

WP/12/193

# IMF Working Paper

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## Latin America: Vulnerabilities Under Construction?

*Luis Cubeddu, Camilo E. Tovar, and Evridiki Tsounta*

## **IMF Working Paper**

Western Hemisphere Department

### **Latin America: Vulnerabilities under Construction?**

**Prepared by Luis Cubeddu, Camilo E. Tovar, and Evridiki Tsounta<sup>1</sup>**

Authorized for distribution by Charles Kramer

July 2012

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#### **Abstract**

This paper documents developments in mortgage credit and the housing sector in Latin America over the past decade, and compares them with those of other emerging economies. In particular, it examines the real estate and mortgage markets to assess whether (i) growth in mortgage credit is excessive compared to long-term trends; (ii) trends in house prices reflect changes in economic fundamentals; and (iii) the extent to which household and banking sector vulnerabilities could lead to potential fragilities. Although data limitations hamper a rigorous analysis of trends, our analysis suggests that while there are no imminent misalignments in the real estate and mortgage sectors, they could emerge if current trends persist. Strengthening supervision and addressing data gaps is thus critical to ensure adequate monitoring of risks and vulnerabilities in these sectors.

JEL Classification Numbers: E44, G10, G20, L85

Keywords: Mortgage, credit, real estate, housing prices, data gaps

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<sup>1</sup> The authors are grateful to Gustavo Adler, Mercedes Garcia-Escribano, Charles Kramer, Miguel Savastano, Sebastian Sosa, Mercedes Vera Martin, and IMF's Western Hemisphere Seminar participants for helpful comments and suggestions. Marola Castillo, Alejandro Carrion-Menendez, and Anayo Osueke provided research assistance, Patricia Delgado and Hildi Wicker-Deady provided production assistance. All errors are our own.

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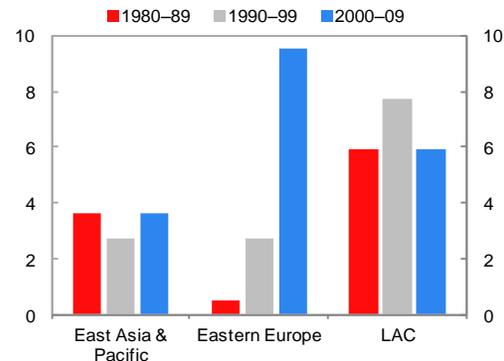
## I. INTRODUCTION

Easy financing conditions and favorable terms of trade have fueled credit and domestic demand in much of Latin America for almost a decade now, with a short interruption during the 2008–09 global crisis. The credit expansion has been particularly impressive for the mortgage sector, where legal reforms and government subsidies have also played a role. However, this growth—from generally low mortgage credit levels—to a large extent reflects a process of financial deepening necessary to address the significant housing deficits in the region.<sup>2</sup>

However, given the region’s long history of credit booms gone wrong, there are valid concerns about the potential buildup of financial sector excesses, even if current credit indicators appear manageable. Experience shows that credit-driven bubbles build slowly but can sour quickly. Indeed, even though housing market crashes have been rare in the region, Colombia’s experience in the late 1990s is a useful reminder of the systemic effects that even a small mortgage sector can have on the economy. Moreover, as seen in the recent U.S. housing crisis, problems in a small market (e.g., the subprime sector) can become systemic, especially in new markets with significant data gaps.

The increase in mortgage credit in many countries of the region has been accompanied by an increase in home prices (Figure 1). In fact, the average real home-price for the more financially integrated economies of the region (i.e., Brazil, Chile, Colombia, Mexico, Peru, and Uruguay) rose at an annual rate of roughly 6 percent between 2005 and 2011. While the

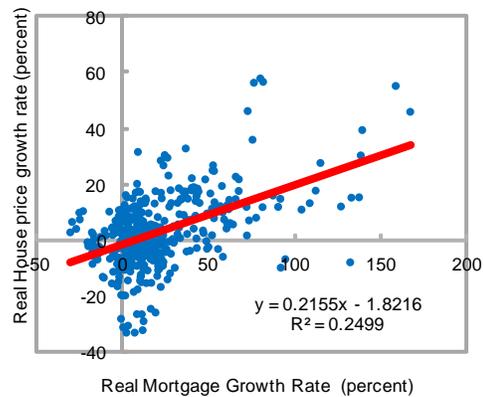
**Incidence of Credit Booms in Emerging Economies**  
(Frequency distribution, percent of all credit expansions)



Source: Dell’Ariccia and others (2012).

<sup>1</sup> Credit booms are identified based on deviations of credit-to-GDP ratio from a country-specific, backward-looking, rolling trend.

**Real Growth in House Prices and Mortgage Credit, 2000–11**



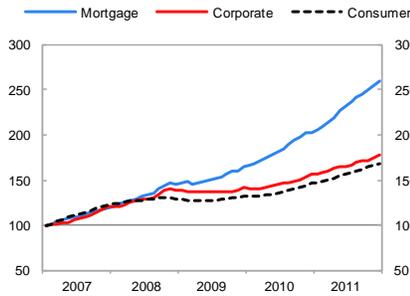
Sources: Haver Analytics, National Authorities; and Fund staff calculations.

<sup>2</sup> The Economic Commission for Latin America and the Caribbean (ECLAC) estimates the housing deficit between 42 and 51 million units. Meanwhile, the Ministerial Commission on Housing and Urbanization for Latin America and the Caribbean found that only 60 percent of families in the region had adequate housing in 2007. For country-specific data on housing deficit see UN Habitat (2011, Chapter 3).

### Figure 1. Latin America: Mortgage and Housing Market Developments

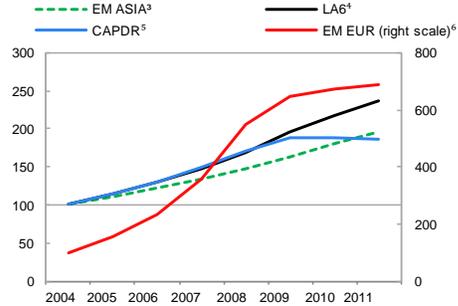
Mortgage credit in Latin America increased significantly in recent years...

**Private Sector Credit by Market Segment<sup>1</sup>**  
(Index, 2007 = 100)



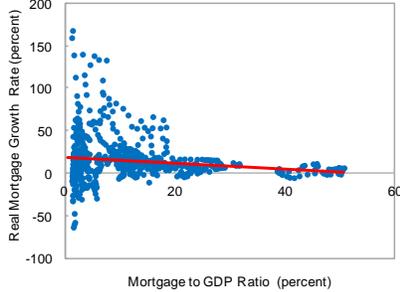
...partly reflecting the shallowness of the market.

**Emerging Economies: Real Mortgage Credit Index<sup>2</sup>**  
(Index, 2004 = 100)

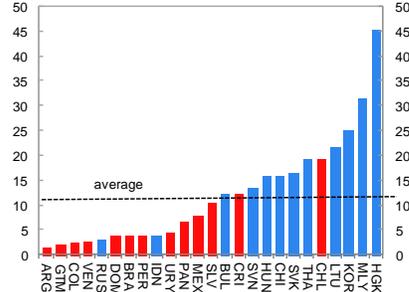


Despite the robust growth, mortgage credit remains low in international comparisons.

**Mortgage Credit Growth and Mortgage Credit Level, 2000-11**

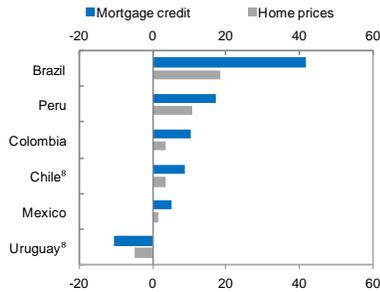


**Emerging Economies: Mortgage Credit to GDP**  
(Average of 2010-11)

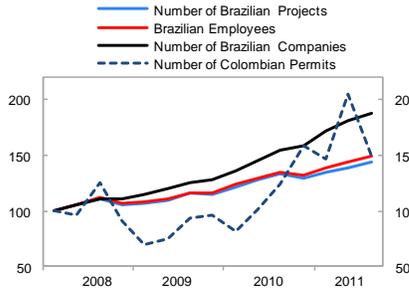


Home prices and construction activity have also risen sharply .

**Real Mortgage Credit and Housing Prices<sup>7</sup>**  
(12-month percent change, average of 2010-11)



**Brazil and Colombia: Construction Sector**  
(2008:Q1 = 100)



Sources: Haver Analytics; national authorities; and IMF staff calculations.  
<sup>1</sup> In real terms. Simple average of Brazil, Chile, Colombia, Mexico, Peru, and Uruguay.  
<sup>2</sup> Last data observation is 2011:Q3.  
<sup>3</sup> China, Hong Kong SAR, Indonesia, Korea, Malaysia, and Thailand.  
<sup>4</sup> Brazil, Chile, Colombia, Mexico, Peru, and Uruguay.  
<sup>5</sup> Costa Rica, Dominican Republic, El Salvador, Guatemala, and Panama.  
<sup>6</sup> Bulgaria, Hungary, Lithuania, Russia, Slovak Republic, and Slovenia.  
<sup>7</sup> All data expressed in local currency and deflated by CPI.  
<sup>8</sup> Includes 2010 only.  
 EM = emerging market.

average price increase is well below that observed in emerging Europe in the run up to the Lehman crisis, it is somewhat above that registered in emerging Asia.

This paper documents developments in the housing and mortgage markets in Latin America, comparing them to that of other emerging economies. In addition, and despite serious data limitations, we attempt to assess whether: (i) growth in mortgage credit is excessive compared to the long-term trend; (ii) trends in house prices reflect changes in economic fundamentals; and (iii) the extent to which vulnerabilities may be building in the household and banking sectors. To the best of our knowledge, this is the first effort to look at the relationship between mortgage credit, house prices, and economic fundamentals for a group of Latin American economies.

Relying on standard statistical and econometric techniques, we find little evidence of excessive growth in mortgage credit in much of the region. In Brazil, while mortgage credit growth has been growing very rapidly in recent years (supported by the expansion of government-sponsored housing credit programs), mortgage credit-to-GDP is still low relative to that of other emerging economies. Similarly, while there is evidence of minor house price misalignments in only a few countries of the region (Peru and to a lesser extent Colombia), we cannot conclude that the real estate market is now experiencing a bubble. However, as is usually the case, excesses and vulnerabilities are not always captured by contemporaneous indicators, only becoming visible if the current rates of mortgage credit and house price growth are sustained for an extended period.

To broaden our assessment of vulnerabilities we also examine the exposure of household and bank balance sheets to the real estate sector. We find that nonperforming mortgage loans are still relatively low, and that mortgages continue to represent a small share of banks' assets. Similarly, household indebtedness indicators (where available) suggest that financial burden remains at manageable levels, although they are rising, especially for low-income households.

Our overall findings should be interpreted with caution, since a proper assessment of the mortgage credit and housing situation is hindered by the fairly limited and weak information available for the real estate sector.<sup>3</sup> House price data are only available for some countries—notably the largest Latin American economies—and even when available, time series are usually of short span, with coverage often limited to large metropolitan areas. In addition, there is little information on the stock and flows of housing, as well as on construction activity. Moreover, information on housing-specific financial soundness indicators and household balance-sheet data is only readily available and complete for just a few countries. Addressing these data gaps is an urgent priority in the region.

The paper is structured as follows. Section II documents developments in the mortgage credit and real estate sector in Latin America, while Section III highlights the data gaps needed to comprehensively assess the risks and vulnerabilities of the real estate sector, a task undertaken despite the constraints in the same section. In particular, Section III

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<sup>3</sup> Although data limitations hamper a more rigorous analysis of trends and risks, the findings shed some light of the degree of exuberance and potential spillovers of these markets (see Agnello and Schuknecht, 2009; Detken and Alessi, 2009).

provides an assessment of misalignments in mortgage credit and house prices. Section IV discusses the state of household and financial balance sheets in the region, and Section V provides policy recommendations and concludes.

## II. DEVELOPMENTS IN THE MORTGAGE CREDIT AND REAL ESTATE SECTOR

### A. Mortgage Credit

During the past decade, much of the region has experienced an unprecedented expansion in overall credit, and mortgage credit, in particular. Favorable external conditions, sustained economic growth, stronger fundamentals, and legal reforms have raised living standards and improved financing conditions, helping to unleash housing finance. Real mortgage credit in the more financially integrated economies of the region (Brazil, Chile, Colombia, Mexico, Peru, and Uruguay) has grown by an annual average of 14 percent since 2003, and was less affected by the 2008–09 global financial crisis than other sectors (such as consumption and corporate credit). Growth in mortgage credit has been particularly strong in Brazil, where the inflation-adjusted stock of mortgage loans has increased seven-fold since 2003, albeit from a low base (Figure 1).

Structural reforms in property and credit markets as well as government efforts to broaden access to credit have been critical. For example, both Brazil (2005) and Mexico (2007) enacted bankruptcy reforms to strengthen creditor rights,<sup>4</sup> and overhauled their credit registries to enable banks to better gauge the credit worthiness of debtors.<sup>5</sup> In addition, Brazil (where  $\frac{3}{4}$  of all housing credit has been provided by state-owned banks) relied extensively on mortgage credit subsidies, while Mexico provided mortgage insurance and guarantees through a government agency to support the residential mortgage-backed securities market (see Scatigna and Tovar, 2007). The expansion of mortgage credit in Latin America has also gone hand in hand with the development of the domestic bond market in local currency and the lengthening of the term structure of yield curves, which in some cases has reached 20–30 years (Jeanneau and Tovar, 2008).<sup>6</sup>

Despite the rapid credit growth in recent years, financial intermediation levels in most of Latin America (with the notable exception of Chile) remain well below those of other emerging regions, even after accounting for income per capita. Mortgage credit in Latin America stands on average at about 7 percent of GDP (22 percent of total credit), is well below the levels observed in other emerging economies (18 percent of GDP and 27 percent of total credit). This gap reflects the shallowness of the credit market in general, as well as the region's long history of macroeconomic instability (often associated with credit booms

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<sup>4</sup> Since its inception in 2000, the insolvency law in Mexico has been used on very few occasions.

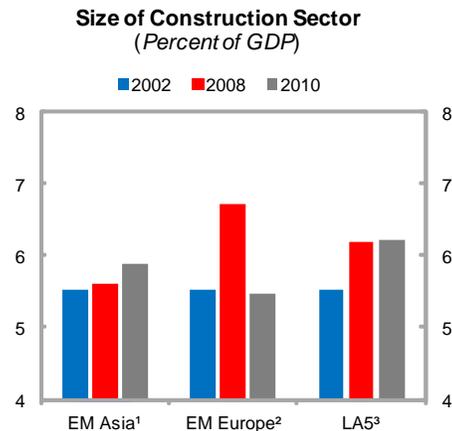
<sup>5</sup> Warnock and Warnock (2008) show that housing finance is positively correlated with the enforceability of legal rights, as well as with the existence of systems to assess credit risk.

<sup>6</sup> See Garcia (2008) for a discussion of developments of housing finance in Chile, including the impact of changes in pension fund regulations on mortgage finance.

and busts), as well as weak institutions, in particular those related to creditor and property rights (Cottarelli and others, 2005; Table 1).<sup>7</sup>

## B. Construction Activity

Rising mortgage credit has gone hand in hand with the expansion of the construction sector. The share of construction in GDP has grown sharply during the past decade in the more financially integrated countries of Latin America, reaching levels above those of emerging Asia, yet remaining below the peaks observed in emerging Europe prior to the Lehman crisis.<sup>8</sup> In Brazil, the number of construction companies and projects has grown strongly since 2008 (SECOVI, 2012), and employment in the construction sector grew by 50 percent during 2008–11 (responsible for about 14 percent of the total 6.5 million jobs created). Similarly, in Colombia building permits almost doubled between 2009 and 2011 and remain at elevated levels despite some recent correction.



Sources: Haver Analytics; national authorities; and IMF staff calculations.

<sup>1</sup>Average of China, Hong Kong SAR, Indonesia, Korea, Malaysia, and Thailand.

<sup>2</sup>Average of Bulgaria, Hungary, Lithuania, Russia, Slovak Republic, and Slovenia.

<sup>3</sup>Average of Brazil, Chile, Colombia, Mexico, and Peru.

EM = emerging market.

<sup>7</sup> According to Jha (2007), less than a quarter of all housing in Latin America is financed through formal mechanisms, with the exception of Chile where mortgage financing represents around half of all house purchases (Morandé and Garcia, 2004 and Central Bank of Chile, 2009). In Brazil, informal submarkets and household self-help initiatives accounted for about three-quarters of all housing finance during 1964–86. Similarly, in Mexico, between 1980 and 2003 more than half of all constructed housing units were built by the households themselves; less than 20 percent of these were built with formal financing (UN Habitat, 2011).

<sup>8</sup> However, housing is not the only factor behind this rising share; commercial real estate and public works also contributed to the rise.

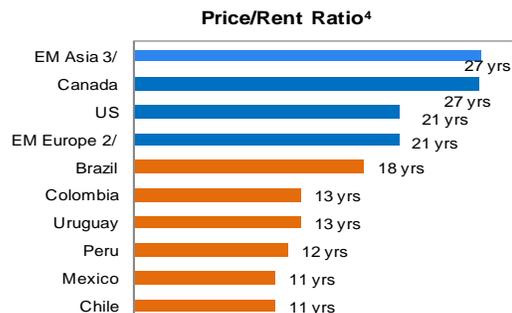
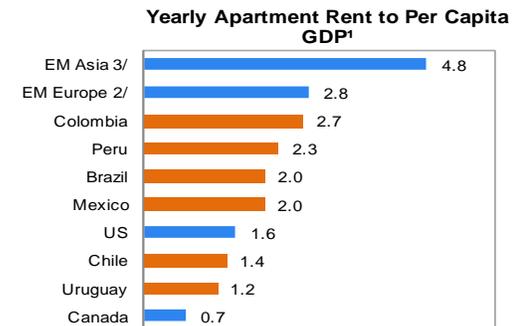
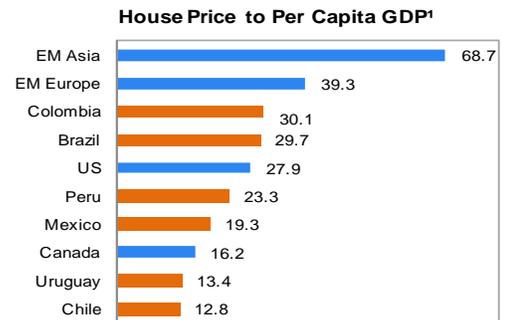
### C. House Prices

The increase in mortgage credit and construction activity has coincided with a significant increase in house prices in many Latin American countries. The average home-price in the six more financially integrated economies in the region rose by an annual real rate of 6 percent between 2005 and 2011. While the average price increase is well below that observed in emerging Europe in the run up to the Lehman crisis, it is somewhat above that registered in emerging Asia; however, in level terms they remain low in international comparisons.

In particular, according to the Global Property Guide (2012), home property prices and rents in some metropolitan areas of the region generally do not appear out of line when measured relative to the country's income per capita as well as rental prices, although they are approaching frothy levels in a few countries (Colombia, Brazil, and Peru).<sup>9</sup>

Notwithstanding, these measures need to be interpreted with caution since they only capture real estate prices in the higher-income segments of metropolitan areas, and do not necessarily reflect the situation at the national level and across income distribution.<sup>10</sup> We attempt to shed further light on the question of real estate overvaluation in the next section.

**Stylized Facts on House Prices and Rents, 2012**



Source: Global Property Guide.

<sup>1</sup> Average price of 100-square meter apartments located in the center of the most important city of each country.

<sup>2</sup> Average for Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, and Ukraine.

<sup>3</sup> Average for China, Indonesia, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

<sup>4</sup> This ratio is typically used for measuring undervaluation/overvaluation of real estate prices, calculated by dividing the gross rental yield by 100. It measures the rent years needed to buy a 120-square meter property in the center of the most important city of each country.

<sup>9</sup> For a discussion on the significance of house price-to-rent ratio as a measure of overvaluation, please refer to Davis, Lehnert and Martin (2008).

<sup>10</sup> Hoek-Smith and Diamond (2003) find that in Brazil and Mexico only households around the 70th income percentile qualified for mortgage financing in early 2000; in Peru the corresponding number was at the 65<sup>th</sup> percentile. In a series entitled Housing Finance Mechanisms, UN Habitat (various years) discusses, among other issues, mortgage access constraints in select emerging economies.

### III. MAKING THE MOST OF IMPERFECT DATA

Assessing risks and vulnerabilities in Latin America's real estate sector are hindered by weak and limited information. Data on housing prices and real estate activity are particularly weak in the region, despite recent progress. Only Brazil, Chile, Colombia, Mexico, Peru, and Uruguay publish housing price data, but in some instances these time series have short spans, and coverage is often limited to large metropolitan areas.<sup>11</sup> Moreover, in several instances they don't distinguish between new and existing homes, as well as between commercial and residential real estate. Little information on the stock and flows of housing, as well as on construction activity (including employment, price of inputs, and land prices), is available (Table 1). Appropriate data on housing transactions is also limited. Moreover, an additional challenge is posed by the fact that trends can vary depending on whether prices are measured in local or foreign currency.<sup>12</sup>

Notwithstanding severe shortcomings in the data, policymakers and analysts in the region still need to assess whether the pace of expansion of mortgage credit is excessive and similarly whether movements in house prices can be explained by economic fundamentals. Despite the limitations, in this section we engage in this quixotic endeavor and tackle these questions with the data available.

#### A. Identifying Mortgage Booms

We identify a credit expansion as a boom when the level of credit exceeds the underlying trend—estimated using end-adjusted rolling Hodrick Prescott filters—by a threshold equal to 1.5 times the standard deviation of the trend as used by Mendoza and Terrones (2008) and Gourinchas, Valdés, and Landerretche (2001) (see Appendix II for a review of different methodologies). The analysis is implemented for a sample of 9 countries (Brazil, Colombia, China, Hong Kong, SAR, Indonesia, Korea, Malaysia, Peru, and Thailand) over the 2000–2011 period using monthly data. Mortgage bank credit data are available from national sources, and include the mortgage claims on the private sector by deposit money banks as well as public finance corporations (where available).

The deviation from the long-run trend in the logarithm of real mortgage credit in country  $i$ , date  $t$  is denoted as  $M_{it}$ , and the corresponding standard deviation of this cyclical component as  $\sigma(M_i)$ . Country  $i$  is defined to have experienced a credit boom when  $M_{it} \geq 1.5\sigma(M_i)$ , that is when the deviations from trend in mortgage credit exceed the typical expansion of credit over the business cycle by a factor of 1.5 or more. The long-run trend is calculated using the Hodrick-Prescott (HP) filter with the smoothing parameter set at 129,600, as is typical for monthly data. The filter is rolled month-over-month with the seed

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<sup>11</sup> Housing prices in the region are often published by a wide variety of agencies, which makes cross-country comparisons more cumbersome.

<sup>12</sup> A clear example of this is Uruguay where the assessments may vary depending on the currency in which the analysis is performed. See IMF (2011c).

**Table 1. Data Availability on Select Financial and Housing Sector Indicators**

Country	Housing Indicators				Household Indicators		Financial Soundness Indicators <sup>1</sup>			Access to Credit	
	House Prices <sup>2</sup>		Housing Starts/Permits	Construction Cost Index	Household Debt to Income	Household Debt Service to Income	Commercial Real Estate Loans to Total Loans	Mortgages to Total Loans	Non-performing Mortgages <sup>3</sup>	Legal Rights (0–10) <sup>4</sup>	Credit Information (0–6) <sup>5</sup>
	Available since	Frequency									
<b>United States</b>	1987	monthly	national	√	√	√	√	√	√	9	6
<b>Canada</b>	1999	monthly	national	√	√	√	√	√	√	7	6
<b>Latin America</b>											
Brazil	2010	monthly	metropolitan		√	√	√	√	√	3	5
Chile	2004	quarterly	national	√	√	√	√	√	√	6	5
Colombia	1997	quarterly	metropolitan	√	√	√	√	√	√	5	5
Mexico	2005	quarterly	national			√	√	√	√	6	6
Peru	1998	quarterly	metropolitan					√	√	7	6
Uruguay	2000	monthly	metropolitan		√	√	√	√	√	4	6
<b>Memo:</b>											
<b>Emerging Asia</b>											
China	2005	monthly	city			√	√			6	4
India	2010	quarterly	metropolitan			√	√			8	4
Indonesia	2002	quarterly	city			√	√	√	√	3	4
Malaysia	1999	quarterly	national	√	√	√	√		√	10	6
Philippines	1994	quarterly	metropolitan					√	√	4	3
<b>Emerging Europe</b>											
Bulgaria	1993	quarterly	national							8	6
Croatia	2006	monthly	national			√		√		6	5
Estonia	2004	monthly	metropolitan		√					7	5
Hungary	1998	quarterly	national					√		7	4
Latvia	2004	monthly	metropolitan		√			√	√	10	5
Lithuania	1994	monthly	city							5	6
Poland	2004	monthly	metropolitan			√		√	√	9	5
Romania	2009	quarterly	national	√		√	√	√	√	9	5
Russia	2000	quarterly	national	√				√	√	3	5
Turkey	2007	monthly	national	√		√		√		4	5
Ukraine	2000	monthly	metropolitan	√						9	4

Sources: Eurostat; Global Property Guide; Haver Analytics; IMF, *Financial Soundness Indicators*; and World Bank, *2012 Doing Business Indicators*.

<sup>1</sup> Information based on reported data reported in the IMF Financial Soundness Indicators (black). In some instances, it was complemented with readily available data (green) from national sources.

<sup>2</sup> Data refer to start date of the series, frequency, and coverage. Some countries have more than one index, we report the one with the highest frequency.

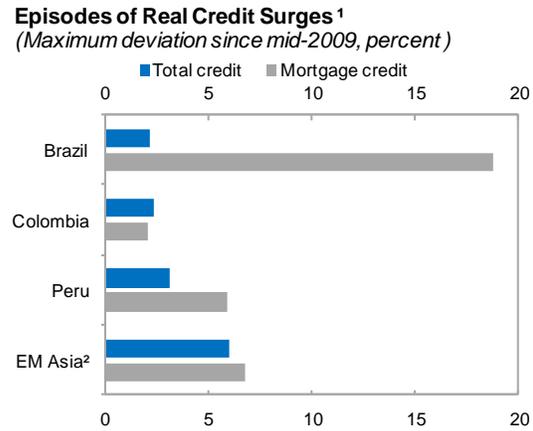
<sup>3</sup> Data not reported in the FSI but are available from national sources.

<sup>4</sup> World Bank index that measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0–10, with higher (green) and lower (red) values.

<sup>5</sup> World Bank index that measures rules and practices affecting the coverage, scope, and accessibility of credit information available through a credit registry. The index ranges from 0–6, with higher values (green) indicating greater availability of credit information.

set in January 2006; the seed was adjusted accordingly for countries with data limitations. In other words, this expanding trend extends the sample over which the trend is computed by one month as each successive month in the sample is added.

Our analysis suggests that mortgage growth is above levels dictated by past long-run trends in a few economies in the region (notably Brazil). In Brazil, the maximum deviation from trend credit growth in recent years seems particularly large, with small deviations recorded in other countries. However, our results should be viewed with caution, since our technique does not capture changes in trend credit growth or structural breaks, which might arise due to the adoption of particular policies. In that regard, the significant increase in Brazilian mortgage credit coincides with the introduction and subsequent expansion of the housing program (“Minha Casa, Minha Vida”) aimed at low-income households.<sup>13</sup> Despite these caveats, the rapid expansion of mortgage credit still warrants careful monitoring of this market segment.



Source: IMF staff calculations based on national sources.

<sup>1</sup> Estimates based on end-adjusted rolling Hodrick-Prescott filters estimated using monthly data since 2000 when available. The smoothing parameter,  $\lambda$ , was set at 129600, and the filter was rolled month-over-month with the seed set in January 2006. In countries where sample size was an issue, the seed was adjusted accordingly. The threshold is defined to be 1.5 times the standard deviation of the level relative to trend.

<sup>2</sup> Average of sample includes China, Hong Kong SAR, Indonesia, Korea, Malaysia, and Thailand.  
EM = emerging market.

## B. Identifying Housing Price Booms

We also construct an econometric model to investigate the existence of house price bubbles for a group of Latin American economies. The idea is to determine the extent to which the recent performance of house prices can be explained by economic fundamentals. Much like Tumbarello and Wang (2010) and Tsounta (2009), we determine the existence of cointegration relationships to uncover the long-run relationship between real house prices and its fundamentals, with variables expressed in levels (A detailed description of the data and sources for house prices is reported in Appendix II).

We find house prices and income (as well as other fundamentals) to be cointegrated (see Appendix III for matrix detail), suggesting that the gap between actual prices and estimated prices, estimated using an error correction model, may be a useful indicator of when house

<sup>13</sup> The Minha Casa, Minha Vida program was introduced to reduce the housing deficit and inequality gap. The authorities are planning to build under the program 3.4 million new houses by 2014 (in partnership with the states, municipalities and private sector) to be allocated to families on a means-tested basis.

prices are above or below their equilibrium values.<sup>14</sup> The model we estimate consists of two to four cointegrating  $I(1)$  variables, real house price,  $P_t$ , real interest rate,  $R_t$ , real per capita GDP,  $Y_t$ , and population,  $S_t$ , depending on the country considered. All variables are in logarithms except for the real interest rate, which is in levels. The error-correction equation for  $P_t$ , in its entirety is:

$$\Delta P_t = \alpha [P_{t-1} - \beta_0 - \beta_1 R_{t-1} - \beta_2 Y_{t-1} - \beta_3 S_{t-1}] + \lambda_1 \Delta P_{t-1} + \lambda_2 \Delta Y_{t-1} + \lambda_3 \Delta R_{t-1} + \lambda_4 \Delta S_{t-1} + \varepsilon_{y,t} \quad \forall t = 1, \dots, T$$

where  $0 < \alpha < 1$ , is the error correction term,  $\beta$ 's and  $\lambda$ 's are estimated parameters, and  $\Delta$  is the difference operator.

Using similar vector error correction models for Chile, Colombia, Mexico, and Peru, we find real GDP per capita, population, and real lending rate—a proxy for real mortgage rate—to be important determinants of equilibrium prices in all four countries (Table 2).<sup>15</sup> Moreover, the coefficients are statistically significant and of the right sign, although the importance of each variable in explaining price movements differs significantly across countries. Our stylized model has the following implications:

- In the long run, a 1 percent increase in population—a proxy for households' formation—will raise the equilibrium house price by about ½ percent in Chile.<sup>16</sup>
- Real GDP per capita—a proxy for households' purchasing power and borrowing capacity—has a significant positive effect on house prices with an elasticity ranging from 0.3 (Mexico) to around 2 (Colombia). These estimates are in line with other findings in the literature as summarized in Iossifov, Čihák, and Shanghavi (2008).
- The real mortgage rate which affects households' ability to borrow also has a significant and negative impact on house prices in Mexico and Chile; in the long run, a 1 percentage point increase in the interest rate will lead to a fall in house prices of 0.6 percent in Chile and 0.8 percent in Mexico.<sup>17</sup> These coefficients are broadly in line with other estimates in the literature; although there is a large dispersion ranging from -0.9 for the Netherlands (Hofman, 2005) to -6 for the United Kingdom (Hunt, 2005). The small coefficient for Mexico might reflect the lower reliance on mortgage finance than in other more advanced economies.
- The negative sign of the coefficient of the error correction term for all four countries suggests that indeed the system is correcting back to its long-run equilibrium, with a

<sup>14</sup> Vector error correction models are preferable to single equation models with variables expressed in percentage changes (as in Hunt et al., 2009; and Terrones, 2004) because they allow the estimation of equilibrium values.

<sup>15</sup> The specification varies slightly for each country since a common specification did not yield a cointegration relationship for each country.

<sup>16</sup> Egert and Mihaljecjk (2007) show that the average long-run elasticity of house prices to the working age population share is close to 4 for 19 OECD countries.

<sup>17</sup> This coefficient expresses the long-run relationship between real house prices and mortgage interest rate and should not be used to gauge the short-term impact of interest rate changes on house prices.

pace of about one-third of the disequilibrium per quarter in Colombia and almost instantaneously in the remaining sample countries.

**Table 2. Determinants of Equilibrium House Prices: Chile, Colombia, Mexico, and Peru** <sup>1 2</sup>

Sample period	Chile	Colombia	Mexico	Peru
	2004Q3–2011Q1	2001Q2–2011Q1	2005Q3–2011Q2	1998Q3–2011Q2
Total population	0.55 [2.52]			
Real GDP per capita	0.97 [14.96]	2.16 [13.08]	0.3 [4.61]	0.99 [160.15]
Real mortgage rate	-0.61 [-1.52]		-0.89 [-10.89]	
Error correction	-0.88 [-4.04]	-0.3 [-4.09]	-0.89 [4.04]	-0.98 [-28.31]

Source: Authors' calculations.

<sup>1</sup> Quarterly data. All variables in the VECM are in log levels with the exception of the real mortgage interest rate.

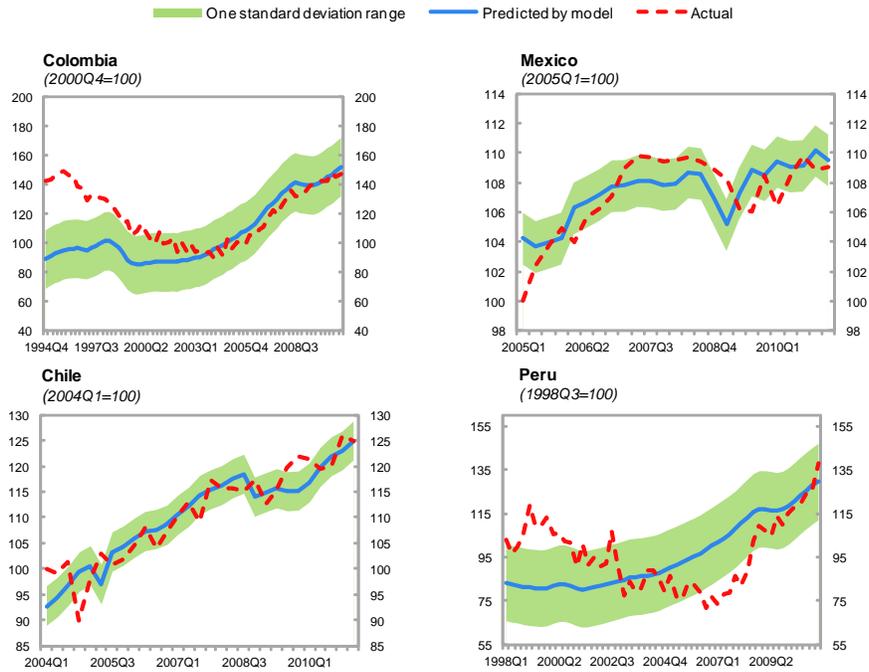
<sup>2</sup> T statistics in brackets [ ].

In addition, the econometric results allow us to conclude that:

- House price dynamics in Latin America can mostly be explained by the basic stylized model of economic fundamentals (IMF, 2011b).
- Prices remain aligned with fundamentals and within a one-standard deviation range from the trend (Figures 2 and 3). The most dynamic market is Peru, where house prices deviate by six percent. Nonetheless, Peru's price-to-rent ratio is low in regional and international comparisons, suggesting that, if any, signs of overvaluation are modest.<sup>18</sup> Chilean house prices are found to be in line with fundamentals. It is also worth noting that the recent run-up in house prices in some countries appears to reflect some catching up from undervalued house prices in the mid 2000s.
- Our stylized model captures the large bubble experienced in Colombia in mid-1990s that led to the mortgage crisis (see Box 1). House prices are estimated to have exceeded the trend by as much as 60 percent in the mid-1990s, and that house prices only returned to levels dictated by fundamentals by mid-2000s.

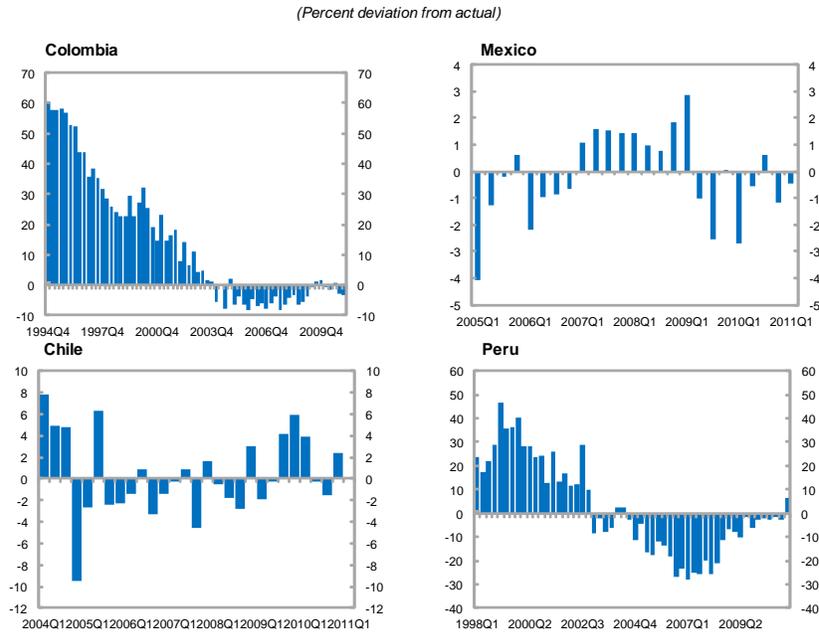
<sup>18</sup> Moreover, the price data for Peru captures only trends in the higher-income areas of Metropolitan Lima, and it is not clear whether the same price dynamics can be replicated in other areas of the capital city or the rest of the country.

**Figure 2. Actual and Estimated Real House Prices**



Source: Authors' calculations.

**Figure 3. House Price Over/(under)valuation**



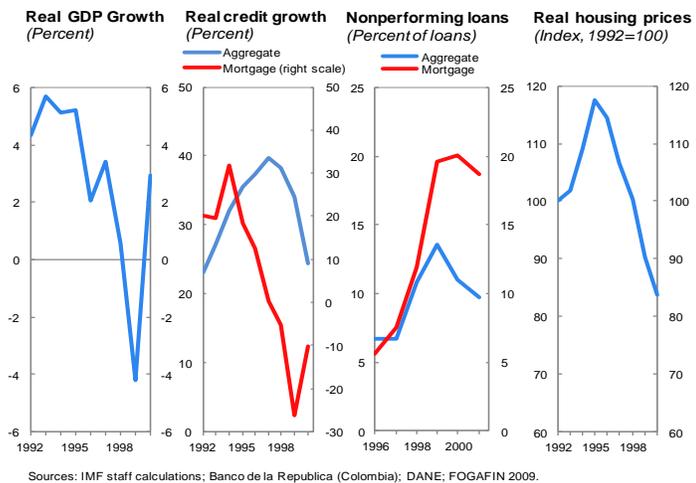
Source: Authors' calculations.

### Box 1. Colombia's Mortgage Crisis of the Late 1990s: A Cautionary Tale<sup>1</sup>

*The Colombian mortgage crisis of the late 1990s illustrates the possible systemic effects of problems in the housing market. The crisis had its origins in the early 1990s when a process of financial deregulation set the stage for unsustainable credit growth and asset price overvaluation, amidst weak regulatory and supervisory frameworks.*

Reforms aimed at increasing competition and efficiency in the Colombian financial system in the early 1990s led to a rapid expansion of bank assets along with undesirable changes in their liability structure. A period of easy external financing conditions triggered massive capital inflows that were intermediated by the domestic financial system. Assets prices (including housing prices) rose quickly and credit boomed (bank credit as a share of GDP doubled between 1991 and 1997). At the same time, financial institutions adopted aggressive funding practices in an environment of increased competition.

Weak regulatory and supervisory systems and internal risk managing models made the financial system vulnerable. Internal risk models were ill suited for assessing borrowers' capacity to pay, and collateral was frequently overvalued. Weak regulation and supervision practices did not prompt an increase in capital requirements or loan-loss provisions to mitigate growing risks as the process unfolded. In addition, there were important information blind-spots that prevented the adequate assessment of risks.



When external conditions became less favorable and the economy began to slow in 1995, housing prices started to fall. This process was compounded by the sudden stop that followed the Asian and Russian crises and domestic political problems. By 1998 interest rates reached historical highs, and households found themselves unable to continue servicing mortgages. Properties were seized, non-performing loans (NPLs) skyrocketed, and banks specializing in mortgage lending became illiquid or insolvent.

In 1999, the government was forced to intervene. Financial institutions were nationalized, closed, or recapitalized, and Colombia suffered its first recession since 1933. The crisis also set back the development of the housing market in Colombia. In the end, the total fiscal cost of the crisis (including the effects of judicial rulings that further undermined creditors' rights) exceeded 15 percent of GDP (FOGAFIN, 2009).

<sup>1</sup> For a detailed overview of the Colombian Mortgage crisis, see FOGAFIN (2009) and Urrutia and Llano (forthcoming).

A drawback to this analysis is the considerable uncertainty about the right technique to model equilibrium house prices, including the possible biases that may arise due to model

specification (e.g., failing to capture macroeconomic volatility or inward migration) and the ensuing “omitted variable bias” or unstable estimated relationships. However, this is intrinsic to most of techniques found in the literature (see Gallin (2003), Gurkaynak (2005), Kluyev (2008), and Girouard et al. (2006), Tsounta (2009), Allen et al. (2006), and Terrones (2004)). As mentioned previously, the relatively short time series for data on prices and its limited coverage also constrain the analysis.<sup>19</sup>

#### IV. THE HOUSEHOLD DEBT BURDEN AND FINANCIAL BALANCE SHEETS

Financial stability concerns related to the fast growth in mortgage credit and real estate prices are counterbalanced by the relatively low exposure of banks in the mortgage market, the small share of nonperforming mortgages, and the strength of household balance sheets.

Banks and households have relatively low direct exposure to housing, providing an important mitigating factor.<sup>20</sup> Mortgages account for less than 20 percent of banks’ total credit in many countries in the region, and banks have a sound funding structure that relies little on cross-border funding or on complex instruments.

Moreover, the few existing household indebtedness indicators suggest that the debt burden remains at manageable levels (also supported by near-record low unemployment rates), although they have been on the rise in recent years, particularly in the case of low-income households. That said, data gaps limit a more-comprehensive assessment of household leverage.

In line with the trends for aggregate bank credit quality in the region, the share of nonperforming mortgage loans is relatively low. Strong growth in household income has contributed to this low rate, as well as the record low unemployment. However, this situation could change should favorable external conditions reverse. Moreover, many loans are new, and defaults are typically rare early in the life of a loan. It also seems that banks are extending loans to households with underdeveloped credit and payment histories; such households tend to be more vulnerable during downturns. In addition, housing corrections tend to have important social ramifications, because construction is labor intensive and employs relatively unskilled workers who experience longer unemployment spells.

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<sup>19</sup> Brazil was omitted from the analysis given the short price time series (house price data only start in 2008). Applying the same technique on the limited data, we find some overvaluation, which is consistent with the relatively high house price-to-rent ratio.

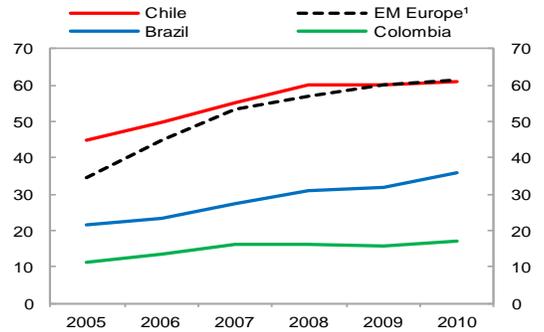
<sup>20</sup> Although not discussed in this chapter, mortgage credit quality can have important implications for fiscal policy depending on the degree of exposure of public banks.

## V. CONCLUSIONS AND POLICY RECOMMENDATIONS

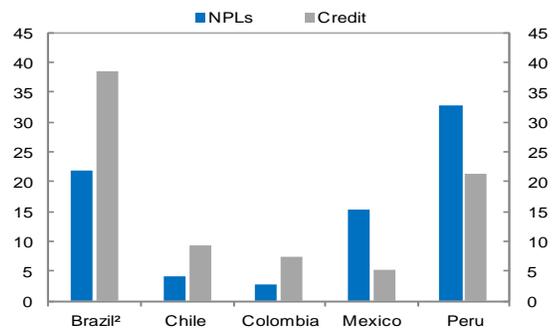
This paper documents developments in mortgage credit and the housing sector in Latin America during the past decade, and compares them with those in other emerging economies. Although data limitations hamper a more rigorous analysis of trends, vulnerabilities, and risks, we find few signs of misalignments in the mortgage and real estate sector. Moreover, house prices in most markets are at near equilibrium levels. Thus, although we do not envision any immediate threats, if left unattended the current credit and house price growth levels could result in misalignments down the road.

In this context, action is needed to close information gaps such as developing more comprehensive and timely information on home prices (with national coverage, distinguishing between new and existing homes, commercial and residential real estate, measured in terms of repeat sales) and construction activity (housing stock and flows, employment in sector, price of construction inputs, including land prices). Supervisory authorities should continue to strengthen the infrastructure to maintain current information on housing-specific financial soundness indicators and household balance-sheet data.<sup>21</sup> The latter is critical for assessing credit risks based on leverage ratios and meaningful affordability indicators. Progress on this issue also lags behind that in other regions.

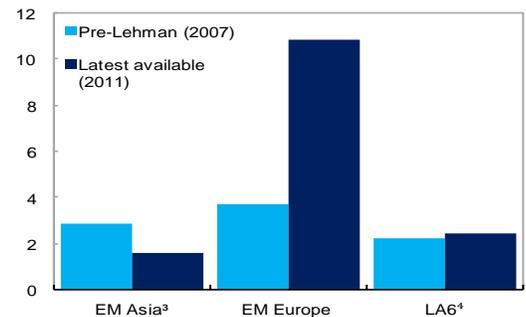
**Emerging Economies: Household Debt**  
(Percent of disposable income)



**Mortgage: Nonperforming Loans and Credit**  
(Real average 12-month percent change, 2009–11)



**Emerging Economies: Non-Performing Loans**  
(in percent of total loans)



Sources: Eurostat; national authorities; IMF, Financial Soundness Database; and IMF staff calculations.

<sup>1</sup> Average of Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovenia, and Slovak Republic.

EM = emerging market.

<sup>2</sup> Data on NPLs are only available for unearmarked housing.

Mortgage credit corresponds to total housing loans.

<sup>3</sup> Includes China, Hong Kong, SAR, Indonesia, Korea, and Malaysia. Pre-Lehman data exclude China.

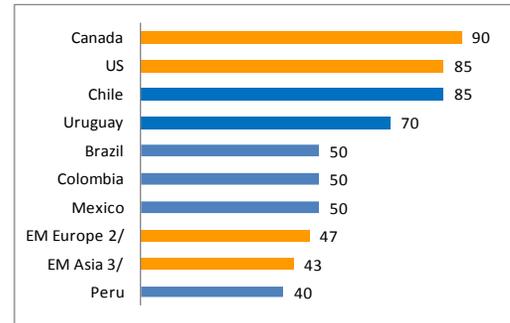
<sup>4</sup> Pre-Lehman data exclude Peru.

<sup>21</sup> Brazil, Chile, and Colombia have household financial or expenditure surveys aimed at collecting micro-data about households' real and financial assets. The data provide a picture of credit access and debt concentration among different household income segments, improving the assessment of credit risk and the implications of household debt for financial stability (see Persson, 2009).

Better data would also facilitate stronger oversight of the overall situation. Internal risk models to gauge misalignments in housing and other credit sectors can help with risk assessments. Further efforts are needed to improve property rights,<sup>22</sup> credit registries and the underwriting standards of mortgage loan originators and brokers, especially given the rising importance of the infant securitization market in some markets. Standards should take into account the value of the underlying property (based on sound independent appraisals) and the borrower's credit worthiness (via credit registries), with proper verification of the submitted information. These efforts should be complemented by efforts to strengthen creditor rights and programs to increase consumer financial literacy, particularly as credit access expands to lower-income households.<sup>23</sup> Finally, attention should be given to the financial implications associated with the rapid expansion of new forms of housing financing (e.g., trusts) in some markets, and mortgage securitization.

Finally, if vigor in the housing sector is sustained, targeted macroprudential measures should be considered, similar to those recently adopted in Asian countries. In this context, the use of loan-to-value (LTV) and debt-to-income (DTI) limits could be particularly useful to dampen credit and hence house price growth; the limits should be lower for emerging markets, as they tend to suffer deeper recessions with more severe financial downturns than advanced economies (Claessens, Kose, and Terrones, 2010, and 2011). The implementation of LTV and DTI limits might be particularly challenging in some of Latin American economies—LTV limits could be less effective given that a large share of mortgage origination is accounted for by the unregulated, informal financial sector, while DTI limits might not properly take into account incomes derived from informal sectors.<sup>24</sup>

**Property Rights Index<sup>1</sup>**



Source: Global Property Guide,; The Heritage Foundation; and the Wall Street Journal

<sup>1</sup> The property index measures the degree to which a country's laws protect private property rights, and the degree to which its government enforces those laws. The index ranges from 0 (worst) to 100 (best).

<sup>2</sup> Average of Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, and Ukraine.

<sup>3</sup> Average China, India, Indonesia, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

<sup>22</sup> According to the UN Habitat (2011), more than a third of Latin American homeowners may have tenure that falls short of full legal title, with informal housing estimated to constitute anywhere between 25 and 50 per cent of the urban housing stock (from 10 percent in Buenos Aires to 50 percent in Quito and Caracas).

<sup>23</sup> Efforts should be made to reduce the costs, duration, and effectiveness of the enforcement and foreclosure processes in the event a borrower defaults. The security of collateral and a relative lack of borrower credit history information have been cited as areas of weakness in the region (UN Habitat, 2011). Warnock and Warnock (2008) find that the size of housing finance systems worldwide – including Latin America – were positively correlated with the enforceability of legal rights relating to foreclosures.

<sup>24</sup> Many Latin American countries would need to construct LTV or DTI ratios in the first place.

## References

- Abraham, Jesse M., and Patric H. Hendershott, 1996, "Bubbles in Metropolitan Housing Markets," *Journal of Housing Research*, Vol. 7, No. 2, pp. 191–207.
- Agnello, Luca, and Ludger Schuknecht, 2009, "Booms and Busts in Housing Markets: Determinants and Implications," *ECB Working Paper No. 1071*, (Frankfurt: European Central Bank).
- Allen, Jason, Robert Amano, David P. Byrne, and Allan W. Gregory, 2006, "Canadian City Housing Prices and Urban Market Segmentation," *Working Paper 2006–49*, (Ottawa: Bank of Canada).
- Borio, Claudio, and Philip Lowe, 2002, "Asset Prices, Financial and Monetary Stability: Exploring the Nexus," *BIS Working Paper 114*, (Basel: Bank for International Settlements).
- \_\_\_\_\_, and Philip Lowe, 2004, "Securing Sustainable Price Stability: Should Credit Come Back from the Wilderness?" *BIS Working Paper 157* (Basel: Bank for International Settlements).
- Bunda, Irina, and Michele Ca' Zorzi, 2009, "Signals from Housing and Lending Booms," *ECB Working Paper No. 1094*, (Frankfurt: European Central Bank).
- Capozza, Dennis R., Patric H. Hendershott, Charlotte Mack, and Christopher, J. Mayer, 2002, "Determinants of Real House Price Dynamics," *NBER Working Paper 9262* (Cambridge, Massachusetts: National Bureau of Economic Research).
- Case, Karl. E., and Robert J. Shiller, 2003, "Is There a Bubble in the Housing Market?" *Brookings Papers on Economic Activity*, Vol. 2, pp. 299–342.
- \_\_\_\_\_, 1989, "The Efficiency of the Market for Single-family Homes," *American Economic Review*, Vol. 79, pp. 125–37.
- Central Bank of Chile 2009. "Encuesta financiera de hogares: EFH 2007 metodología y principales resultados." (Santiago).
- Claessens, Stijn, M. Ayhan Kose, and Marco E. Terrones, 2011, "How Do Business and Financial Cycles Interact?" *IMF Working Paper No. 11/88*; (Washington: International Monetary Fund).
- \_\_\_\_\_, 2010, "Financial Cycles: What? How? When?" in Richard Clarida and Francesco Giavazzi (ed.), *NBER Chapters, NBER International Seminar in Macroeconomics 2010*, pp. 303–43, (Cambridge, Massachusetts: National Bureau of Economic Research).
- Clayton, Jim F., 1996, "Rational Expectations, Market Fundamentals and Housing Price Volatility," *Real Estate Economics*, Vol. 24, pp. 441–70.

- Cottarelli, Carlo, Giovanni Dell'Ariccia, and Ivanna Vladkova-Hollar, 2005, "Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and in the Balkans," *Journal of Banking and Finance*, Vol. 29, No. 1, pp. 83–104.
- Davis, Morris, Andreas Lehnert, and Robert F. Martin, 2008, "The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing," *Review of Income and Wealth*, Vol. 54, pp. 279–328.
- Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, and Hui Tong, with Bas Bakker and Jerome Vandenbussche, 2012, "Policies for Macroeconomic Stability: How to Deal with Credit Booms," IMF Staff Discussion Note No. 12/06 (Washington: International Monetary Fund).
- \_\_\_\_\_, 1998. "Financial Liberalization and Financial Fragility," IMF Working Papers 98/83, (Washington: International Monetary Fund).
- Detken, Carsten, and Lucia Alessi, 2009, "Real Time Early Warning Indicators for Costly Asset Price Boom/Bust Cycles—A Role for Global Liquidity," *ECB Working Paper No. 1039*, (Frankfurt: European Central Bank).
- Égert, Balasz, Peter Backé and Tina Zumer, 2006, "Private Credit in Central and Eastern Europe: New (Over) Shooting Stars?" *ECB Working Paper 687*, (Frankfurt: European Central Bank).
- European Central Bank, 2006, "Assessing House Price Developments in the Euro Area," *Monthly Bulletin*, February, pp. 55–70.
- Fondo de Garantías de Instituciones Financieras, 2009, "Crisis financiera colombiana en los años noventa: origen, resolución y lecciones institucionales," (Bogotá: FOGAFIN and Universidad Externado de Colombia).
- Gallin, Joshua, 2003, "The Long-run Relationship between House Prices and Incomes: Evidence from Local Housing Markets," *Finance and Economics Discussion Series, No. 2003–17*, (Washington: Board of Governors of the Federal Reserve System).
- Garcia, Pablo, 2009, "The Changing Face of Housing Finance in Chile," *Latin America Housing Finance Summit*.
- Girouard, Nathalie, Mike Kennedy, Paul van den Noord, and Christophe André, 2006, "Recent House Price Developments: The Role of Fundamentals," *Economics Department Working Papers*, No. 475, (Paris: OECD Publishing).
- Global Property Guide, 2012, *Country Statistics*, Available at: [www.globalpropertyguide.com](http://www.globalpropertyguide.com)

- Gourinchas, Pierre-Olivier, Rodrigo Valdés, and Oscar Landerretche, 2001, “Lending Booms: Latin America and the World,” *CEPR Discussion Paper No. 2811*, (London: Centre for Economic Policy Research).
- Gurkaynak, Refet S., 2005, “Econometric Tests of Asset Price Bubbles: Taking Stock,” *Finance and Economics Discussion Series*, No. 2005–04, (Washington: Board of Governors of the Federal Reserve System).
- Himmelberg, Charles, Christopher Mayer and Todd Sinai, 2005, “Assessing High House Prices: Bubbles, Fundamentals and Misperceptions,” *NBER Working Paper 11643*, (Cambridge, Massachusetts: National Bureau of Economic Research).
- Hoek-Smit, Marja C., and Douglas B. Diamond, 2003, “The Design and Implementation of Subsidies for Housing Finance,” paper prepared for the *World Bank Seminar on Housing Finance*, March 10–13.
- Hofman, David, 2005, “House Prices in the Netherlands,” *Kingdom of the Netherlands, IMF Country Report*, No. 05/255, (Washington: International Monetary Fund).
- Hunt, Benjamin, 2005, “How Should Policymakers Respond to a Decline in House Prices,” *United Kingdom: Selected Issues, IMF Country Report*, No. 05/81, (Washington: International Monetary Fund).
- \_\_\_\_\_, Khoi Nguyen, and Patrizia Tumbarello, 2009, “Australian Household Vulnerabilities,” *Australia: Selected Issues, IMF Country Report* No. 09/249, (Washington: International Monetary Fund).
- International Monetary Fund, 2011a, *Global Financial Stability Report: Durable Financial Stability, Getting There from Here*, (Washington: April).
- \_\_\_\_\_, 2011b, *Regional Economic Outlook—Western Hemisphere, Watching Out for Overheating*, (Washington: April).
- \_\_\_\_\_, 2011c, *Uruguay: 2011 Article IV Consultation*, IMF Country Report No. 11/375, December.
- Iossifov, Plamen, Martin Čihák, and Amar Shanghavi, 2008, “Interest Rate Elasticity of Residential Housing Prices,” IMF Working Paper 08/247, (Washington: International Monetary Fund).
- Jeanneau, Serge, and Camilo E. Tovar, 2008, “Latin America’s Local Currency Bond Markets: An Overview,” *BIS Papers No. 36: New Financing Trends in Latin America: A Bumpy Road towards Stability*, pp. 46–64 (Basel: Bank for International Settlements).
- Jha, Abhas K, 2007, “Low-income Housing in Latin America and the Caribbean,” *En Breve*, No. 101 (Washington: World Bank).

- Kaminsky, Graciela and Carmen Reinhart, 1999, "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," *American Economic Review*, Vol. 89, No. 3, June, pp. 473–500.
- Klyuev, Vladimir, 2008, "What Goes Up Must Come Down? House Price Dynamics in the United States," IMF Working Paper No. 08/187, (Washington: International Monetary Fund).
- Malpezzi, Stephen, 1999, "A Simple Error Correction Model of House Prices," *Journal of Housing Economics*, Vol. 8, pp. 27–62.
- Mankiw, Gregory and David N. Weil, 1989, "The Baby Boom, the Baby Bust, and the Housing Market," *Regional Science and Urban Economics*, Vol. 19, No. 2, pp. 235–58.
- Mayer, Christopher, 2003, "Is There a Bubble in the Housing Market?—Comments and Discussion," *Brookings Papers on Economic Activity*, Vol. 2, pp. 343–354.
- Meen, Geoffrey, 2002, "The Time-Series Behavior of House Prices: A Transatlantic Divide?" *Journal of Housing Economics*, Vol. 11, pp. 1–23.
- Mendoza, Enrique G., and Marco E. Terrones, 2008, "An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data," NBER Working Paper No. 1404, (Cambridge, Massachusetts: National Bureau of Economic Research).
- Morandé, Felipe G, and Carlos Garcia, 2004, "Financiamiento de la Vivienda en Chile," *RES Working Papers 4357*, (Washington, Inter-American Development Bank, Research Department).
- OECD, 2005, "Recent House Price Developments: The Role of Fundamentals," OECD Economic Outlook No. 78, (Paris: Organization of Economic Cooperation and Development).
- Parrado, Eric, H.; Paulo P Cox; and Marcello C. Fuenzalida, 2009, "Evolución De Los Precios De Viviendas En Chile," *Economía Chilena*, Vol. 12, No. 1, pp. 51–68.
- Persson, Mattias, 2009, "Household Indebtedness in Sweden and Implications for Financial Stability-The Use of Household-Level Data," *BIS Papers No. 46* (Basel: Bank for International Settlements).
- Poterba, James M., 1991, "House Price Dynamics: The Role of Tax Policy and Demography," *Brookings Papers on Economic Activity*, Vol. 2, pp. 143–203.
- \_\_\_\_\_, 1984, "Tax Subsidies to Owner-occupied Housing: An Asset Market Approach," *Quarterly Journal of Economics*, Vol. 98, pp. 730–52.
- Roche, Maurice J., "The Rise in House Prices in Dublin: Bubble, Fad or Just Fundamentals," *Economic Modeling*, Vol. 18, No. 2, pp. 281–95.

- Scatigna, Michela and Camilo E. Tovar, 2007, "Securitisation in Latin America," *BIS Quarterly Review*, September, pp 71–82, (Basel: Bank for International Settlements).
- SECOVI, 2012, *Industry Data*, available via Haver Analytics.
- Terrones, Marco, 2004, "What Explains the Recent Run-Up in House Prices?" IMF World Economic Outlook, Chapter II, Box 2.1, September, (Washington: International Monetary Fund).
- Tsounta, Evridiki, 2009, "Is the Canadian Housing Market Overvalued? A Post-Crisis Assessment;" IMF Working Paper 09/235, (Washington: International Monetary Fund).
- Tumbarello, Patrizia and Shengzu Wang, 2010, "What Drives House Prices in Australia? A Cross-Country Approach," IMF Working Paper No. 10/291, (Washington: International Monetary Fund).
- UN Habitat, 2011, "Affordable Land and Housing in Latin America and the Caribbean, Adequate Housing Series," Vol. 1, United Nations Human Settlements Program.
- \_\_\_\_\_, various years, Housing Finance Mechanisms, available in:  
<http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=2548>.
- Urrutia, Miguel, and Jorge Llano, 2012, "Los actores de la crisis económica de fin de siglo," forthcoming (Bogotá: Universidad de los Andes).
- Warnock, Veronica C., and Francis E. Warnock, 2008, "Markets and Housing Finance," *Journal of Housing Economics*, Vol. 17, No. 3, pp. 239–51.

## Appendix I. Data Definitions and Sources

### House Price Data Sources and Definition

	Source	Description
Brazil	Fundação Instituto de Pesquisas Econômicas.	FipeZap Price Index of Real Estate, Sao Paulo
Colombia	Banco de la República	HPI - For the three major Colombian cities using the repeat sales methodology.
Chile	Central Bank of Chile based on information from the Internal Revenue Service	Real House Price Index
Mexico	Sociedad Hipotecaria Federal	The house price index (HPI) at the national level.
Peru	Central Bank	Average Price per Square meter for La Molina, Miraflores, San Borja, San Isidro y Surco apartments.

Sources: National authorities and authors' calculations.

Data on lending rates—a proxy for mortgage rate—are from *IMF's International Financial Statistics*, while population and real GDP data are from Haver Analytics. Mortgage data are from national sources.

## Appendix II. Methodologies for Estimating Credit Booms and House Price Bubbles

### Credit Booms

The most typical approach of assessing credit booms involves estimating the standard deviation of a country's credit fluctuations around trend (typically using the Hodrick-Prescott filter) and identifying a credit boom when that deviation exceeds a certain benchmark (see Borio and Lowe (2002, 2004), Kaminsky and Reinhart (1999), Mendoza and Terrones (2008), and Gourinchas, Valdés, and Landerretche (2001)). An alternative is to use credit-to-GDP growth rate, and evaluate the existence of a credit boom based on a Bry-Boschan algorithm (Bunda and Ca'Zorzi, 2009). Another approach involves estimating the level of credit explained by economic fundamentals and identifying as booms/busts the deviations from the estimated equilibrium level (Égert et al., 2006). In this paper, we estimate deviations around a long-term trend given its general appeal, data limitations in using a longer time series or a more comprehensive dataset, and simplicity in interpreting the results.

### Housing Price bubbles

To empirically assess the existence of a housing boom, two main approaches have been employed in the literature.<sup>25</sup> The standard approach consists of checking the compatibility between observed prices and fundamentals (such as interest rates, income and supply side variables) using an estimated equilibrium model for house prices (see for example, Poterba 1984, 1991, Abraham and Hendershott, 1996; Malpezzi, 1999; Capozza et al., 2002; Meen, 2002, Mankiw and Weil, 1989; Roche, 2001; Terrones, 2004; and Tsounta, 2009). This is commonly formalized by positing a cointegrating relationship between house prices and fundamentals, and then estimating an error-correction specification.<sup>26</sup> An alternative, more finance-based approach relies on the underlying notion of arbitrage; where the costs and benefits of renting relative to buying a house are compared (see Case and Shiller, 1989 and Clayton, 1996; OECD, 2005; Himmleberg et al., 2005; and ECB, 2006). Deviations of the current rental price ratio from its long-run average are frequently taken to be an indication of over or undervaluation. A drawback of this approach is that supply and demand factors such as income or demographics are not modeled; they enter indirectly the analysis by affecting either the growth rate of rental income or in terms of a changing discount factor. Moreover, this approach has little to say regarding any adjustment path for house prices if house prices are away from their fundamental level. In this study we follow the standard approach of estimating a cointegrating relationship of house prices and economic fundamentals given its general appeal as well as due to data limitations in obtaining a comprehensive time series for rents.<sup>27</sup>

<sup>25</sup> See Iossifov, Čihák, and Shanghavi (2008) for a comprehensive survey of determinants of house prices.

<sup>26</sup> The error correction approach is simple enough for application to a large number of markets with reasonable data collection, yet grounded in theory and with some intuitive appeal (Malpezzi, 1999).

<sup>27</sup> There are just a few studies that analyze the evolution of house prices in Latin America, given the data limitations (for example, Parrado, Cox and Fuenzalida, 2009 for Chile).

### Appendix III. Cointegration Tests

#### Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
<i>Chile</i>				
None *	0.711549	60.62428	47.85613	0.002
At most 1	0.410888	27.05704	29.79707	0.1002
At most 2	0.376502	12.7703	15.49471	0.1235
At most 3	0.000565	0.01526	3.841466	0.9015
<i>Colombia</i>				
None *	0.317795	17.1544	15.49471	0.0279
At most 1	0.045374	1.857411	3.841466	0.1729
<i>Mexico</i>				
None *	0.671747	38.55229	29.79707	0.0038
At most 1	0.329514	11.81701	15.49471	0.1659
At most 2	0.088463	2.222965	3.841466	0.136
<i>Peru</i>				
None *	0.994599	271.5917	15.49471	0.0001
At most 1	0.001784	0.092851	3.841466	0.7606

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

#### Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
<i>Chile</i>				
None *	0.711549	33.56724	27.58434	0.0075
At most 1	0.410888	14.28673	21.13162	0.342
At most 2	0.376502	12.75504	14.2646	0.0854
At most 3	0.000565	0.01526	3.841466	0.9015
<i>Colombia</i>				
None *	0.317795	15.29699	14.2646	0.0342
At most 1	0.045374	1.857411	3.841466	0.1729
<i>Mexico</i>				
None *	0.671747	26.73528	21.13162	0.0073
At most 1	0.329514	9.594045	14.2646	0.24
At most 2	0.088463	2.222965	3.841466	0.136
<i>Peru</i>				
None *	0.994599	271.4989	14.2646	0.0001
At most 1	0.001784	0.092851	3.841466	0.7606

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values