of current growth and the lagged level of VIX are negatively correlated with house price, indicating global market risk perception as another key driver of house price dynamics. Long-term interest rates and GDP growth show expected signs, although the interest rate coefficient is insignificant.

Results are similar when global flow instead of global leverage is included as an instrument (Model 1B). Column (3) shows global flow as positively correlated with cross-border bank inflows, indicating that capital inflows co-move across the sampled countries. The GDP growth rate coefficient remains positively significant. The interest rate coefficient becomes negative and significant in this model. This result implies pro-cyclicality of cross-border bank inflows, but is inconsistent with intuition on uncovered interest parity. If models use total capital inflows instead of cross-border

[7] Formally, all the F-statistics shown in this paper exceed the critical value on weak instruments that is presented in Stock and Yogo (2005).

bank inflows, the interest rate coefficient becomes positive (but remains insignificant), as shown in robustness checks. Moreover, the F-statistic remains sufficiently high. In the second stage, column (4) indicates that the cross-border bank inflow coefficient remains positively significant, although it becomes relatively small compared to Model 1A. In this model, the coefficient for the lagged level of VIX is negatively significant.

The principal results are maintained when the models use the interaction terms of the instrument with the country-specific dummies, described in the last section as an alternative set of instruments (Models 1C and 1D).[8] A possible concern is that, in two out of three over-identified models (Model 1C and 1D), the Sargan–Hansen test rejects the null hypothesis of the instruments being uncorrelated with the error term. However, the main results are similar to those of just-identified models and the models that pass the test. Thus, estimation bias is of little concern, at least with this sample.

[Insert Tables 1 and 2 here]

To explore the sensitivity of house prices to risk perception in global markets, measured by VIX, the models in Table 2 contain the interaction terms of the growth of VIX, with growth of bank credit to GDP ratio as an additional explanatory variable. The principal results remain unchanged: coefficients for cross-border bank inflows are positively significant, and those for VIX are largely negatively significant in the second stage; however, coefficients for current growth of VIX are marginally insignificant in models 2B and 2D. These robustness concerns are cleared, as shown in a later section.

Moreover, coefficients for the lagged interaction terms on house price are negatively significant in all specifications. This indicates that the effects of VIX on house prices can vary non-linearly with the conditions of local financial systems: they are stronger in

[8] The results of the first stage are omitted because of space constraints.

countries with faster expansion of bank credit relative to their real economies. In other words, it suggests that house price fluctuations are more strongly linked to U.S. financial and monetary conditions in economies with a higher local leverage growth, because VIX is closely tied with federal fund rate shocks (see Bekaert et al. (2013) and Bruno and Shin (2015b)). Thus, house prices in economies with a larger growth of local leverage might be more strongly exposed to the spillover effects of U.S. monetary policy. Furthermore, the result is in line with Jordà et al. (2016a), who suggest that local boom–bust cycles of credit creation are closely synchronized with the global cycle in more leveraged countries (measured by bank credit to GDP ratio).

3.2 Determinants of bank credit

Next, the results on the determinants of bank credit are presented. Table 3 summarizes results from panel regression models, similar to Tables 1 and 2. One noticeable difference is that bank credit models include changes in short-term instead of long-term interest rates.[9] Models 3A and 3C (Models 3B and 3D) use global leverage (global flow) as an instrument. Columns (1) and (2) show the results of the first and second stage regressions of Model 3A, respectively.

In the first stage, global leverage (lagged level and current growth) is positively correlated with cross-border bank inflows at the 1% significance level, consistent with results in Table 1 and 2. VIX is again positively correlated with the inflows, although the result is not robust (as shown in the other models). Moreover, the GDP growth coefficient is positively significant, while that of short-term interest rates is negatively

[9] The main results hold even when the models include long-term interest rates. However, coefficients for the interest rates become positive, although they are insignificant. Long-term interest rates may work as a proxy for the return of lending for banks in empirical models, at least in this sample. That is why long-term interest rates are associated with higher bank credit. For better understanding and readability, specifications on bank credit include short-term instead of long-term interest rates throughout this paper.

significant, indicating pro-cyclicality of cross-border bank inflows. The exchange rate coefficient is positive, as revealed in Bruno and Shin (2015a), but insignificant.

In the second stage, cross-border bank inflows are positively correlated with bank credit at the 1% significance level. This indicates that the inflows contribute toward credit creation. In this model, a 1% increase in the inflows induces a 0.62% higher quarterly growth of bank credit. Moreover, VIX (lagged level and current growth) is negatively correlated with bank credit. This result indicates that risk perception in global markets is also a key driver of credit growth. In contrast, the coefficients of country-specific factors are insignificant or have unexpected signs, except for the short-term interest rate, which implies that credit growth is not strongly supported by a country's domestic conditions. This is consistent with the fact that boom–bust cycles of credit creation coincide with stable GDP growth and low inflation rates (called "great moderation"). Moreover, the Sargan–Hansen test cannot reject the null hypothesis of the instruments being uncorrelated with the error term in all specifications, indicating that instruments empirically satisfy the assumption of validity.

[Insert Tables 3 and 4 here]

These results almost hold true when a model uses global flow as an instrument (Model 3B). As shown in column (3), global flow is positively correlated with cross-border bank inflows. Moreover, coefficients of VIX lose significance, whereas those of local stock market volatility become negative and significant in the first stage, implying that country-specific risk factors affect the inflows. Similarly, column (4) shows that the signs of the coefficients of cross-border bank inflows and VIX remain unchanged and are significant, whereas country-specific factors still have mainly ambiguous effects on bank credit. In addition, these results hardly change when the models use the interaction terms described in the previous section as an alternative set of instruments (Models 3C and 3D).[10]

To explore the sensitivity of bank credit to VIX, the models in Table 4 contain the interaction terms of growth of the VIX with growth of bank credit to GDP ratio as an additional explanatory variable. The principal results remain unchanged: coefficients for cross-border bank inflows are positively significant, and those for the VIX are negatively significant in the second stage. Moreover, coefficients for the additional interaction terms on bank credit are negatively significant in models 4A and 4C. However, this result on the interaction terms is not robust, as shown in robustness checks. Thus, in contrast to house prices, there is little evidence that the effects of VIX on bank credit are non-linear, depending on the conditions of local financial systems.

3.3 Robustness checks and extensions

The results presented in the previous sections are robust to various changes. First, we perform a different estimation method. Table 5 provides the results on the determinants of house prices when the models are estimated by the standard OLS method with lagged right hand side variables. According to columns (1) to (4), results are similar to those of Table 1. Lagged cross-border bank inflows are positively correlated with house prices, which implies that the inflows lead to subsequent appreciation in house prices. In addition, lagged growth of VIX is negatively significant. These results are also consistent with the results by IV regressions. As for controls, the GDP growth rate coefficients remain positive and significant. Coefficients for local stock market volatility become negatively significant, implying that country-specific risk factors affect house price cycles. Moreover, as shown in columns (5) to (8), the

[10] The results of the first stage are omitted because of space constraints.

interaction terms of VIX with growth of local leverage are negatively significant in all specifications. These results strengthen the results presented in Table 2.

[Insert Table 5 here]

Similarly, Table 6 presents the results when the determinants of bank credit are estimated by the OLS method. Columns (1) to (4) show the robustness of the key results: coefficients for cross-border bank inflows are positively significant, and those for growth of VIX are negatively significant. Moreover, coefficients for interest rates remain negatively significant, and those for GDP growth rate become positively significant. In contrast, as can be seen in columns (5) to (8), the interaction terms of the growth of VIX with that of local leverage are insignificant in all specifications. These results indicate that there is little evidence that the sensitivity of bank credit to VIX is higher in economies with larger local leverage growth, highlighting the difference between the results on house prices and those on bank credit.

[Insert Table 6 here]

Second, results hold true when the models use alternative local leverage measures. The models in Table 7 use the deviation of bank credit to the GDP ratio from its trend (calculated by the one-year moving average) instead of the growth of the ratio. This alternative measure enables a focus on the level instead of the growth of local leverage. Table 7 shows the robustness of the key results: cross-border bank inflows are positively correlated with house prices and bank credit, VIX is negatively correlated with the two variables, and coefficients for the interaction terms of VIX with local leverage measure are negatively significant only when house prices are used as dependent variable.

[Insert Table 7 here]

Third, the results hold even when the models use total capital inflows instead of cross-border bank inflows. A focus on the latter is valuable for understanding the effects of global liquidity, but might miss the total effects of capital inflows on house prices. Specifications using total capital inflows can reduce this concern.[11][12] Tables 8 and 9 show that this extension does not change the key results. Coefficients for gross capital inflows are positively significant in all specifications, corroborating the global imbalance hypothesis that states (net) capital inflows induce appreciation in house prices (e.g., Bernanke, 2010; Sà et al., 2014; Sà and Wieladek, 2015). Results on VIX and its interaction terms are consistent with the results shown in other tables.

[Insert Tables 8 and 9 here]

Finally, results hold when the models use winsorized data (available on request). Winsorizing reduces the undesirable effects of outliers. In this sample, the procedure mainly excludes the sample during the great financial crisis of the late 2000s. This reduces concern that these results rely on relationships in a severe crisis period.

4. Conclusion

This paper explored the determinants of house prices and bank credit, focusing on cross-border banking activity and risk perception in global markets. Empirical analysis comprised IV regressions with quarterly panel data of 22 developed countries over two decades. The results indicate that the key drivers of house prices and bank credit are cross-border bank inflows (i.e., global liquidity), which are closely tied with U.S.

---

[11] Tobe (2017) explores the effects of total capital inflows on total credit, which provides additional robustness checks.

[12] Data on capital inflows are divided by external liability to avoid the undesirable effects of outliers that undertake large cross-border capital transactions relative to the scale of their real economy (e.g., Ireland and Switzerland). Results hold true even when inflows are normalized relative to GDP. However, F-statistics in the first-stage regressions in that case often decrease below 10, which raises concerns with regard to weak instruments. Trimming outliers by winsorizing cannot fully resolve this problem.

broker-dealer leverage, and VIX-measured risk perception in global markets. More interestingly, they also indicate that linkage between house prices and VIX are non-linear, depending on leverage of local financial systems.

The results have some implications for international transmission channels of U.S. monetary policy. Previous literature, such as Bekaert et al. (2013) and Bruno and Shin (2015b) revealed that federal fund rate shocks could explain a large part of the variation in U.S. broker-dealer leverage and VIX. Considering these facts, house prices and bank credit are directly or indirectly exposed to cross-border spillover effects of U.S. monetary policy through cross-border banking activity and risk perception in global markets. In other words, country-specific factors, including monetary policy, cannot fully anchor or smooth local financial cycles.

Thus, the results also suggest that house prices in economies with higher leveraged financial sectors seem to be more sensitive to shocks in U.S. monetary policy. This non-linearity in responsiveness to the shocks or spillover effects implies the productiveness of macro-prudential policy. For example, some counter-cyclical regulations on banks' balance sheets could partly insulate local house price cycles from the spillover effects of U.S. monetary policy, as well as smooth or restrain excess fluctuations in local banking activities.

Finally, further research could include an extension of the sample to emerging economies, for which cross-border bank lending is a key funding source. Moreover, policy makers in these economies often underline the undesirable effects of global liquidity and the spillovers of monetary policy in financially developed core countries. In addition, extending the sample would enable us to compare the determinants of house prices and bank credit between the two country groups. Thus, exploring the effects of cross-border bank inflows and VIX on house prices and bank credit in emerging economies will be another interesting topic. This would contribute to a more detailed understanding of the global financial cycle.

Acknowledgments

The author appreciate the helpful comments of Kazuhito Ikeo, Kentaro Iwatsubo, Yasuo Maeda, Se-Jin Min, Masaya Sakuragawa, Kwanho Shin, Shumpei Takemori, Leran Wang, and participants at the International Trade and Finance Association 27th conference, The Korea Money & Finance Association Annual Conference, and Annual Meeting of Japan Society of Monetary Economics. Financial support from Keio Economic Society is greatly acknowledged.

Appendix. Variables and Data Sources

ΔHouse: Residential property price index (log difference). Source: BIS.

ΔCredit: Total bank credit to the private non-financial sector (log difference). Source: BIS.

Bank_Flow: Cross-border bank claims of all BIS reporting countries on the banking sector in a given country (log difference). Source: BIS.

Inflow: Gross capital inflow (divided by external liability). Source: IMF.

Global_Leverage: U.S. broker-dealer leverage defined as the ratio of asset over equity (logged). Source: FRB.

ΔGlobal_Leverage: U.S. broker-dealer leverage defined as the ratio of asset over equity (log difference). Source: FRB.

Global_Bank: Sample sum of cross-border bank claims of all BIS reporting countries on the banking sector, excluding claims on the country under consideration (log difference). Source: BIS.

Global_Flow: Sample sum of gross inflow, excluding the inflow to the country under consideration (divided by sample sum of external liability, excluding the country under consideration). Source: IFS.

VIX: CBOE VIX index of implied volatility of S&P index options (logged). Source: FRED.

ΔVIX: CBOE VIX index of implied volatility of S&P index options (log difference). Source: FRED.

Stock_Vol: 12-month standard deviation of return of local stock price index (logged). Source: FRED.

ΔLong_Rate: Change in interest rate on a 10-year government bond. Source: OECD.

ΔShort_Rate: Change in interest rate on a three-month government bond. Source: OECD.

ΔGDP: GDP growth rate. Source: OECD.

Inflation: Inflation rate. Source: IFS.

ΔREER: Real effective exchange rate (log difference). Source: BIS.

ΔCredit/GDP: Ratio of total bank credit to the private nonfinancial sector to GDP (log difference). Source: BIS.

CreditDev: Deviation of the bank credit to GDP ratio from its trend (calculated using a four-quarter moving average). Source: BIS.

References

Adrian, T., Shin, H.S., 2010. Liquidity and Leverage. J. Financ Intermed 19, 418–437.

Adrian, T., Shin, H.S., 2014. Procyclical Leverage and Value-at-Risk. Rev.Financ. Stud. 27(2), 373–403.

Avdjiev, S., Hardy, B., Kalemli-Ozcan, S., 2017. Gross capital inflows to banks, corporates, and sovereigns. NBER Working Paper No 23116.

Baskaya, Y. S., Di Giovanni,J., Kalemli-Ozcan, S., Ulu, M.F., 2017. International spillovers and local credit cycles. NBER Working Paper No 23149.

Bekaert, G., Hoerova, M., Lo Duca, M., 2013. Risk, uncertainty and monetary policy. J. Monetary Econ. 60, 771–788.

Bernanke, B. S., 2010. Monetary policy and housing bubble. Remarks at the Annual Meeting of the American Economic Association, Atlanta, Georgia, January 3, 2010.

Blanchard, O., Ostry, J.D., Ghosh, A.R., Chamon, M., 2015. Are capital inflows expansionary or contractionary? Theory, policy implications, and some evidence. International Monetary Fund Working Paper Series 15–17.

Brunnermeier, M.K., De Gregorio, J., Lane, P., Rey, H., Shin, H.S., 2012. Banks and cross-border capital flows: policy challenges and regulatory responses. Committee on International Economic Policy and Reform.

Bruno, V., Shin, H.S., 2015a. Cross-border banking and global liquidity. Rev. Econ. Studies 82, 535–564.

Bruno, V., Shin, H.S., 2015b. Capital flows and the risk-taking channel of monetary policy. J. Monetary Econ., 71, 119–132.

Calvo, G., Leiderman, L., Reinhart, C.M., 1993. Capital inflows and real exchange rate appreciation in Latin America. Staff Pap. Int Monet. Fund 40(1), 108–151.

Calvo, G., Leiderman, L., Reinhart, C.M., 1996. Inflows of capital to developing countries in the 1990s. J. Econ. Perspect. 10(2), 123–139.

Cerutti, E., Claessens, S., Puy, D., 2015. Push factors and capital flows to emerging markets: why knowing your lender matters more than fundamentals. IMF Working Paper No 127.

Cerutti, E., Claessens, S., Ratnovski, L., 2017. Global liquidity and cross-border bank flows. Econ. Policy 32(89), 81–125.

Cesa-Bianchi, A., Cespedes, L.F., Rebucci, A., 2015. Global liquidity, house prices, and the macroeconomy: evidence from advanced and emerging economies. J. Money Credit Bank. 47(2), 301–335.

Cesa-Bianchi, A., Martin, F.E., Thwaites, G., 2017. Foreign Booms, Domestic Busts: the global dimension of banking crises. Bank of England Staff Working Paper, No. 644.

Forbes, K.J., Warnock, F.E., 2012. Capital flow waves: surges, stops, flight and retrenchment. J. Int. Econ. 88(2), 235–251.

Gourinchas, P., Obstfeld, M., 2012. Stories of the twentieth century for the twenty-first. Am. Econ. J-Macroecon. 4(1), 226–265.

Hahm, J., Shin, H.S., Shin, K., 2013. Non-Core Bank liabilities and Financial Vulnerability. J. Money Credit Bank. 45(S1), 3–36.

Hale, G. Obstfeld, M., 2016. The Euro and the geography of international debt flows. J. Eur. Econ. Assoc. 14(1), 115–144.

Hirata, H., Kose, M.A., Otrok, C., Terrones, M.E., 2012. Global house price fluctuations: synchronization and determinants. NBER International Seminar on Macroeconomics 2012.

Hume, M., Sentence, A., 2009. The global credit boom: challenges for macroeconomics and policy. J. Int. Money Finance 28, 1426–1461.

Jordà, Ò., Schularick, M., Taylor, A.M., 2015. Leveraged bubbles. J. Mon. Econ. 76, S1–S20.

Jordà, Ò., Schularick, M., Taylor, A.M., 2016a. The great mortgaging: housing finance, crisis and business cycles. Econ Policy 31(85), 107–152.

Jordà, Ò., Schularick, M., Taylor, A.M., 2016b. Macrofinancial history and the new business cycle facts. NBER Working Paper No 22743.

Marinda-Agrippino, S., Rey, H., 2012. World asset markets and global liquidity. Paper presented at the Frankfurt ECB BIS Conference, Mimeo, London Business School.

Marinda-Agrippino, S., Rey, H., 2013. Funding flows and credit in carry trade economics. Paper presented at the conference on "Liquidity and Funding Markets," Federal Reserve of Australia, August 19–20.

Marinda-Agrippino, S., Rey, H., 2015. World asset markets and the global financial cycle. NBER Working Paper No 21722.

McCauley, R., McGuire, P., Sushko, V., 2015. Global Dollar credit: links to U.S. monetary policy and leverage. Econ. Policy. 30(82), 188–229.

McGuire, P., Tarashev, N., 2007. International banking with the Euro. BIS Quart. Rev. 47–61.

Passari, E., Rey, H., 2015. Financial flows and the international monetary system. Econ. J. 125(584), 675–698.

Rey, H., 2013. Dilemma not trilemma: the global financial cycle and monetary policy independence. A Symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 22–24.

Rey, H., 2016. International channels of transmission of monetary policy and the

Mundellian trilemma. NBER Working Paper No 21852.

Schularick, M., Taylor, A.M., 2012. Credit booms gone bust: monetary policy, leverage cycles, and financial crises, 1870–2008. Am. Econ. Rev, 102(2), 1029–1061.

Shin, H. S., 2012. Global banking glut and loan risk premium. IMF Econ. Rev. 60(2), 155–192.

Stock, J., Yogo, M., 2005. Testing for weak instruments in linear IV regression, in: Andrews, D.W.K. (Ed.), Identification and Inference for Econometric Models, Cambridge University Press, New York, pp. 80–108.

Sá, F., Towbin, P., Wieladek, T., 2014. Capital inflows, financial structure and housing booms. J. Eur. Econ. Assoc. 12(2), 522–546.

Sá, F., Wieladek, T., 2015. Capital inflows and the housing boom. J. Money Credit Bank. 47(1), 221–260.

Tobe, S., 2017. Domestic credit growth, international capital inflows, and risk perception in global markets. Econ. Bull. 37(2), 631–636.

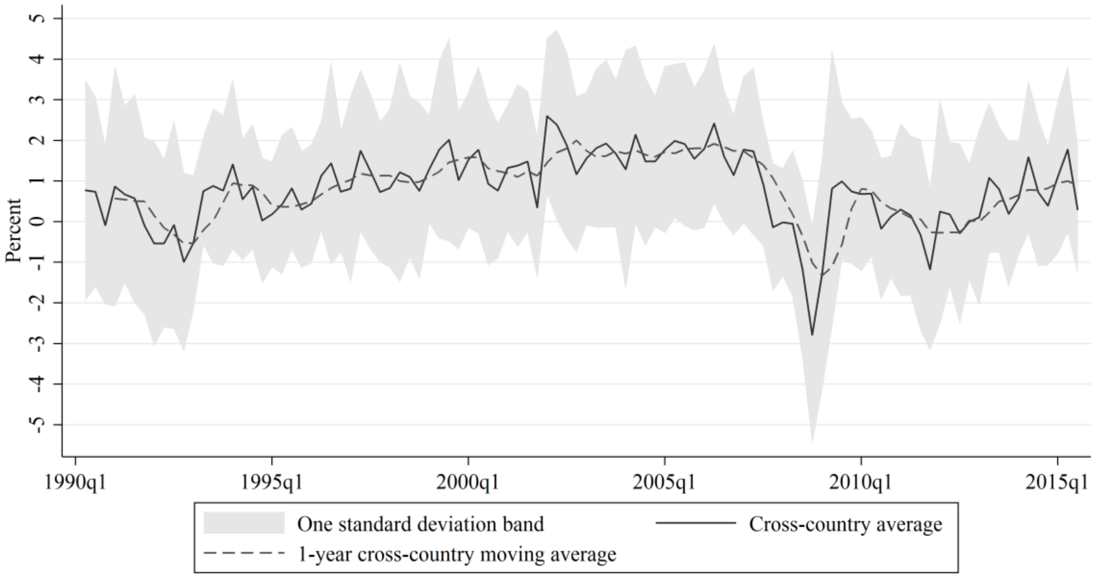

Figure 1. House Price Index (quarterly growth).

NOTES: The solid line is the cross-country average of the quarterly growth rate in house prices. The shaded area represents the one standard deviation band. The dashed line is the one-year moving average.

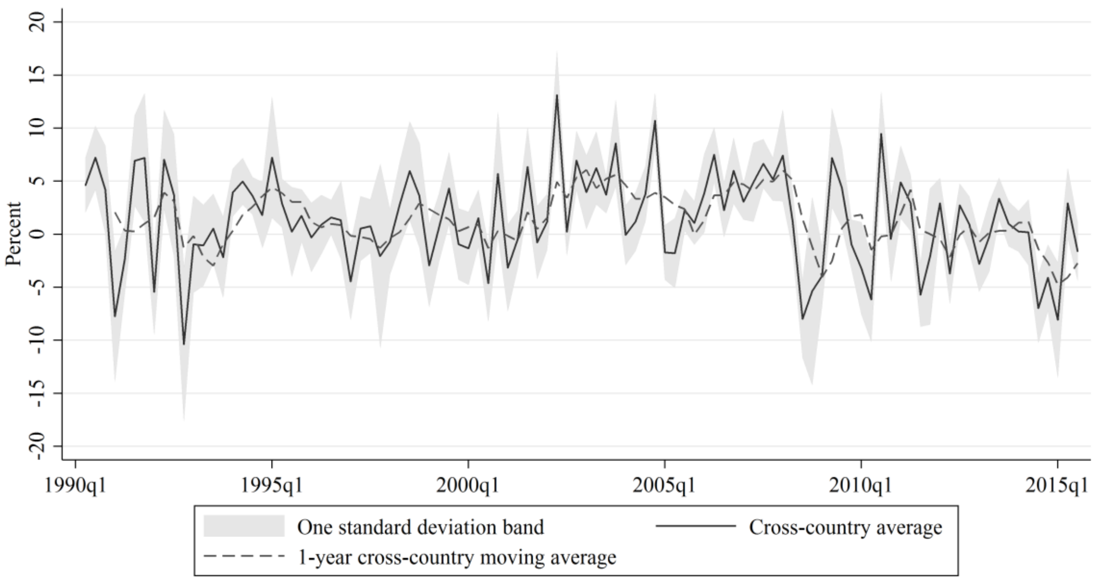

Figure 2. Bank Credit to Non-financial Private Sector (quarterly growth).

NOTES: The solid line is the cross-country average of the quarterly growth rate of bank credit to the non-financial private sector. The shaded area represents the one standard deviation band. The dashed line is the one-year moving average.

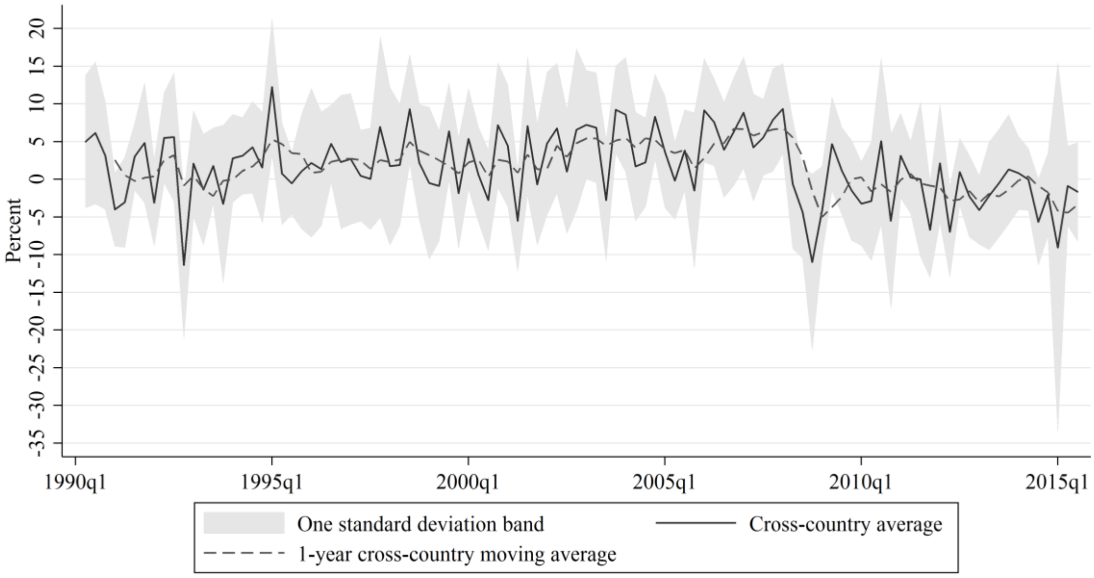

Figure 3. Cross-border Bank Inflow.

NOTES: The solid line is the cross-country average of the quarterly growth rate of cross-border bank claims of all BIS reporting countries on the banking sector. The shaded area represents the one standard deviation band. The dashed line is the one-year moving average.

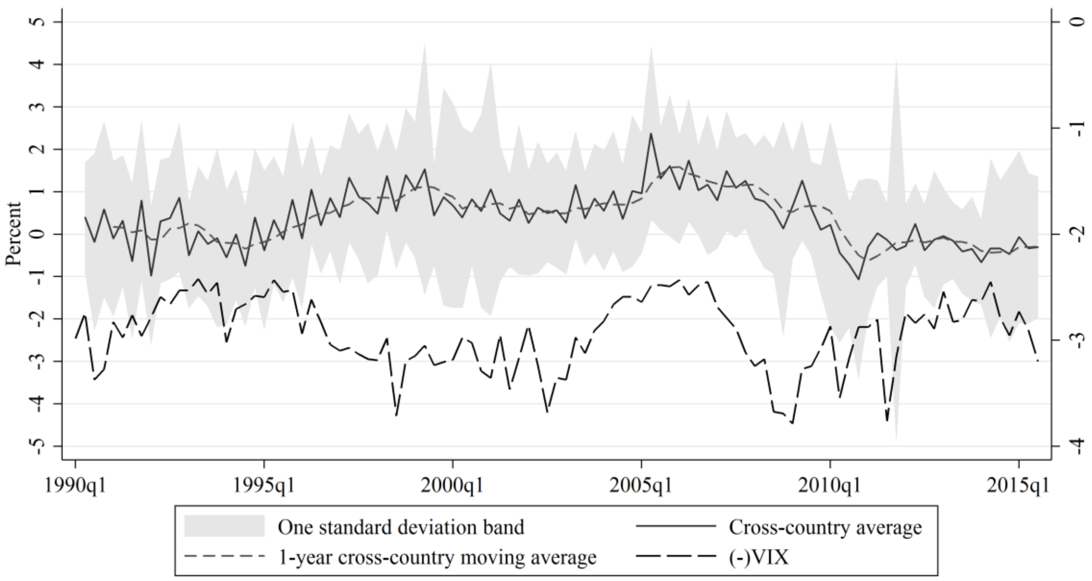

Figure 4. CBOE VIX Index and Bank Credit to GDP Ratio.

NOTES: The dashed black line is the level of VIX (inversed right hand side axis). The solid line is the cross-country average of the quarterly growth rate of bank credit to GDP ratio. The shaded area represents the one standard deviation band. The dashed grey line is the one-year moving average.

	Model 1A		Model 1B		Model 1C	Model 1D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	$Bank_t$	$\Delta House_t$	$Bank_t$	$\Delta House_t$	$\Delta House_t$	$\Delta House_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Endogenous variable						
$Bank\_Flow_t$		0.139***		0.051***	0.120***	0.055***
		(0.021)		(0.013)	(0.018)	(0.014)
Instruments						
$Global\_Leverage_{t-1}$	0.086***					
	(0.011)					
$\Delta Global\_Leverage_t$	0.245**					
	(0.041)					
$Global\_Bank_t$			0.907***			
			(0.065)			
Control variable						
VIX_{t-1}	0.019**	-0.004**	0.010	-0.004**	-0.004**	-0.004**
	(0.007)	(0.002)	(0.006)	(0.001)	(0.002)	(0.001)
ΔVIX_t	0.025***	-0.005**	0.007	-0.003	-0.005**	-0.003
	(0.007)	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)
$Stock\_Vol_{t-1}$	-0.002	0.001	-0.003	0.000	0.000	0.000
	(0.004)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
$\Delta Long\_Rate_{t-1}$	-0.069	-0.255	-1.124***	-0.254	-0.254	-0.254
	(0.710)	(0.219)	(0.353)	(0.166)	(0.207)	(0.168)
ΔGDP_{t-1}	0.713***	0.165***	0.574***	0.247***	0.182***	0.245***
	(0.177)	(0.062)	(0.172)	(0.050)	(0.056)	(0.051)
$Inflation_{t-1}$	-0.079	-0.018	0.114	-0.026	-0.019	-0.025
	(0.331)	(0.141)	(0.323)	(0.132)	(0.139)	(0.133)
$\Delta REER_{t-1}$	0.084	0.001	0.083	0.010	0.003	0.009
	(0.064)	(0.021)	(0.060)	(0.019)	(0.020)	(0.019)
$\Delta House_{t-1}$	0.157	0.340***	0.119	0.368***	0.346***	0.367***
	(0.107)	(0.070)	(0.095)	(0.072)	(0.072)	(0.073)
Constant	-0.344***	0.012**	-0.029	0.014***	0.013**	0.014***
	(0.050)	(0.006)	(0.019)	(0.005)	(0.006)	(0.005)
AR(1)	0.016	0.020	0.019	0.026	0.021	0.026
Fixed effect	Y		Y		Y	Y
Liner trend	Y		Y		Y	Y
F-stat	25.68	-	36.43	-	-	-
Wald χ^2	-	250.58	-	214.23	288.17	215.82
Sargan-Hansen test	2.337		-		55.665	34.967
(p-value)	(0.126)				(0.093)	(0.028)
R^2	0.098	0.154	0.220	0.239	0.171	0.237
Observation	1976		1976		1976	1976
# Country	22		22		22	22

Table 1. IV Regressions on House Prices

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 1A (Model 1D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.

	Model 2A		Model 2B		Model 2C	Model 2D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	$Bank_t$	$\Delta House_t$	$Bank_t$	$\Delta House_t$	$\Delta House_t$	$\Delta House_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Endogenous variable						
$Bank\_Flow_t$		0.138***		0.051***	0.118***	0.054***
		(0.022)		(0.013)	(0.017)	(0.014)
Instruments						
$Global\_Leverage_{t-1}$	0.086***					
	(0.011)					
$\Delta Global\_Leverage_t$	0.245***					
	(0.041)					
$Global\_Bank_t$			0.907***			
			(0.065)			
Control variable						
VIX_{t-1}	0.019**	-0.004**	0.010	-0.004**	-0.004**	-0.004**
	(0.007)	(0.002)	(0.007)	(0.001)	(0.002)	(0.001)
ΔVIX_t	0.025***	-0.005**	0.008	-0.003	-0.005**	-0.003
	(0.007)	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)
$\Delta VIX_t * \Delta Credit/GDP_t$	-0.602	-0.060	-0.570	-0.105	-0.071	-0.104
	(0.372)	(0.093)	(0.402)	(0.077)	(0.089)	(0.077)
$\Delta VIX_{t-1} * \Delta Credit/GDP_{t-1}$	-0.389	-0.242**	-0.398	-0.280**	-0.251*	-0.278**
	(0.487)	(0.101)	(0.479)	(0.116)	(0.103)	(0.115)
$Stock\_Vol_{t-1}$	-0.002	0.001	-0.003	0.000	0.000	0.000
	(0.004)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
$\Delta Long\_Rate_{t-1}$	-0.031	-0.241	-1.087***	-0.237	-0.240	-0.237
	(0.709)	(0.218)	(0.351)	(0.166)	(0.206)	(0.167)
ΔGDP_{t-1}	0.711***	0.168***	0.574***	0.250***	0.187***	0.248***
	(0.179)	(0.061)	(0.174)	(0.050)	(0.056)	(0.051)
$Inflation_{t-1}$	-0.048	-0.013	0.144	-0.019	-0.015	-0.019
	(0.322)	(0.138)	(0.319)	(0.131)	(0.136)	(0.131)
$\Delta REER_{t-1}$	0.082	0.000	0.080	0.008	0.001	0.007
	(0.065)	(0.001)	(0.062)	(0.018)	(0.020)	(0.018)
$\Delta House_{t-1}$	0.152	0.338***	0.115	0.366***	0.344***	0.365***
	(0.101)	(0.070)	(0.089)	(0.072)	(0.072)	(0.072)
Constant	-0.345***	0.012**	-0.029	0.014***	0.013**	0.014***
	(0.050)	(0.006)	(0.019)	(0.005)	(0.006)	(0.005)
AR(1)	0.016	0.019	0.019	0.026	0.020	0.025
Fixed effect	Y		Y		Y	Y
Liner trend	Y		Y		Y	Y
F-stat	42.29	-	69.07	-	-	-
Wald χ^2	-	329.59	-	366.9	364.87	341.88
Sargan-Hansen test	1.955		-		55.599	34.506
(p-value)	(0.162)				(0.094)	(0.032)
R^2	0.100	0.157	0.221	0.244	0.176	0.242
Observation	1976		1976		1976	1976
# Country	22		22		22	22

Table 2. IV Regressions on House Prices with Interaction Terms of Local Leverage

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 2C (Model 2D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.

	Model 3A		Model 3B		Model 3D	Model 3D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	Bank$_t$	ΔCredit$_t$	Bank$_t$	ΔCredit$_t$	ΔCredit$_t$	ΔCredit$_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Endogenous variable						
Bank_Flow$_t$		0.624***		0.864***	0.543***	0.874***
		(0.079)		(0.046)	(0.058)	(0.041)
Instruments						
Global_Leverage$_{t-1}$	0.081***					
	(0.011)					
ΔGlobal_Leverage$_t$	0.239***					
	(0.036)					
Global_Bank$_t$			0.851***			
			(0.060)			
Control variable						
VIX$_{t-1}$	0.016**	-0.007*	0.007	-0.008*	-0.006*	-0.008*
	(0.006)	(0.004)	(0.006)	(0.005)	(0.003)	(0.005)
ΔVIX$_t$	0.023***	-0.022***	0.004	-0.027***	-0.020***	-0.027***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Stock_Vol$_{t-1}$	-0.006	0.008***	-0.007**	0.012***	0.006***	0.012***
	(0.004)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
ΔShort_Rate$_{t-1}$	-0.394**	-0.336**	-0.381***	-0.274*	-0.357**	-0.271
	(0.142)	(0.142)	(0.123)	(0.155)	(0.140)	(0.156)
ΔGDP$_{t-1}$	0.778***	0.047	0.605***	-0.198	0.131	-0.209
	(0.142)	(0.168)	(0.150)	(0.209)	(0.171)	(0.210)
Inflation$_{t-1}$	0.077	0.273	0.175	0.268	0.275	0.268
	(0.246)	(0.249)	(0.236)	(0.295)	(0.235)	(0.297)
ΔREER$_{t-1}$	0.002	-0.060	0.000	-0.043	-0.065	-0.042
	(0.076)	(0.069)	(0.069)	(0.079)	(0.064)	(0.080)
ΔCredit$_{t-1}$	0.124***	-0.007	0.103**	-0.056**	0.009	-0.058**
	(0.039)	(0.029)	(0.040)	(0.023)	(0.022)	(0.024)
Constant	-0.314***	0.005	-0.011	0.000	0.008	0.000
	(0.045)	(0.012)	(0.020)	(0.015)	(0.011)	(0.015)
AR(1)	0.007	0.008	0.008	0.009	0.008	0.009
Fixed effect	Y		Y		Y	Y
Liner trend	Y		Y		Y	Y
F-stat	21.47	-	38.62	-	-	-
Wald χ^2	-	534.31	-	865.34	511.17	901.6
Sargan-Hansen test	0.113		-		48.593	22.767
(p-value)	(0.736)				(0.257)	(0.356)
R^2	0.096	0.188	0.205	0.181	0.191	0.181
Observation	2179		2179		2179	2179
# Country	22		22		22	22

Table 3. IV Regressions on Bank Credit

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 3C (Mode 3D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.

	Model 4A		Model 4B		Model 4C	Model 4D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	$Bank_t$	$\Delta Credit_t$	$Bank_t$	$\Delta Credit_t$	$\Delta Credit_t$	$\Delta Credit_t$
	(1)	(2)	(3)	(4)	(5)	(6)
<u>Endogenous variable</u>						
$Bank\_Flow_t$		0.627***		0.864***	0.542***	0.873***
		(0.078)		(0.045)	(0.057)	(0.041)
<u>Instruments</u>						
$Global\_Leverage_{t-1}$	0.081***					
	(0.011)					
$\Delta Global\_Leverage_t$	0.239***					
	(0.036)					
$Global\_Bank_t$			0.851***			
			(0.060)			
<u>Control variable</u>						
VIX_{t-1}	0.016**	-0.007*	0.008	-0.008*	-0.007*	-0.009*
	(0.006)	(0.004)	(0.006)	(0.005)	(0.003)	(0.005)
ΔVIX_t	0.024***	-0.021***	0.004	-0.026***	-0.019***	-0.026***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
ΔVIX_t*$\Delta Credit/GDP_t$	-0.334	-0.515*	-0.328	-0.451	-0.538*	-0.449
	(0.441)	(0.309)	(0.451)	(0.370)	(0.299)	(0.374)
ΔVIX_{t-1}*$\Delta Credit/GDP_{t-1}$	-0.386	0.293	-0.455	0.385	0.259	0.389
	(0.425)	(0.267)	(0.421)	(0.360)	(0.243)	(0.363)
$Stock\_Vol_{t-1}$	-0.006	0.008***	-0.007*	0.012***	0.007***	0.012***
	(0.004)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
$\Delta Short\_Rate_{t-1}$	-0.381**	-0.322**	-0.368***	-0.264*	-0.343**	-0.262*
	(0.142)	(0.145)	(0.117)	(0.158)	(0.141)	(0.158)
ΔGDP_{t-1}	0.776***	0.029	0.605***	-0.214	0.116	-0.223
	(0.144)	(0.168)	(0.153)	(0.210)	(0.171)	(0.210)
$Inflation_{t-1}$	0.082	0.295	0.178	0.289	0.297	0.289
	(0.244)	(0.244)	(0.240)	(0.289)	(0.230)	(0.291)
$\Delta REER_{t-1}$	0.002	-0.062	0.000	-0.046	-0.068	-0.045
	(0.077)	(0.068)	(0.069)	(0.079)	(0.063)	(0.079)
$\Delta Credit_{t-1}$	0.122***	-0.004	0.101**	-0.052*	0.013	-0.054**
	(0.039)	(0.028)	(0.039)	(0.022)	(0.022)	(0.023)
Constant	-0.315***	0.006	-0.011	0.000	0.008	0.008
	(0.046)	(0.012)	(0.020)	(0.015)	(0.011)	(0.015)
AR(1)	0.007	0.008	0.008	0.009	0.008	0.009
Fixed effect	Y		Y		Y	Y
Liner trend	Y		Y		Y	Y
F-stat	33.93	-	55.33	-	-	-
Wald χ^2	-	766.87	-	1123.15	875.59	1170.4
Sargan-Hansen test	0.076		-		48.007	22.520
(p-value)	(0.783)				(0.277)	(0.370)
R^2	0.097	0.190	0.206	0.183	0.193	0.183
Observation	2179		2179		2179	2179
# Country	22		22		22	22

Table 4. IV Regressions on Bank Credit with Interaction Terms of Local Leverage

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 4C (Model 4D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.

	Dependent Variable: $\Delta House_t$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Bank\_Flow_t$	0.021**	0.021**			0.020**	0.020**		
	(0.009)	(0.009)			(0.008)	(0.008)		
VIX_{t-1}	0.002		0.002		0.002		0.002	
	(0.002)		(0.002)		(0.002)		(0.002)	
ΔVIX_{t-1}	-0.012***	-0.011***	-0.012***	-0.010***	-0.012***	-0.011***	-0.012***	-0.010***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
$\Delta VIX_{t-1}*\Delta Credit/GDP_{t-1}$					-0.307*	-0.307*	-0.317*	-0.318*
					(0.173)	(0.170)	(0.179)	(0.176)
$\Delta VIX_{t-2}*\Delta Credit/GDP_{t-2}$					-0.160**	-0.157**	-0.166***	-0.162**
					(0.057)	(0.056)	(0.058)	(0.057)
$Stock\_Vol_{t-1}$	-0.004**	-0.003*	-0.005**	-0.003*	-0.005**	-0.003*	-0.005**	-0.004**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
$\Delta Long\_Rate_{t-1}$	-0.254	-0.249	-0.264	-0.259	-0.232	-0.226	-0.242	-0.236
	(0.171)	(0.174)	(0.165)	(0.168)	(0.167)	(0.170)	(0.161)	(0.164)
ΔGDP_{t-1}	0.549***	0.540***	0.571***	0.562***	0.543***	0.534***	0.564***	0.555***
	(0.073)	(0.072)	(0.072)	(0.071)	(0.074)	(0.074)	(0.074)	(0.073)
$Inflation_{t-1}$	-0.016	-0.021	0.000	-0.006	-0.002	-0.008	0.012	0.006
	(0.129)	(0.131)	(0.131)	(0.132)	(0.133)	(0.135)	(0.135)	(0.137)
$\Delta REER_{t-1}$	0.038	0.038	0.049**	0.049**	0.036	0.036	0.046*	0.047**
	(0.024)	(0.024)	(0.022)	(0.022)	(0.024)	(0.024)	(0.022)	(0.022)
Constant	0.004	0.010	0.004	0.011**	0.004	0.010	0.004	0.011***
	(0.007)	(0.003)	(0.007)	(0.004)	(0.007)	(0.003)	(0.007)	(0.004)
AR(1)	0.049	0.051	0.051	0.053	0.050	0.052	0.051	0.054
Fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Liner trend	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.123	0.121	0.115	0.113	0.130	0.128	0.123	0.120
Observation	1979	1979	1979	1979	1962	1962	1962	1962
# Country	22	22	22	22	22	22	22	22

Table 5. OLS Regressions on House Prices

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

	Dependent Variable: $\Delta Credit_t$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Bank\_Flow_t$	0.032**	0.032**			0.032**	0.032**		
	(0.014)	(0.014)			(0.014)	(0.014)		
VIX_{t-1}	0.001		0.001		0.001		0.002	
	(0.003)		(0.003)		(0.003)		(0.003)	
ΔVIX_{t-1}	-0.005**	-0.004*	-0.005**	-0.004*	-0.004*	-0.003	-0.004*	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\Delta VIX_{t-1}*\Delta Credit/GDP_{t-1}$					0.056	0.055	0.047	0.046
					(0.174)	(0.174)	(0.178)	(0.178)
$\Delta VIX_{t-2}*\Delta Credit/GDP_{t-2}$					-0.216	-0.214	-0.226	-0.223
					(0.159)	(0.160)	(0.164)	(0.165)
$Stock\_Vol_{t-1}$	-0.003	-0.002	-0.003	-0.003	-0.003	-0.003	-0.004	-0.003
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
$\Delta Short\_Rate_{t-1}$	-0.462***	-0.462***	-0.453***	-0.453***	-0.439***	-0.439***	-0.429***	-0.430***
	(0.143)	(0.143)	(0.138)	(0.139)	(0.133)	(0.133)	(0.129)	(0.129)
ΔGDP_{t-1}	0.732***	0.728***	0.765***	0.761***	0.722***	0.717***	0.754***	0.748***
	(0.160)	(0.155)	(0.159)	(0.154)	(0.165)	(0.160)	(0.164)	(0.160)
$Inflation_{t-1}$	0.258	0.256	0.285	0.282	0.229	0.226	0.253	0.250
	(0.180)	(0.181)	(0.175)	(0.175)	(0.180)	(0.180)	(0.176)	(0.176)
$\Delta REER_{t-1}$	0.018	0.018	0.034	0.034	0.016	0.016	0.031	0.032
	(0.044)	(0.044)	(0.041)	(0.042)	(0.044)	(0.044)	(0.041)	(0.042)
Constant	0.011	0.015**	0.012	0.016**	0.009	0.014**	0.009	0.015**
	(0.010)	(0.006)	(0.010)	(0.006)	(0.010)	(0.006)	(0.010)	(0.006)
AR(1)	0.006	0.006	0.006	0.006	0.006	0.006	0.007	0.006
Fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Liner trend	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.033	0.033	0.030	0.030	0.030	0.030	0.028	0.028
Observation	2179	2179	2179	2179	2159	2159	2159	2159
# Country	22	22	22	22	22	22	22	22

Table 6. OLS Regressions on Bank Credit

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

	$\Delta House_t$				$\Delta Credit_t$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Bank\_Flow_t$	0.019**	0.020**			0.030**	0.031**		
	(0.008)	(0.008)			(0.013)	(0.013)		
VIX_{t-1}	0.003		0.003		0.007*		0.007**	
	(0.002)		(0.002)		(0.003)		(0.003)	
ΔVIX_{t-1}	-0.012***	-0.010***	-0.012***	-0.010***	-0.011***	-0.007**	-0.010***	-0.006**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)
$\Delta VIX_{t-1}*CreditDev_{t-1}$	-0.003***	-0.003***	-0.003***	-0.003***	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
$\Delta VIX_{t-2}*CreditDev_{t-2}$	-0.002***	-0.002***	-0.002***	-0.002***	-0.002	-0.002	-0.002	-0.002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)
$Stock\_Vol_{t-1}$	-0.005***	-0.004**	-0.005***	-0.004**	-0.005	-0.002	-0.005*	-0.002
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)	(0.002)
$\Delta Long\_Rate_{t-1}$	-0.220	-0.214	-0.230	-0.224				
	(0.155)	(0.159)	(0.149)	(0.153)				
$\Delta Short\_Rate_{t-1}$					-0.381***	-0.383***	-0.371***	-0.373***
					(0.110)	(0.112)	(0.106)	(0.107)
ΔGDP_{t-1}	0.522***	0.511***	0.543***	0.532***	0.746***	0.728***	0.778***	0.760***
	(0.069)	(0.068)	(0.068)	(0.067)	(0.165)	(0.161)	(0.167)	(0.163)
$Inflation_{t-1}$	-0.002	-0.011	0.012	0.002	0.290	0.273	0.315*	0.297
	(0.145)	(0.148)	(0.147)	(0.150)	(0.181)	(0.179)	(0.177)	(0.175)
$\Delta REER_{t-1}$	0.033	0.034	0.044*	0.044*	0.014	0.016	0.029	0.031
	(0.025)	(0.024)	(0.023)	(0.023)	(0.042)	(0.043)	(0.040)	(0.041)
Constant	0.003	0.011***	0.004	0.012***	0.001	0.015**	-0.001	0.016**
	(0.007)	(0.003)	(0.007)	(0.003)	(0.010)	(0.006)	(0.010)	(0.006)
AR(1)	0.053	0.055	0.055	0.057	0.007	0.006	0.007	0.007
Fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Liner trend	Y	Y	Y	Y	Y	Y	Y	Y
R^2	0.130	0.127	0.123	0.120	0.035	0.034	0.033	0.032
Observation	1928	1928	1928	1928	2119	2119	2119	2119
# Country	22	22	22	22	22	22	22	22

Table 7. OLS Regressions with Alternative Measure for Local Leverage

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively.

	Model 8A		Model 8B		Model 8C	Model 8D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	$Inflow_t$	$\Delta House_t$	$Inflow_t$	$\Delta House_t$	$\Delta House_t$	$\Delta House_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Endogenous variable						
$Inflow_t$		0.168***		0.090***	0.065**	0.079***
		(0.043)		(0.027)	(0.025)	(0.023)
Instruments						
$Global\_Leverage_{t-1}$	0.065***					
	(0.015)					
$\Delta Global\_Leverage_t$	0.179***					
	(0.036)					
$Global\_Flow_t$			0.716***			
			(0.101)			
Control variable						
VIX_{t-1}	0.004	-0.003	0.009	-0.003*	-0.003*	-0.003*
	(0.007)	(0.002)	(0.008)	(0.002)	(0.002)	(0.002)
ΔVIX_t	0.005	-0.004*	0.008	-0.004*	-0.004*	-0.004*
	(0.005)	(0.002)	(0.006)	(0.002)	(0.002)	(0.002)
$Stock\_Vol_{t-1}$	-0.006	0.002	-0.002	0.001	0.000	0.001
	(0.005)	(0.001)	(0.005)	(0.001)	(0.001)	(0.001)
$\Delta Long\_Rate_{t-1}$	0.274	-0.253***	0.069	-0.226**	-0.218**	-0.223**
	(0.645)	(0.088)	(0.698)	(0.091)	(0.093)	(0.094)
ΔGDP_{t-1}	0.688***	0.119*	0.305	0.188***	0.210***	0.198***
	(0.206)	(0.066)	(0.214)	(0.056)	(0.067)	(0.057)
$Inflation_{t-1}$	0.173	-0.123	0.211	-0.110	-0.105	-0.108
	(0.487)	(0.140)	(0.531)	(0.126)	(0.125)	(0.125)
$\Delta REER_{t-1}$	0.011	0.000	0.015	0.002	0.003	0.002
	(0.081)	(0.015)	(0.077)	(0.015)	(0.016)	(0.016)
$\Delta House_{t-1}$	0.203	0.397***	0.218*	0.425***	0.434***	0.429***
	(0.119)	(0.075)	(0.118)	(0.077)	(0.075)	(0.076)
Constant	-0.153**	-0.005	-0.002	0.004	0.008	0.006
	(0.060)	(0.009)	(0.025)	(0.006)	(0.006)	(0.005)
AR(1)	0.050	0.066	0.051	0.056	0.052	0.054
Fixed effect	Y		Y		Y	Y
Linear trend	Y		Y		Y	Y
F-stat	17.00	-	14.08	-	-	-
Wald χ^2	-	194.13	-	205.43	315.43	192.66
Sargan-Hansen test	2.518		-		77.021	38.248
(p-value)	(0.112)				(0.000)	(0.005)
R^2	0.125	0.177	0.191	0.263	0.290	0.276
Observation	1732		1732		1732	1732
# Country	22		22		22	22

Table 8. Determinants of House Price Using Total Inflows

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 9C (Model 9D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.

	Model 9A		Model 9B		Model 9C	Model 9D
	1st stage	2nd stage	1st stage	2nd stage	2nd stage	2nd stage
	Inflow$_t$	ΔHouse$_t$	Inflow$_t$	ΔHouse$_t$	ΔHouse$_t$	ΔHouse$_t$
	(1)	(2)	(3)	(4)	(5)	(6)
Endogenous variable						
Inflow$_t$		0.169***		0.090***	0.063**	0.077***
		(0.044)		(0.027)	(0.025)	(0.023)
Instruments						
Global_Leverage$_{t-1}$	0.066***					
	(0.015)					
ΔGlobal_Leverage$_t$	0.180***					
	(0.037)					
Global_Flow$_t$			0.717***			
			(0.099)			
Control variable						
VIX$_{t-1}$	0.004	-0.003	0.009	-0.003*	-0.003*	-0.003*
	(0.007)	(0.002)	(0.008)	(0.002)	(0.002)	(0.002)
ΔVIX$_t$	0.006	-0.004*	0.009	-0.004*	-0.004*	-0.004*
	(0.005)	(0.002)	(0.006)	(0.002)	(0.002)	(0.002)
ΔVIX$_t$*ΔCredit/GDP$_t$	-0.694**	-0.136	-0.652**	-0.184**	-0.200**	-0.192**
	(0.249)	(0.095)	(0.266)	(0.092)	(0.084)	(0.091)
ΔVIX$_{t-1}$*ΔCredit/GDP$_{t-1}$	-0.183	-0.165*	-0.201	-0.177**	-0.182**	-0.179**
	(0.332)	(0.088)	(0.276)	(0.083)	(0.080)	(0.083)
Stock_Vol$_{t-1}$	-0.006	0.001	-0.002	0.000	0.000	0.000
	(0.005)	(0.001)	(0.005)	(0.001)	(0.001)	(0.001)
ΔLong_Rate$_{t-1}$	0.311	-0.239***	0.106	-0.209**	-0.199**	-0.204**
	(0.648)	(0.089)	(0.699)	(0.091)	(0.092)	(0.093)
ΔGDP$_{t-1}$	0.685***	0.120*	0.303	0.189***	0.213***	0.201***
	(0.199)	(0.066)	(0.206)	(0.057)	(0.068)	(0.058)
Inflation$_{t-1}$	0.213	-0.115	0.248	-0.099	-0.093	-0.096
	(0.488)	(0.140)	(0.533)	(0.126)	(0.125)	(0.125)
ΔREER$_{t-1}$	0.009	-0.001	0.012	0.000	0.001	0.001
	(0.081)	(0.015)	(0.077)	(0.015)	(0.016)	(0.016)
ΔHouse$_{t-1}$	0.202*	0.395***	0.218*	0.423***	0.432***	0.428***
	(0.115)	(0.073)	(0.115)	(0.075)	(0.073)	(0.074)
Constant	-0.155**	-0.005	-0.002	0.004	0.008	0.006
	(0.061)	(0.009)	(0.025)	(0.006)	(0.006)	(0.005)
AR(1)	0.051	0.064	0.053	0.053	0.048	0.051
Fixed effect	Y		Y		Y	Y
Linear trend	Y		Y		Y	Y
F-stat	17.48	-	16.57	-	-	-
Wald χ^2	-	208.45	-	271.84	358.28	334.60
Sargan-Hansen test	2.233		-		78.450	38.475
(p-value)	(0.135)				(0.000)	(0.005)
R^2	0.126	0.179	0.192	0.267	0.297	0.282
Observation	1732		1732		1732	1732
# Country	22		22		22	22

Table 9. Determinants of House Price Using Total Inflows with Interaction Terms

Note: Standard errors clustering at the country level are reported in parentheses. ***, **, and * denote significance at the 1, 5, and 10% levels, respectively. Model 10C (Model 10D) uses interaction terms of global leverage (global flow) with country-specific dummies as instruments.