

Credit, housing prices, expectations, and the macroeconomy. Evidence from developed and developing countries

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Abstract. *The interlinkages between housing and credit markets can be critical for financial and overall macroeconomic stability. This paper empirically examines the impact of housing prices and expectations on debt buildups. These linkages are analyzed for a set of 41 countries that includes 28 developed and 13 developing countries using dynamic panel estimation over the sample period from 1997:Q1 to 2020:Q1. The findings indicate that the amount of credit generated in an economy is significantly related to housing and equity prices (indicators of sentiments and expectations) in developed and developing economies.*

Keywords: expectations, housing prices, macro economy, equity prices, mortgages.

JEL Classification: D84, E44.

1. Introduction

It has been pointed out that an expansion of credit need not inevitably lead to a growth in productive activity; instead, it may increase the demand and price of fixed assets (such as real estate) (Stiglitz, 2018). Expectations of borrowers and lenders regarding the economy's performance and asset prices can influence the credit-house price relation significantly. Indeed, different types of expectation formation mechanisms can work in an economy. For example, it can be based on adaptive expectations or sentiments about the economy's overall state.

With adaptive expectations, lenders believe that future house price movements will be the same as current ones. Thus, if housing prices rise, they will continue to grow. If this expectation formation mechanism works, we should find credit and house price cycles moving together. Another expectation formation could be related to the overall state of the economy. Lenders may believe that if the economy is expected to grow, so do the real estate sector. Thus, lenders' sentiments about the state of an economy may influence their lending decisions. Suppose such a type of belief system or expectation formation mechanism prevails. In that case, credit and equity price cycles are expected to move together, primarily if equity prices closely reflect expectations about the economy.

Since both demand and supply factors influence credit, one needs to examine these factors more closely. Supply factors include factors such as domestic deposit growth. At the same time, demand factors include economic growth, inflation, and loose monetary conditions, domestic or global. Given the aftermath of the recent global financial crisis, it is observed that domestic credit is linked with an even broader set of variables that were not included in such an analysis. Gennaioli, Shleifer, and Vishny (2015) argue that many debt investors ignore the existence of the downturn of the distribution of possible results, assuming that risky instruments are close to risk-free. When the initial problems emerge, they bring the down tail of the distribution into their consciousness and decision-making, generating self-reinforcing downward cycles of credit supply, liquidity, and asset prices. Hence, investors' expectations play a crucial role in the credit market that can be quantified using banks' risk-weighted assets or the proportion of risky instruments in bank portfolios. Equity prices also signal the confidence level of investors.

House price is also a crucial factor influencing credit in an economy. The amount of credit generated in an economy closely correlates with housing prices in developed and developing economies. Also, varying the maximum loan-to-value ratio helps stabilize house prices. Mendiratta (2016) provides evidence from Indian cities where real estate prices influence banks' lending behavior. The author also identified a few Indian cities where credit impacts housing prices and where this relation is bi-directional. Arora and Dastidar (2022), exploring long-run causality between credit and housing prices for Emerging Market Economies (EMEs), found that the mortgage market influences housing prices in an upward direction in some EMEs found evidence of real estate pricing impacting the credit market in others. Hence, the relationship between credit and house price may be bidirectional, and any analysis dealing with these variables must strictly deal with this endogeneity.

Against this backdrop, this paper empirically investigates the influence of housing prices and the expectation of lenders on the amount of credit generated in the economy. A holistic perspective on this issue is provided by including a set of 41 countries, including 28 developed and 13 developing countries. These linkages are analyzed over the sample period from 1997:Q1-2020:Q1 to examine the relationship between credit and house prices before and after the subprime crisis, accounting for any developments over time.

The paper is organized as follows: Section 2 reviews the empirical literature on the relationship between credit and housing prices. Section 3 describes an analytical framework. The description of the data and variables used is given in Section 4. Section 5 outlines the research model and methodology employed in the study, followed by Section 6, which presents an analysis of the data with descriptive statistics and critical features of variables. Section 7 provides the empirical estimates and the main findings. Finally, Section 8 concludes and provides policy implications.

2. Literature review

Pre-crisis (Pre-crisis and post-crisis refer to the 2008 financial crisis that originated in the US subprime crisis) empirical modeling on determinants of bank credit did not include housing prices as a determinant of bank credit. Guo and Stepanyan (2011) examine the determinants of bank credit in emerging market economies. Their results show that domestic and foreign funding contribute positively to growth in credit; however, the authors have yet to include housing prices as a critical variable influencing recognition. Sharma and Govender (2012), analyzing the determinants of bank credit in six small open economies of Pacific island countries, do not include housing prices as a critical variable determining credit. The Results show that deposits contribute positively to credit growth. More robust economic growth also leads to higher credit growth.

The banking crisis is typically seen to be preceded by housing price bubbles and credit booms (Reinhart and Rogoff, 2009). Post-crisis theories or more recent literature link banking crises with asset price bubbles rather than economic fundamentals. Such literature has an element of irrational behavior (Hott, 2011) or information asymmetry.

The most recent work on housing prices and their role in creating or aggravating banking sector problems has identified credit boom as a strong predictor of a banking crisis. In particular, researchers have examined the interaction between the boom in bank credit and housing prices. For example, Cerutti et al. (2017) analyze the dynamic relationship between household credit and house price booms using a data set from 1970-2012 on housing finance and house prices for a sample of more than 50 countries. They find that credit and house price booms are tightly linked. House price booms have mostly occurred with simultaneous booms in both firm and household credit rather than a solo boom in Household credit.

Many papers have identified and discussed the interaction between real estate and loan markets post-crisis, giving empirical evidence mostly from a developed country. Real estate markets can be viewed in terms of commercial or residential property. Davis and

Zhu (2011) investigate the interaction between commercial property prices and aggregate Bank lending by illustrating a theoretical model suggesting that lending is closely related to property prices. Their empirical analysis of dynamic interaction also suggests that own lagged shocks largely explain variance in commercial property prices. At the same time, GDP and Bank credit also have a significant impact. Another paper by Goodhart and Hofmann (2008) finds evidence of an essential multidirectional link between house prices, monetary variables, and the macroeconomy. The connection between house prices and economic variables is more robust over a more recent period from 1985 to 2006. There is also evidence of reverse causality from credit to housing prices in developed countries. Tsataronis and Zhu (2004) find that house prices generally depend on inflation, bank credit, and the yield curve. Also, more aggressive lending practices are associated with more substantial feedback from prices to bank credit. Levitin and Wachter (2012) demonstrated that the housing bubble in the United States before the crisis period was attributable to an oversupply of mortgage finance. Hence, according to the authors, the housing bubble was a supply-side phenomenon caused by excess mispriced mortgage finance.

There are other country-specific studies on credit and its determinants. Using Chinese city-level data, Huang et al. (2015) suggest that recognition plays a vital role in dealing with house prices, whereas housing prices only influence credit before 2008. They used multi-step estimation and included one-year lagged variables as regressors to address the endogeneity problem. Applying a non-linear modeling approach, Zhang et al. (2012) analyze the determinants of housing prices in China from 1999:01 to 2010:06. They found that mortgage rate, producer price, and broad money supply are key variables influencing housing prices. In contrast, actual economic variables like income are not significant.

On the one hand, it appears that rising real estate prices tend to enhance mortgage-based lending by banks (e.g., as observed by Gimeno and Martinez-Carrascal, 2010 based on Spanish data and by Gerlach and Peng, 2005, based on data from Hong Kong). On the other, the willingness of banks to lend against real estate-based collateral itself can drive up property prices (e.g., Mora, 2008 finds such evidence from Japan's real estate boom in the 1980s decade), which would explain why banking crises are followed by prolonged and precipitous fall in housing prices.

Existing post-crisis literature also recognizes the role of expectations in influencing the lending behavior of lenders (e.g., Hott, 2011 and Brueckner et al., 2012). Brueckner et al. (2012) construct a theoretical model that seeks to explain subprime mortgage lending by banks. The model shows that upward movement in house prices spurs bank lending to subprime borrowers as it reduces their default probability through the wealth effect. In turn, this increases housing demand and pushes house prices further. So subprime lending is as much a cause as an effect of the rise in house prices. In this model, lenders' expectation regarding house price trends is essential in driving the results. A shift in lenders' expectations (e.g., based on the past appreciation in house prices) is a crucial factor driving subprime loans. The theoretical model in Brueckner et al. (2012) captures the two-way relationship between mortgage lending and the housing market. As lenders expect a rise in house prices, the extent of subprime lending expands, fueling a surge in housing demand and an increase in the stock of houses, which drives house prices down. With a fall in house

prices, there is a rise in defaults and consequent financial instability. The authors also tentatively supported their model by empirically exploring the link between subprime lending and expectations. They used past price appreciation as a proxy for lenders' expectations regarding future prices.

The existing literature needs to explicitly model the cycles in credit and housing prices. Most existing cross-country literature on modeling credit and housing prices is for developed countries. This paper adds to the existing literature by incorporating a more extensive set of countries, including 28 developed and 13 developing countries. It analyzes the interaction between cycles in credit, cycles in housing prices, and macroeconomy using a more recent dataset spanning from 1997 to 2020. We also look separately into two components of credit, i.e., credit given to households and non-financial corporations. Moreover, we contribute to the literature by analyzing the role of the expectations of lenders about asset prices in credit and house price dynamics. We also explicitly include the exchange rates in the dynamic interaction of credit, house prices, and the macroeconomy.

3. Analytical framework

The analytical framework considers the existence of a two-way causality between house prices and credit. Accordingly, this section analyses the factors that influence this two-way relation and examines other factors likely to determine the volume of credit in an economy. The following section's discussion forms the basis for the empirical model.

3.1. Effect of house prices on credit

Housing prices influence credit in two ways: the demand for credit and the supply of credit. Due to the problem of asymmetric information in credit markets, giving rise to adverse selection and moral hazard problems, financial intermediaries often lend by taking a house (mortgaged property) in the form of collateral. Hence, changes in house prices change the borrowing capacity of the household and, hence, credit demand from households. Secondly, a rise in nominal house prices also increases credit demand, as investors require more financing to purchase a house. During the house price boom, the wealth of homeowners rises, and they tend to perceive that this wealth effect will allow them to achieve greater lifetime consumption, inducing them to spend and borrow more. Thus, rising housing prices encourage consumption spending through the wealth effect, increasing the demand for credit. Housing prices may also increase credit demand for capital gains on higher valuations.

An increase in housing prices increases the supply of credit by increasing the valuation of investments in real estate assets, thereby increasing lenders' capacity to lend. Also, rising property prices may lead to speculative lending by lenders. In contrast, a fall in property price, especially a drastic fall, may reduce the motivation to repay the loan on the part of households. Falling prices hence increase the proportion of non-performing loans.

3.2. Effect of credit on house prices

Credit may also have an impact on housing prices. Expansion in credit may expand the demand for credit. Given that the housing supply is inelastic in the short run, increased demand for housing puts upward pressure on housing prices. Credit expansion indirectly affects housing prices, as consumption and investment may rise due to increased credit availability, increasing economic activity and expectations for future income flows from assets, boosting property valuations.

3.3. Other factors affecting credit

The economy's overall health is measured through GDP and can lead to increased or decreased demand for credit. As the economy grows, it should result in higher demand for credit due to higher consumption and investment, leading to growth in credit. Further, higher credit, in turn, adds to the economy's growth performance as credit is used for financing productive investments, leading to more production and consumption expenditure. Hence, there is a two-way causation between credit and Gross Domestic Product.

Equity prices reflect the confidence level of investors. However, the impact of equity prices on credit to households is less direct than in the case of corporations. Any positive and significant effect of equity prices on household credit may be due to high investors' confidence, as reflected in high equity prices. Equity prices are an indicator of the expectations of lenders about the state of the economy. Lenders with positive sentiments about the state of the economy may increase their mortgage lending, expecting positive returns from the housing sector too. Lenders expecting favorable economic conditions may also have positive expectations about real estate markets. Thus, equity price cycles moving together with households' credit cycles indicate the role of investors' sentiments in the mortgage loans market.

Thus, different types of expectation formation mechanisms can work in an economy. It can be based on adaptive expectations or the economy's overall state. In adaptive expectations, lenders believe that future house price movements will be the same as current ones. Thus, if housing prices rise, they will continue to grow. If this expectation formation mechanism works, we should find credit positively related to current and previous housing prices. Another kind of expectation formation could be related to the overall state of the economy. Lenders may believe that if the economy is expected to grow, so do the real estate sector. Thus, lenders' sentiments about the state of an economy may influence their lending decisions. If such a belief system or expectation formation mechanism works, we should expect credit and equity price cycles to move together. Thus, equity prices are used as an indicator of lenders' expectations about the state of an economy.

Interest rate captures the supply side of the loanable funds market. Higher interest on deposits may lead to increased deposits, with financial intermediaries contributing positively to the flow of credit. Inflation may also influence credit as prices rise, the value of money falls, and more money is required to purchase goods and services.

It is also conceivable that in an increasingly interconnected world, the global environment impacts domestic credit even though domestic house price movements and other determinants are more or less the same. Global liquidity conditions also influence the domestic credit market of any country. Higher global liquidity enters different countries' credit markets through cross-border lending. Hence, one might expect the positive impact of global liquidity conditions on credit. In this context, exchange rates play an essential role as changes in the exchange rate critically affect the domestic cost of cross-border funds and, hence, influence the incentives to access global liquidity. Private credit also includes foreign currency loans, which may represent a significant portion of personal credit. Therefore, growth in private credit (in terms of dollars) may reflect exchange rate movements rather than real growth. We now turn to describe our empirical model in the next section.

4. Research model and methodology

We analyze the co-movements between cycles around the trend in nominal housing prices, nominal equity prices, and nominal credit to households by fitting the following model on cyclical movements in credit, housing prices, equity prices, and GDP.

$$cr_{it} = \beta_0 + \beta_1 cr_{i(t-1)} + \sum_{j,q=0}^q \alpha_j hp_{i(t-q)} + \gamma_1 GDP_{it} + \gamma_2 eqp_{it} + \sum_{j=3}^7 \gamma_j X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where: cr_{it} refers to nominal credit to households, hp_{it} refers to nominal housing prices, GDP_{it} refers to GDP at constant prices, and eqp_{it} refers to the nominal equity price index. X_{it} is a vector of control variables, including inflation rate, interest rate, exchange rate, global liquidity indicator (in dollars), and a dummy for developing economies. The last term represents a dummy variable taking value 1 for developing economies. We have 12 economies considered developing throughout our study period: Brazil, China, Colombia, India, Indonesia, Korea, Malaysia, Mexico, Russia, South Africa, Thailand, and Turkey. Two countries have recently graduated to being developed countries: the Czech Republic (considered developed since 2006) and Chile (considered developed since 2016). For these two countries, the dummy variable takes on value 1 when they were considered developing and 0 when they graduated to developed country status.

The data series is de-trended using the Hodrick-Prescott filter with a lambda value 1600. Since the GDP series had a very strong seasonality component, we have de-seasonalised the GDP series using the census X-13 method to get business cycles around the trend.

Rising property prices may lead to speculative lending by lenders. Using the adaptive expectations approach, we use current and lagged values of housing prices to proxy for lenders' expectations about future house price movements. It may be expected that lenders consider the recent house price movement in forming their expectations about future house price moments. Hence, boom-and-bust cycles in the housing market can cause the boom-and-bust cycle in the credit market through the supply channel. Based on their high house

price expectations, banks may relax the lending standards to maximize their yields, leading to higher credit. Although an imperfect indicator of overall sentiments about the economy's future, equity prices are positively correlated. There is a paucity of data for other measures of sentiments for all countries in the data set.

Interest rates, inflation rate, global liquidity indicator, and exchange rates are exogenous variables in our model, while housing prices and GDP are endogenous. Inflation is included in the model to nullify the impact of prices on nominal variables. The order of lag for credit is chosen to eliminate serial correlation in the error term. The lag order of housing prices is chosen depending on the significance of respective coefficients. Table 1 presents the expected signs of different variables:

Table 1. *Expected sign of variables*

Variables	Expected signs
Housing Prices	Positive
GDP	Positive
Equity Prices	Positive
Inflation	Negative
Interest Rate	Negative
Exchange Rate	Negative
Global Liquidity	Positive

We attempt to address the endogeneity problem by using lagged values of dependent and endogenous variables as Blundell and Bond's (1998) two-step GMM estimator proposed. Models (i) and (ii) are the regressions on household credit. Model (i) is without time dummies. Model (ii) presents the estimates for the entire sample with time dummies.

4.1. Dynamic panel estimation

Since the dependent variable, credit to households is observed over time in our panel data set, it may happen that its values partially depend on its values in the past. There may be different reasons for the correlation in credit over time. It can be true state dependence when credit is directly linked with previous period credit or due to observed heterogeneity (i.e., due to correlation in observables such as house prices, GDP, equity prices, etc.) or due to unobserved heterogeneity (due to individual effects μ_i which is time-invariant). In this case, OLS estimates are inconsistent due to serial correlation in the error term ε_{it} .

We can obtain consistent estimates using instrument variables (IV) estimation, taking appropriate lags of dependent and independent variables as the instruments. Thus, dynamic Panel Estimation is also attempting to solve the problem of endogeneity arising due to two-way causal relationship between credit and housing prices. Equation 1 is a fixed-effect model and can be estimated by eliminating the fixed effects using the first difference. The first different model is:

$$\Delta cr_{it} = \sum_{j,p=1}^p \theta_j \Delta cr_{i(t-p)} + \sum_{j,q=0}^q \delta_j \Delta hp_{i(t-q)} + \rho_1 \Delta GDP_{it} + \rho_2 \Delta eqp_{it} + \sum_{j=3}^7 \rho_j \Delta X_{it} + \Delta \varepsilon_{it} \quad (2)$$

OLS estimator of the first-differenced model (2) give inconsistent estimates even if ε_{it} is not serially correlated because the error $\Delta\varepsilon_{it} = \varepsilon_{it} - \varepsilon_{i,t-1}$ is correlated with the regressor $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$ as $y_{i,t-1}$ depend on $\varepsilon_{i,t-1}$. But we can use IV estimation using lagged variables as instruments since $\Delta\varepsilon_{it}$ is not correlated with $\Delta y_{i,t-k}$ for $k \geq 2$.

Hence, we can obtain consistent estimators of equation (1) by IV estimation of the first-differenced model. This estimator is popularly known as the Arellano Bond estimator after Arellano and Bond (1991).

IV estimation proposed by Arellano-Bond uses the lags $y_{it-2}, y_{it-3}...$ as instruments for the first differenced model (2). Blundell and Bond (1998) extended the Arellano-Bond estimator and proposed incorporating the levels (equation (1)) and use Δy_{it-1} as an instrument. Similarly, first-differences of endogenous variables can be added as instruments for the level equation (1). Blundell-Bond estimator has better finite sample properties and obtain estimates with improved precision.

The important assumption is that the error term ε_{it} is not serially correlated. This is most likely to hold if sufficient lags of the dependent variable, here credit, are taken in the model. For consistent estimation, we test that the error ε_{it} be serially uncorrelated up to the lag order of 2. Sargan tests of over-identifying restrictions are performed to test for the validity of instruments.

5. Data and variables

Considering the availability of data on both private credit and housing prices, our analysis consists of 41 countries (out of which 13 are emerging market economies) naming Brazil, Colombia, Indonesia, Ireland, India, Korea, Mexico, Malaysia, Russia, Thailand, Turkey, Switzerland, Chile, China, Czech-Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Hungary, Israel, Italy, Japan, Luxembourg, Netherlands, Norway, New Zealand, Poland, Portugal, Sweden, Singapore, and United States. We employ an unbalanced panel of quarterly data spanning from 1997 Quarter 1 to 2020 Quarter 1 due to the lack of availability of long time series for a set of countries.

Long-time-series data on mortgage credit is lacking in most countries. However, since mortgage credit typically represents a large part of household credit, we use household credit as a proxy for mortgage credit as is done by Cerutti et al. (2017). For housing prices, long-time-series data is available for only a set of countries (mainly developed). Consequently, we are left with an unbalanced panel of quarterly data on housing prices.

The list of variables included in the analysis along with their respective details is given below in Table 2.

Table 2. Variable definitions

Variable	Brief description of quarterly data
Credit	Credit (in billions of US dollars) given to (a) households and NPISH b) nonfinancial corporations (also called 'firms') is obtained from Bank for International Settlements. This data calculation is based on market exchange rates and is available at market value. In terms of financial instruments, credit covers loans, debt securities, currency, and deposits.
House Price	The nominal house price index is obtained from the Bank of International Settlements. These are indices with the base year as 2010 for the residential property price and do not include commercial property prices.
Exchange Rates	US Dollar bilateral nominal exchange rates, both end of period and averages, are obtained from the Bank of International Settlements. Whenever both the series are available, then an average of the period exchange rates is used.
Price Indices	Monthly Data on consumer prices index with the base year as 2010 is also obtained from Bank for International Settlements. Monthly data is converted into quarterly data by taking simple averages.
Gross Domestic Product	Data on the Real Gross Domestic Product index with the year 2010 base is obtained from the International financial statistics of IMF.
Interest Rate	Interest rate data on deposit rate, money market interest rate, and lending rate in percent per annum is obtained from International financial statistics. Money market interest rate (MMI) is used as an indicator of monetary policy and deposit rate (DR) is used for whichever country data on money market interest rate is not available.
Equity Price	The equity price Index is obtained from International Financial statistics either at the end of the period or the average of the period. Whenever both the series are available, an average of the period is used for the equity price index.
Global liquidity indicators	Foreign currency loans (both cross-border and local) to all sectors (banks, non-banks, and non-financial private sector) given by the global banking sector are used as an indicator of global liquidity. The data is expressed in terms of US dollars and as a percentage of GDP.

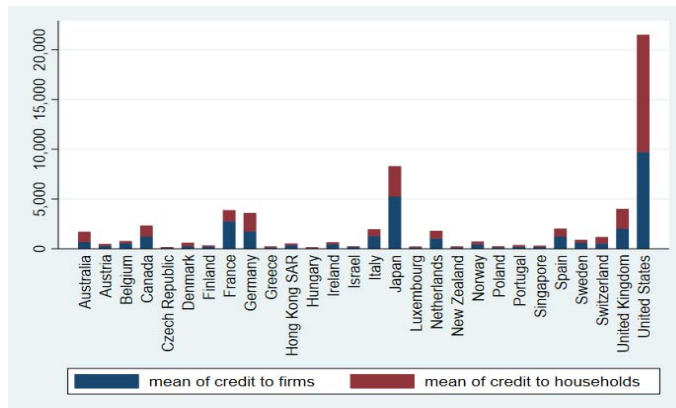
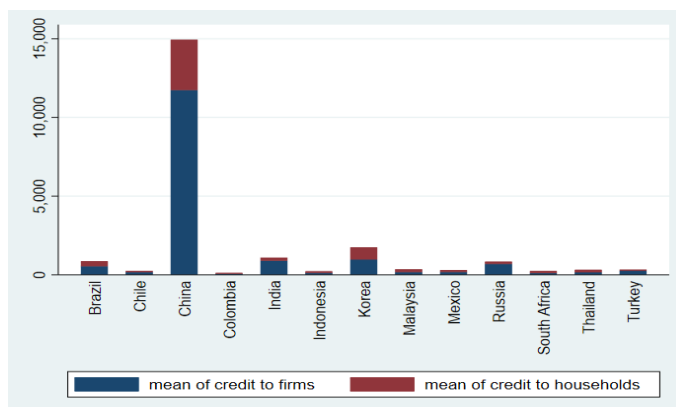
6. Data analysis

According to the World Bank classification, countries are divided into four income groups: Low income (L), lower middle income (M), upper middle income (UM), and high income (H). We use the latest available classification i.e. for the data for the calendar year 2016. According to this classification, Table 3 presents respective lists of countries under study in each group. We have 30 countries belonging to high-income countries, 9 countries belonging to upper middle income, and 2 countries belonging to the lower-middle-income category.

Table 3. Country classification

Income Category	Lower Middle	Upper Middle	High Income
Country	India and Indonesia	Brazil, China, Colombia, Malaysia, Mexico, Russia, S. Africa, Thailand and Turkey	Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, France, Finland, Germany, Greece, Hong Kong, Hungary, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, UK, and the US.

Figures 1 and 2 show graphs of a share of credit to households and firms for developed and developing countries respectively. We find that share of credit to households in total credit to the private sector is higher in developed countries particularly in Australia, Switzerland, UK, Germany, and the USA. Credit is most prevalent in the US followed by Japan, France, Germany, and the UK. Amongst developing countries, credit is most prevalent in China followed by Korea, Brazil, India, and Russia. But the share of credit to households is smaller in developing countries. Thus, mortgage credit is at its initial stages in developing countries.

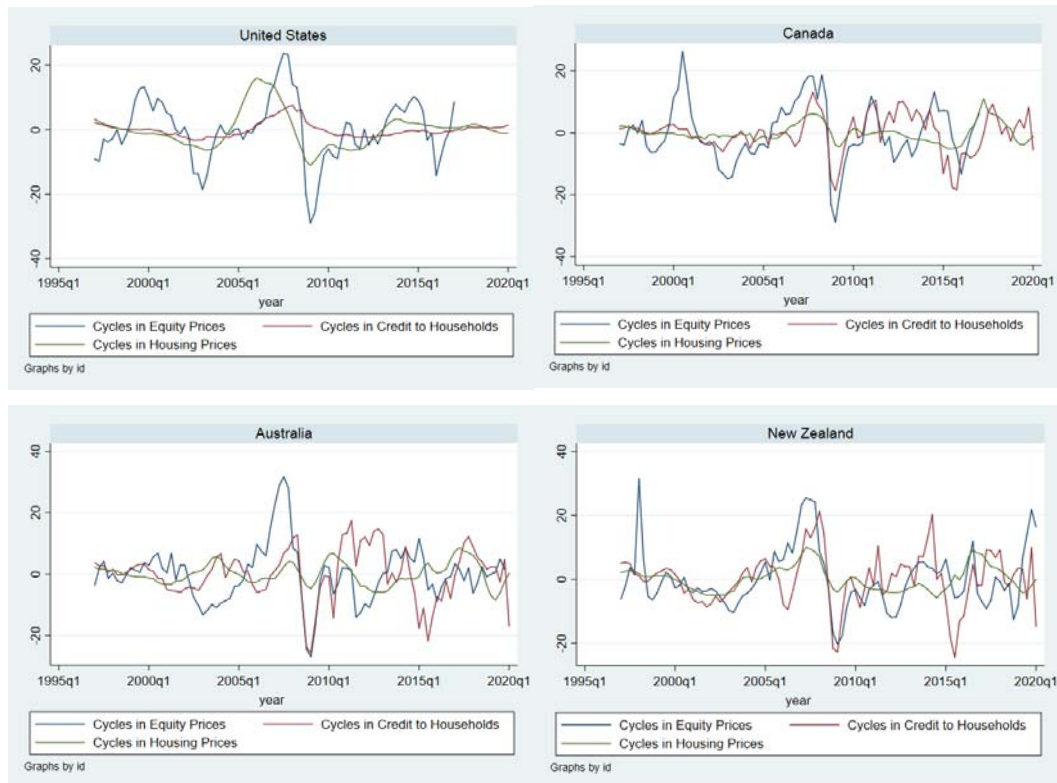
Figure 1. Share of credit to households and non-financial corporations in total credit in developed countries**Figure 2.** Share of credit to households and non-financial corporations in total credit in developing countries

6.1. Cycles in asset prices and credit

Analyzing the cycles in credit and housing prices in high-income countries, we find that both tend to move together. We begin our analysis of cycles in credit and asset prices with the United States from where the subprime crisis emerged recently. Figure 3 presents cycles in nominal credit given to firms, nominal credit given to households and NPISH, nominal house price, and nominal equity prices in US, Canada, New Zealand, and Australia.

Beginning from 1997:Q1 house prices were showing downward movement until 2003:Q3, began rising after that till 2006:Q1 and took a downturn after reaching its peak. Credit to households and equity prices followed this complete cycle of housing prices. The banking crisis in the United States occurred in 2007 when housing prices turned downwards after reaching a peak. This crisis was the outcome of the defaults from sub-prime borrowers. The defaults from households had led to the overall decline in lending by banks. Equity prices being highly volatile reached 29 percent below the trend. In the post-crisis period also, all three variables moved together. The situation started to improve by 2009:Q1 when both equity prices and house prices started to recover. However, credit to households has not shown any recovery till 2017:Q1.

Figure 3. HP filtered cycles in nominal house prices, nominal equity prices and nominal credit to households in US, Canada, New Zealand, and Australia



Now, we look at the similar pictorial representation for neighboring countries of the United States. For Canada, credit to households and housing prices show strong co-movements throughout the period under study. New Zealand and Australia also clearly indicate co-movement amongst the three variables. These economies, namely, the USA, Australia, Canada, and New Zealand, have a high maximum LTV ratio of 85-100 percent, offering long-term loans ranging from 25 to 30 years.

Unlike the USA, the interest amount paid on mortgage loans is not tax-deductible in Australia, Canada, and New Zealand. Thus, a co-movement between housing prices and credit is seen even though the governments are not actively encouraging housing loans.

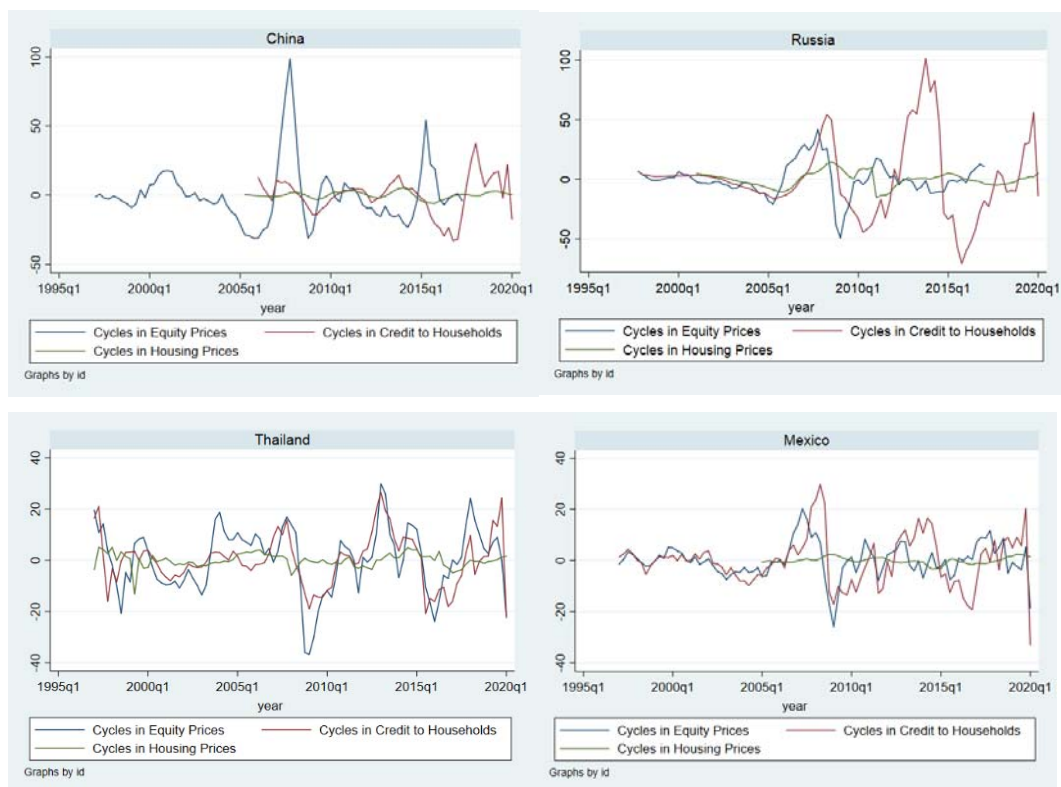
Countries like Denmark, Hong Kong, France, Israel, Korea, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, and the U.K. have clear indications of co-movement between house prices, credit to households, and equity prices. These are the countries with relatively high maximum LTV ratios. Hence, for these economies, both types of expectations formations are working. Lenders taking into account previous housing prices in lending decisions and also taking into account the expected overall state of the economy.

We also have instances where housing prices do not deviate significantly from the trend; however, equity prices and credit to households show similar ups and downs, such as in the

Czech Republic, Germany, Greece, Hungary, Italy, Poland, and Switzerland. This indicates that investors' sentiments have a role in the credit market, supporting our argument that the expectations of lenders about the state of the economy influence their lending behavior. These are mostly those economies with a maximum LTV between 70 to 80 percent. Thus, there is the prominence of sentiments about the state of the economy rather than adaptive expectations in these countries.

We also have evidence of co-movement between housing prices and the credit market for Upper Middle-Income Countries. For example, in the case of the Chinese economy, we have a clear indication of strong co-movements between credit to households and housing prices (equity prices being highly volatile, sometimes moving together and sometimes deviating). This indicates the prominence of adaptive expectations about housing prices (combined with collateral effect and wealth effect) in lending decisions. We also find evidence of co-movement in these variables in the case of Russia and Thailand.

Figure 4. HP filtered cycles in nominal house prices, nominal equity prices and nominal credit to households in China, Thailand, Mexico, and Russia



In Mexico, there was a substantive decline in household credit after 2008:Q3. This indicates the impact of the global financial crisis on the sentiments of investors in Mexico and its impact on the credit market. Housing prices in Mexico had not deviated much from the trend however they also fell during 2006 by around 7 percent from the trend. In Brazil, Colombia, Malaysia, Mexico, and Turkey also housing markets are relatively stable

(although little signs of co-movements in the housing and credit market are observed) while equity market and credit markets are moving together. This again reflects the importance of investors' confidence about the state of the economy in the loan market in upper-middle-income economies too.

Despite the lack of data, we find evidence of co-movement between house prices, equity prices, and the credit market in India. The mortgage market is growing fast in India, and credit to households is moving with both housing and equity prices. This may be interpreted as evidence that both types of expectations formations seem to be working in the Indian economy. Lenders taking into account previous period housing prices in lending decisions (combined with collateral and wealth effect) and their sentiments about the state of the economy also influencing credit to both household and firms.

In Indonesia, housing prices are relatively stable however equity prices are moving first followed by the credit market indicating the role of investors' sentiments about the state of the economy in lending decisions in lower-middle-income countries too.

Figure 5. HP filtered cycles in nominal house prices, nominal equity prices and nominal credit to households in India

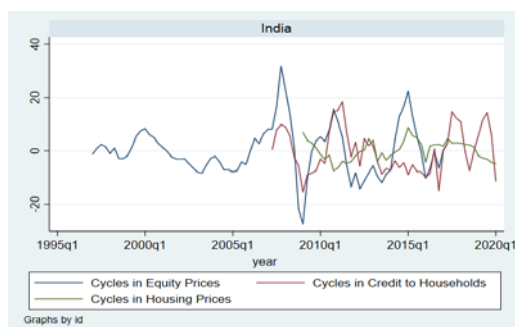
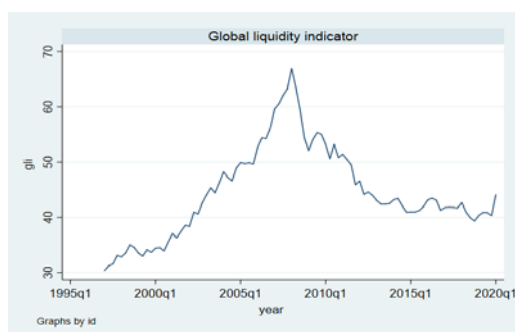


Figure 6. Global liquidity



Thus, we have very strong evidence of credit to households and housing prices moving together for many countries. Although for some countries housing prices are seen to be deviating very little from the trend. These are mostly developing countries where the share of credit to households is still small as the mortgage market is not yet fully developed as in the developed countries. But investors' confidence level about the economy still has a role in lending decisions.

Figure 6 presents the global liquidity indicator (as a percentage of GDP) which was observed to be continuously rising before the crisis. But after the crisis cross border lending is declining, although it again has shown some improvement from 2015 onwards.

Figures 7 and 8 present cycles in global liquidity indicator with Nominal housing prices and equity prices respectively. There is evidence of global liquidity to move with both housing prices and equity prices. Thus, investors' sentiments and expectations do influence cross-border lending activities too.

Figure 7. Cycles in global liquidity and nominal housing prices

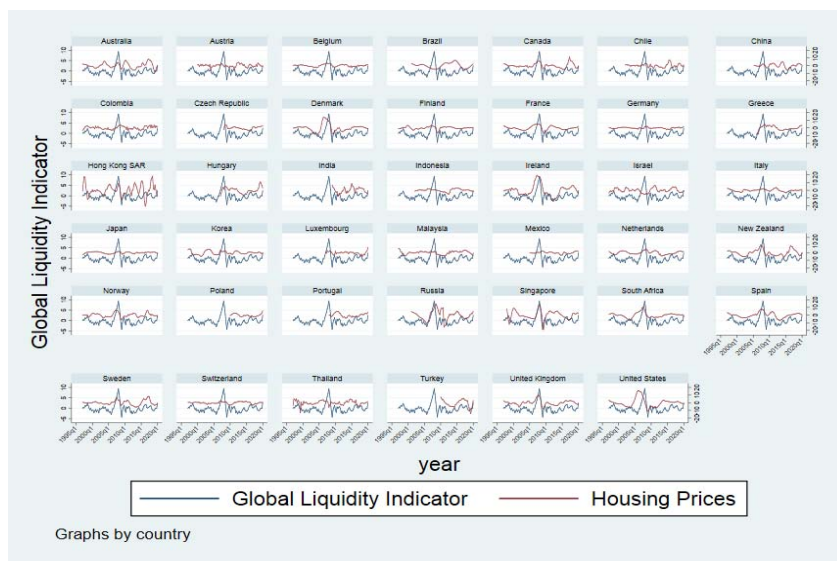
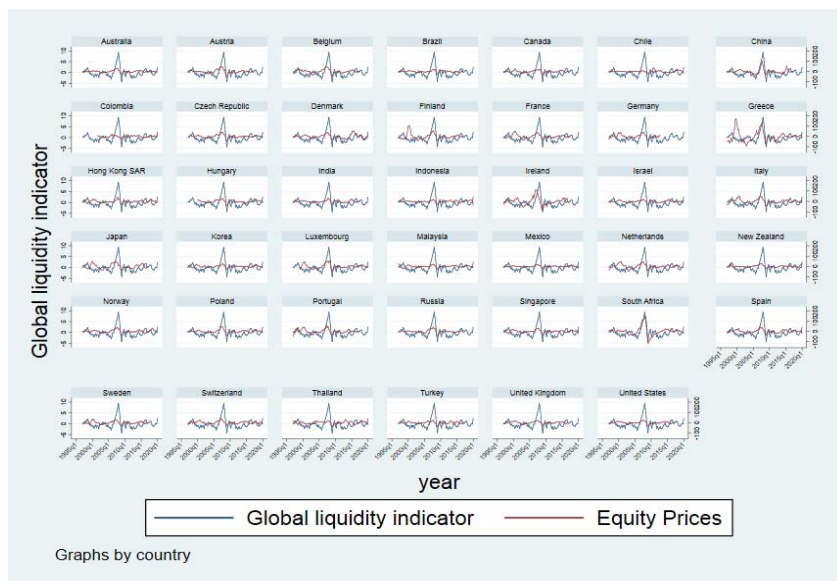


Figure 8. Cycles in global liquidity and equity prices



7. Estimation results

Using the system GMM approach, we find that both housing prices and equity prices come out to be significantly influencing credit to households. Table 4 presents models on credit to households. We also find that lag values of credit are significantly influencing current values. Hence, the data generating process for credit is an autoregressive process.

We find that our variables of interest measuring expectations i.e., housing prices have a key role in mortgage loan market. Housing prices, reflecting the sentiments of investors about the state of the economy play an important role in credit market. The fact that it is found to be a significant variable influencing credit to households clearly indicates role of expectations and investors sentiments in mortgage market. Hence, our argument of lenders getting involved in speculative lending in mortgage market is supported by empirical evidence.

Table 4. *Determinants of cyclical movements in credit to households*

Variables	Model (i)	Model (ii)
One-quarter lag in credit	.8301***(.0000)	.843*** (.0000)
Cycles in housing prices	1.5938**(0.036)	1.3588** (.040)
Cycles in GDP	.5819(.563)	.1700(0.858)
Exchange rate	.0039(.159)	0.0004 (.801)
Interest rate	-4.069*(.088)	-.9430**(.029)
Consumer Price Index	-.5279* (.083)	-.0054 (.917)
Cycles in equity prices	-.0157 (0.764)	-.0867(.139)
Global liquidity indicator	.0935(.579)	.1592 (.182)
Constant	60.3872(.134)	0
Number of instruments	9	100
Number of observations	2745	2745
Number of groups	41	41

Note: *** indicates significance at 1%, ** at 5%, and * at 10%, respectively.

In the first model, credit to households' cycles in housing prices come out to be a significant variable influencing credit to households. This may be because of the wealth and collateral effect or because of positive expectations of lenders about housing prices based on adaptive expectations. This provides empirical evidence to our theoretical model illustrating that under certain circumstances, intermediaries get involved in speculative lending that may result in financial instability and have disastrous consequences. The results are also confirmed in Model (ii), presenting the estimates with time dummies. The coefficient of interest rate in both models is significant and has a negative sign; as expected, interest is the cost of loans.

8. Conclusions

In this paper, we have provided empirical evidence on the interlinkage between the real estate market and the mortgage loan market. This interlinkage may work either through wealth effect and collateral effect or through expectation formation. The fact that housing price cycles are found to have a significant impact on credit market proves that investor sentiments play a key role in lending behavior of intermediaries. This explains the empirical evidence (Chakraborty et al., 2018; Cerutti et al., 2015; Li et al. 2022; Justiniano, 2015) that banks assets are likely to have relatively high exposure to real estate sector. Owing to

'herd behavior' and pressure of competition, banks are likely to lend more to sectors that are booming. Intermediaries may also reduce their lending standards to maximize their yields. Such risky lending may prove to be detrimental to financial stability. Any negative shock influencing the repaying capacity of borrowers would lead to defaults. Any sharp fall in housing prices may also reduce the motivation to repay a loan. This happened during the time of the subprime crisis when the bursting of the house price bubble led to many defaults from subprime borrowers.

Given that banks' assets are likely to have relatively high exposure to the real estate sector and that banks are likely to lend more to booming sectors, this calls for extensive use of macroprudential supervisory tools on the part of the regulator for achieving financial stability. Macroprudential tools would have to be used to supplement the standard interest rate tool of the central bank, which may prove ineffective, especially in a crisis situation. The financial sector in developing and developed countries consists of banks and NBFCs (non-banking financial corporations), which typically do not come under the central bank's purview and are relatively less regulated. As such, these entities (often called shadow banks) are more likely to indulge in speculation. The entire process is heavily influenced by rapid advances in financial innovation and financial engineering that lead to a proliferation of financial assets based on certain sectors like housing that may be booming. The proliferation of speculative lending can enhance systemic vulnerability to financial crises. Our analysis calls for close monitoring of the lending activities of financial intermediaries by the monetary authorities and financial regulators. Only such an active role of supervisory authorities can help to reduce the risk of speculative lending based on sentiments and expectations and safeguard financial stability.

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