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Evolution of Housing Prices in Chile^{*}

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Abstract

The availability of real estate data is clearly limited in Chile, which makes more complex the discussion of the possible vulnerabilities of households and the financial sector to risks arising from real estate markets. This paper proposes a set of housing price indicators for measuring the potential pressures that could be developing in the credit market. Using these price measures, we find that the recent sustained rise in home prices coincides with the sustained increase in disposable income and the decreasing trend of long-term interest rates, factors that have strongly driven the expansion of mortgage loans. However, we cannot overlook the presence of factors that point to the beginning of strong dynamics of housing prices in Greater Santiago.

JEL Classification Numbers: E42, E52, E58.

Keywords: House prices, hedonic prices, repeated sales method.

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I. INTRODUCTION

Real estate markets of many developed countries have experienced a boom over the past several years. Housing prices have grown considerably faster than personal income and yields.¹ Many observers and regulators have expressed concern for a possible correction of these prices in developed economies and the potential impact on private consumption and the growth outlook both for these economies and for the world economy.

In the case of Chile, the lack of systematic series on housing, office and land prices makes it difficult to follow and analyze trends in the real estate market and its consequences. This paper is a step toward filling in this absence of data. In particular, the paper constructs several housing price indicators using both sale and transaction prices and contrast them with macroeconomic variables that could explain their behavior. Interesting results emerge from the analysis. First, using different methodologies, the results show that housing prices have recovered significantly in the last two years. Apartment prices were less dynamic in the same period, which may be tied to the significant increase in supply and the change in its composition. Second, the recent upward trend in house prices is partially consistent with the increase in disposable income and the reduction in the cost of long-term financing.

The paper is organized as follows: Section II describes the importance of the real estate sector in the Chilean economy. Here, the paper reveals the importance of the real estate sector in the balance sheets of both households and the financial system. Section III discusses the effects of housing prices fluctuations on macroeconomic and financial stability. Section IV proposes and analyzes a set of housing price indicators for the city of Santiago, with the goal of systematically monitoring this market. This section presents a description of the data and the methodological issues associated to the proposed indicators. Section V presents a brief analysis of the evolution of housing prices and how macroeconomic foundations could explain their behavior on time. The final section summarizes the results and their implications for economic policy.

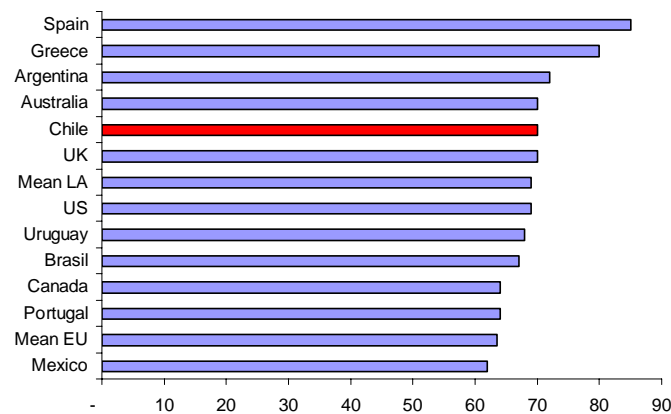
¹ The increase in property prices has been considerable in some areas of the United States, United Kingdom, Australia, France, Spain, and China. Some of these countries have reported, in their financial stability reports, the possible financial vulnerabilities that a correction of real estate asset prices could imply.

II. THE CHILEAN REAL ESTATE SECTOR

In Chile, as in many other countries in the world, housing is the main component of households' wealth, and it constitutes households' main collateral to loans issued by the financial system. Consequently, fluctuations in housing prices influence the consumption and investment decisions of households, affecting their financial position and that of the financial entities that provide loans.

According to the National Socioeconomic Characterization (*Casen*) survey, nearly 70% of all households own the dwelling they live in, while 17% of households are renters.² This home ownership rate is higher than the rate observed in developed countries or in other Latin American economies (figure 1).³ Of the total home owners, 73% live in houses that have been fully paid for; the remaining 27% (equivalent to 770,000 housing units) state that they are still paying a mortgage loan.

Figure 1
Share of owner occupied dwellings
(percentage)



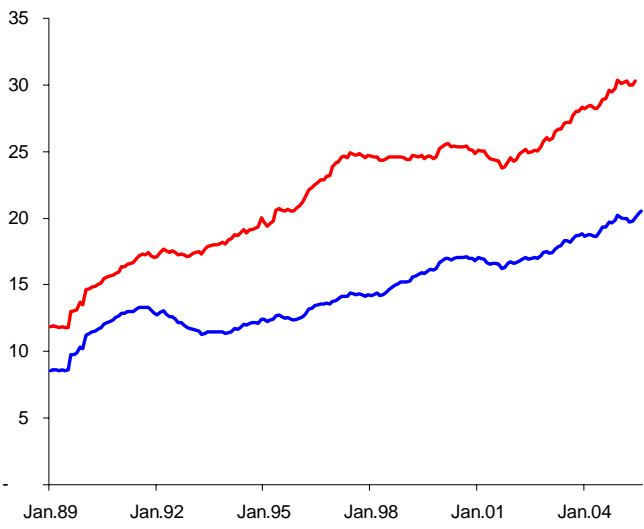
Sources:
de Ferranti et al. (2003).
Debelle (2004).
Mideplan, based on Casen 2003.

² The remaining percentage includes the following categories: granted by a family member or other person, granted for services rendered, usufruct, irregular occupation, and own home shared with other households.

³ This shows that the lower income level of Latin American countries has not prevented high rates of home ownership, despite the low coverage of formal credit. However, the high rates observed could be explained by the various housing policies implemented by the respective governments. In the case of Chile, the results of the 2003 Casen survey indicate that 43.3% of the households that own the home in which they live have benefited from one of the State housing programs.

The volume of household mortgage debt represented 16% of GDP in June 2005. Bank exposure to mortgage loans represented 60% of total exposure to households— that is, around 20% of total loans (figure 2). Although the exposure of the financial system to households is significant, it is lower than the levels observed in developed countries (figure 3).

Figure 2
 Banks exposure to households' mortgage debt: ratio of mortgage loans to total banking loans (percentage)
 Red line: Exposure to households
 Blue line: Exposure to households' mortgage debt

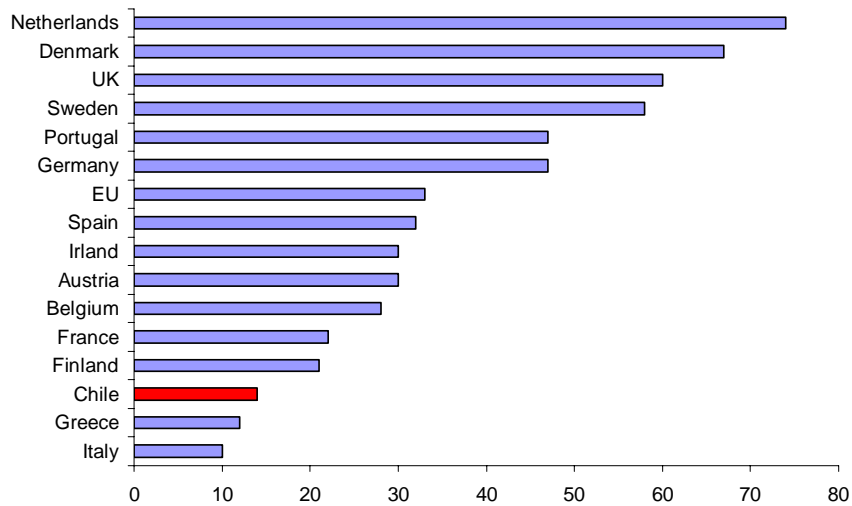


Source: Authors' calculations using provided by SBIF.

The banking system’s exposure through credit to construction firms or real estate corporations is also significant. Loans to the building sector account for nearly 7% of total loans of the banking system, which is similar to the share of loans to manufacturing industries.⁴ The insurance companies are another important actor in the real estate sector: real estate investments represent nearly 8% of the insurance industry’s total investments (the share is close to 30% if investment in mortgage bills and endorsable mortgage loans are included).

⁴ The current information does not allow us to separate housing construction projects from other types of construction projects, so it is not possible to determine the direct exposure to this sector.

Figure 3
Ratio of Mortgage debt to GDP (2001)
(percentage)



Sources:
ECB (2003).
SBIF.
CC.NN.

The above evidence reveals the relative importance of the real estate sector in our economy, given its role in the balance sheets of both households and the financial system. This implies that developments in this sector can have important impacts on aggregate demand and financial stability, through the financial system's exposure to changes in housing prices.

III. EFFECTS ON MACROECONOMIC AND FINANCIAL STABILITY

A. Effects on macroeconomic stability

Household mortgage debt plays a fundamental role in the evolution of aggregate demand and the transmission of monetary policy, through several mechanisms. First, higher mortgage debt implies that households are more exposed to changes in interest rates, especially if the loans are contracted at variable rates, as has been the case in the recent expansion of bank mortgage loans. Thus, an unexpected interest rate rise would increase

the financial burden of households and raise the cost of mortgage loans,⁵ thereby reducing consumption and aggregate demand. Second, the higher the debt, the more sensitive is household consumption to the evolution of employment, interest rates and income. Finally, mortgage debt or the holding of real estate has an important effect on consumption via changes in the real estate wealth of households. When the value of a dwelling increases, the household can extend its debt by using the housing appreciation as a guarantee for financing the consumption of other goods (the equity withdrawal effect). Households can even adjust the ratio of the value of the loan and the value of their dwelling (the loan-to-value ratio) —which falls with the increase in prices— so as to hold it constant, thus extending the amount of the loan.⁶ Moreover, as it has been noted in some economies that have experienced sustained low levels in mortgage interest rates, this mechanism allows households to fund the acquisition of financial assets, which in turn heightens the importance of housing prices in business cycles.

B. Effects on financial stability

The real estate sector is also important for the financial system and its stability. There are many mechanisms through which the housing sector is important for the financial system and its stability. The first one worth to mention operates directly, through the financing to home buyers and sellers. Other mechanisms, less direct, include the prepayment risk and the impact real estate prices variations have on the banks' capital adequacy ratios. Despite its importance, this last mechanism will not be further discussed in what follows.

The default risk arising from households' economic and financial fragilities are deepened by higher levels of mortgage debt. The higher the mortgage debt the higher the exposure of households' financial outlook to changes in the interest rates and to the performance of the labour market. This mechanism increases both the banking sector's exposure and the default risk. Sharp adjustments in house prices could make things even worse if they increase the Loss Given Default ratio, although this is limited by the maximum loan to

⁵ Changes in the demand for housing appear to respond even to transitory short-term interest rate shocks, which can have a strong impact on the initial mortgage debt service. See, for example, Meen (2001) and Miles (2004).

⁶ This would even allow the purchase of other assets at mortgage interest rates. Evidence of this type of effect is found in Ahearne et al. (2005), who examines data from 18 industrial countries; they show that housing prices are procyclical.

value ratio fixed by regulatory entities in most countries. Moreover, even if there were no limits, increasing default rates and sharp adjustment in house prices only would be of concern if the fall in prices goes beyond the loan's value, which seem plausible if the burst in housing prices accompanies high unemployment rates. As the stylised facts show, however, unemployed workers do not carry high levels of debt. Nevertheless, as some studies have shown, even if the impact of housing prices on financial stability through default risk has low probability, the losses are considerably big (Hilbers, 2001; WEO, 2003). This is the main reason for studying this subject.

The prepayment risk, when generalized, could affect the balance sheet of mortgage loans' tenants. In scenarios of decaying interest rates households refinance their mortgage loans' conditions. If mortgage interest rates are mostly fixed the tenants' balance sheets will deteriorate when interest rates begin to recover: the funding cost increases while mortgage cash flows decrease (naturally, this effect is stronger the lower the cost of refinancing.) However, this risk appears to be highly diversifiable, especially if there is a well developed securitization market. Differently to default risk, therefore, this type of risk is commonly not systemic. Accordingly, we must pay less attention to it if we are concerned with financial stability.

Summing up, the housing sector, including housing prices variations, has important linkages with both the macroeconomic business cycle and the financial system's stability. Before going a step further in the discussion, there are some factors that should be considered in analysing the mechanisms aforementioned.

Maybe the most important one is the evolution of demographic variables. According to the life cycle hypothesis, young households hold higher levels of indebtedness. As they become older they reduce their level of debt and gradually become net savers. At the end of the household's lifespan, finally, wealth is consumed or simply bequeathed. From a financial stability perspective, therefore, the distribution of assets and liabilities conditional on the population's demographic status is relevant. For example, volatility in housing prices could be higher the older the debtors, who will consider their real estate acquisition

as an investment

A structural factor is whether the mortgage interest rates are fixed or not. In markets where mortgage rates are mostly fixed these rates will depend on the long term interest rates' evolution, which weakens the monetary policy impact on the mortgage market. On the contrary, in markets where mortgage rates are mainly variable, the monetary policy has strong effects on the mortgage market and on the economy (Meen, 2001).

C. Housing prices variation and financial stability

When are housing prices' adjustments important for financial stability? Are there any distinguishable common patterns? How does housing prices impact financial stability when this occurs? These are some questions that naturally arise when we analyze the housing sector. In this section we will sum the main findings in attempting to tackle these three questions.

Evidence provided by many works shows that housing prices can produce financial instability when sharp downturn adjustments are preceded by sharp and sustained upturn adjustments (bubble breeding). Thus, we should narrow our scope of analysis to those episodes in which a bubbles bursts (we have responded to the first question).

Therefore, it is very important to characterize housing prices bubble behaviour. How common they are? For how long do housing prices increase? Which magnitudes of appreciation should be indicative of bubbles in the housing market? Here we will present the findings of Hilbers et al (2001) and WEO (2003), two of the most remarkable works in this subject.

In WEO (2003) housing prices indexes of 14 developed countries were analysed, for the time period 1970-2003. There were 20 bubble bursts⁷ episodes identified – the authors also identify 25 asset price crashes for the same time span and country set - . On average, real

price downturn corrections (bursts) were of 30% and lasted 4 years. Interestingly, there is a higher correlation between strong increments followed by sharp downturns in housing prices than in asset prices. In addition, half of the housing crashes coincided with asset price crashes.

Another important finding is the fact that although housing-price-bubble-bursts (HPBB) are less frequent than asset price bubble bursts (APBB), they last longer and their losses in terms of GDP are higher (twofold) –the estimated loss in terms of GDP reported by the study is 8% - . In addition, the study’s evidence suggests that pro-banking financial systems are less resilient to HPBB than pro-market are, a fact that is central to financial stability analysis.

Through which mechanisms are bubbles created? Hilbers et al (2001) gives some insights to this subject. One mechanism is the combination of fixed stock of buildings (in the short run or in highly populated areas) with investors excessively optimistic. If optimistic investors are important enough, so as to put pressure upon housing prices, and housing markets are not complete, a bubble is a likely outcome. Another story for housing price bubbles is the lagged response of building projects and incomplete information. Because building projects take several years to be completed the offer of dwellings adjusts slowly to price information, causing episodes with sharp adjustments to pop up.

A purely financial mechanism for HPBB is the expansion of debt highly collateralized. Mortgage collateral increases with housing prices’ growth, reducing the mortgage’s default risk and the loss given default (LGD) ratio. Favourable risk conditions impules an expansion in mortgage lending, which in turn pressures house prices up again. The contrary effect occurs when house prices are falling.

Hilbers (2001) identifies 11 episodes of financial stress directly associated to the housing market, in several countries⁸. In most cases house prices depicted sharp increments first and

⁷ In this paper a bubble burst is defined as a fall in prices above the 75th percentile of the respective series; a boom is defined analogously. A downturn adjustment is considered a burst if it is superior to 14%.

⁸ Namely: Spain, Mexico, Netherlands, Canada, Ireland, Finland, Japan, Sweden, Thailand, Malaysia.

then began to fall before the crises. On average, house prices grew 20% real, between two to seven years before the crises. Interestingly, the financial system's exposure to housing markets (measured as the share of mortgage credit and credit to the building sector, and one of the principal factors in explaining financial stress due to HPBB) was near to 20% on average before the crises, which is far below Chile's banking system current exposure.

As Hilbers (2001) also addresses, there were HPBB cases in which the financial system was not significantly affected. These are Singapore and Hong Kong. In both cases house prices' growth and the financial system's exposure were higher than those observed in the rest of the cases. However, as the authors especially remark, differently to all the "bad" cases, in both Singapore and Hong Kong, the financial system was highly capitalized and correctly supervised and the economy evidenced strong fundamentals.

As highlighted earlier, however, real estate assets are used as collateral on loans with other ends, which also has implications for financial stability. Real estate assets (such as actual buildings or real estate investments) are often a significant component of the financial institutions' assets. Consequently, the real estate sector is important for the stability of the financial system, especially through fluctuations in housing prices, which raise the risk of default of both mortgage and consumer loans.

IV. HOUSING PRICES AND THEIR IMPLICATION FOR FINANCIAL STABILITY IN CHILE

A. Information on housing prices

In Chile, there are few systematic and continuous indicators of housing prices, and scarce public data on the real estate market in general.⁹ This paper analyzes a set of housing price indicators (HPIs) for the city of Santiago. A first set of indicators is based on the effective prices of transactions involving houses and apartments as recorded by the Real Estate

⁹ Exceptions include the sales and listed price indicators for new dwellings in Greater Santiago, put together by the consulting firm Collect since 1993. In the case of land prices in Greater Santiago, the consulting firm Trivelli registers listed prices since 1982. Finally, the *Cámara Chilena de la Construcción* estimates a price indicator for the municipality of Ñuñoa, using the hedonic price method (see footnote 12).

Registrar (*Conservador de Bienes Raíces*, or CBR) of Santiago (HPI-T). The source of this data is the Real Estate Agents' Association (*Asociación de Corredores de Propiedades*, or ACOP); the data set covers ten municipalities in Santiago.¹⁰ A second group of indicators is based on the price of houses up for sale in 19 municipalities in Greater Santiago.¹¹ This data was collected by ACOP based on advertisements published in the newspaper *El Mercurio* (HPI-O).

These two sources differ in the frequency and representativeness of the data. The data provided by the CBR includes the values of all the transactions from January 2001 to December 2004.¹² Listed prices, in contrast, are published by ACOP on a quarterly basis, and with a quarterly lag. The current sample covers the period between the second quarter of 2002 and the second quarter of 2005.

B. Housing price indexes: methodologies and results

The construction of aggregate housing price indicators has several difficulties inherent to the type of asset under analysis. First, the high degree of heterogeneity of dwelling units makes it difficult to predict the value of one dwelling based on the price of another. Various attributes make them dissimilar, starting with the fact that no two dwellings occupy the same physical space. Second, it is difficult to know the value of a house if it is not traded in the market. Dwellings are generally sold following complex negotiations, which imply that the asking or listed price does not accurately reflect the house's value in the majority of cases. Finally, houses are sold infrequently, which limits the continuous monitoring of their value through time. In Chile, for example, data from the CBR of Santiago indicates that houses are sold every nine years, on average.¹³

¹⁰ The following municipalities are considered: La Florida, La Reina, Las Condes, Lo Barnechea, Macul, Ñuñoa, Peñalolén, Providencia, Santiago and Vitacura.

¹¹ La Florida, La Reina, Las Condes, Lo Barnechea, Macul, Ñuñoa, Peñalolén, Providencia, Santiago, Vitacura, Huechuraba, Independencia, Quilicura, Recoleta, Renca, Puente Alto, La Cisterna, San Bernardo, and Maipú.

¹² The total volume sold per year is around 5% of GDP.

¹³ Total repeated transactions over total transactions.

The literature proposes a number of methods that can be used to construct housing price indicators, taking into account the aforementioned problems. However, all the empirical methods have both advantages and disadvantages. The measures of a central trend, such as the mean and median values of houses in a set sample, are simple, easily constructed indicators, but they can present problems stemming from changes in the composition of the sample. For example, to the extent that incomes rise, the demand for certain housing attributes can be expected to change (in favor of improvements in the quality of construction, for example), which could cause a change in the price trend only by a change in the “type” of houses sold. Consequently, alternative indicators have been suggested to try to minimize these effects.

This study uses two additional methods to evaluate the importance of this type of consideration. First, in the case of the listed price of houses, we use a hedonic specification to control for the size of the lot and area of construction,¹⁴ while for apartments, we normalize the value of the dwelling by the area of construction. Second, based on the sample of transaction prices, we use the repeat sales method, which consists in identifying houses in the sample that are sold more than once during the period under study.

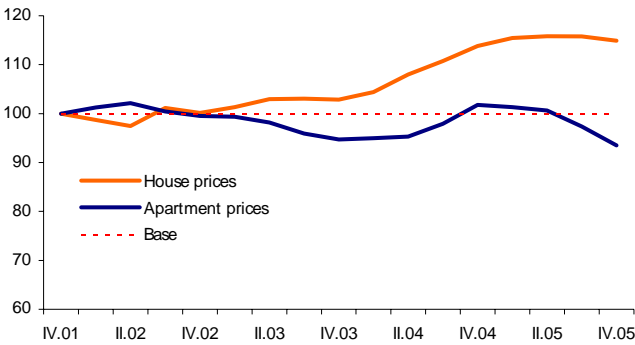
Median prices

The most direct measure of housing prices is based on the median sales or listed price. From a statistical perspective, the median price is simply the price at the midpoint of all the prices observed in a given period. The economic interpretation is that the median corresponds to the “representative” price for that period. One of the main reasons for using medians rather than means is the wide dispersion in the observations, with markedly asymmetrical price distributions.

¹⁴ The seminal empirical work on this methodology was carried out by Griliches (1961), while Rosen (1974) proposed the theory. Other useful references include Thibodeau (1995), Palmquist (1979), and Gillingham (1975). In the case of Chile, Morandé and Soto (1992), Morandé (1992), Bergoeing et al. (2002), and Desormeaux and Piguillen (2003) use the methodology to construct a continuous quarterly price indicator for the municipality of Ñuñoa in Santiago. Figueroa and Lever (1992) use this methodology to analyze the determinants of housing prices in Santiago.

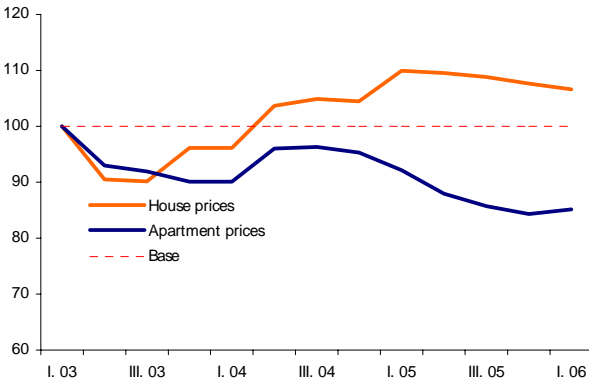
Figures 4 and 5 present the evolution of transaction and listed price indicators for houses and apartments. They show the moving average of the median housing price for each of the quarters considered. In the case of transaction price indicators, house prices increased significantly in 2004, accruing a real increase of 10.6%. The apartment transactions price indicator, on the other hand, was less dynamic, which is consistent with the growth of the supply of apartments in Santiago.¹⁵ Thus, the apartment prices index increased 7.4% between the last quarter of 2003 and December 2004.

Figure 4
Transactions real price index (HPI-T)
(December 2001 = 100, moving average)



Source: Authors' calculations using data provided by ACOP (CBR).

Figure 5
Listed real price index (HPI-O)
(March 2003 = 100, moving average)



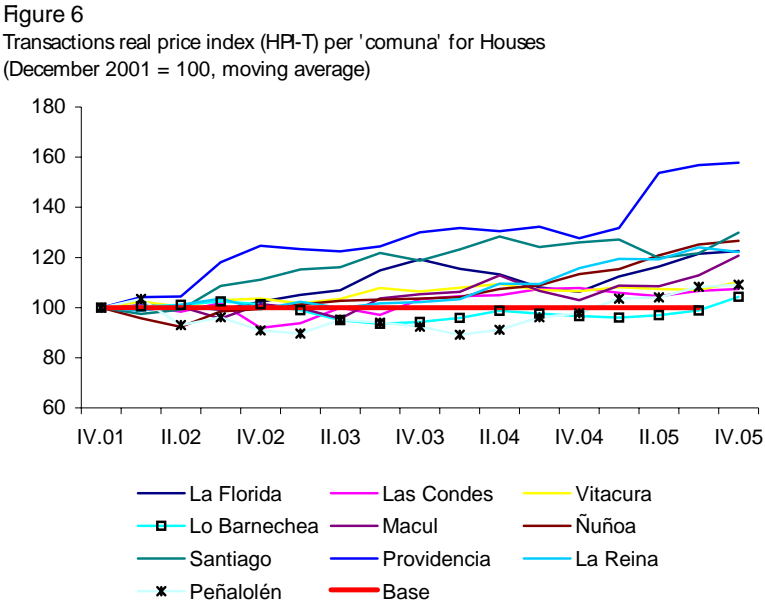
Source: Authors' calculations using data provided by ACOP.

¹⁵ For example, according to the consulting firm *Collect*, the total supply of new apartments in Greater Santiago increased 36% between the first quarter of 2003 and December 2004.

In the case of listed prices, house prices registered a recovery beginning in 2003, although they were less dynamic. Between 2003 and June 2005, the listed price increased 9.5% in real terms, while the listed price of apartments fell 11.9% in the same period. As in the case of transactions prices developments in 2004, listed prices of houses and apartments were also vigorous registering similar increases in prices: 8.7% and 5.4%, respectively. However, listed prices of houses were less dynamic in the first half of 2005, accumulating an expansion of 4.8%. Listed prices of apartments, on the other hand, registered a decline of 7.3% in the same period.

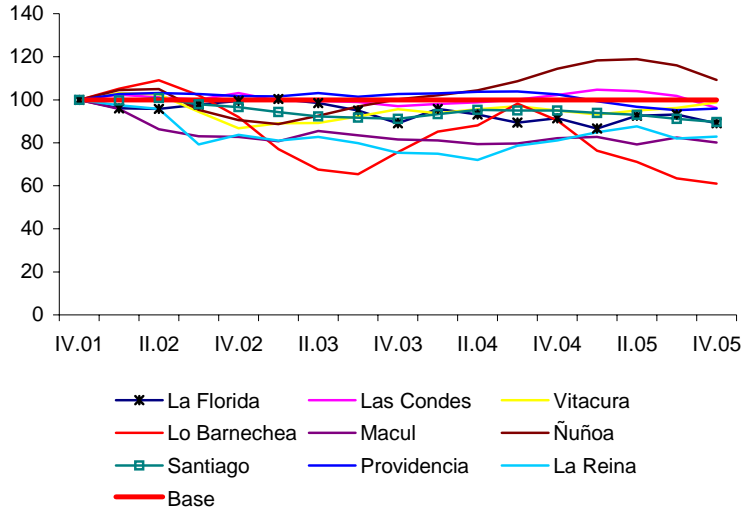
It is important to highlight that the evolution of transaction and listed price indicators is similar for houses, but not for apartments.

Despite high heteroskedasticity encountered in the levels of inter-counties' house prices and apartments appreciation and depreciation, respectively, most of them follow similar trends (figure 6 and figure 7).¹⁶



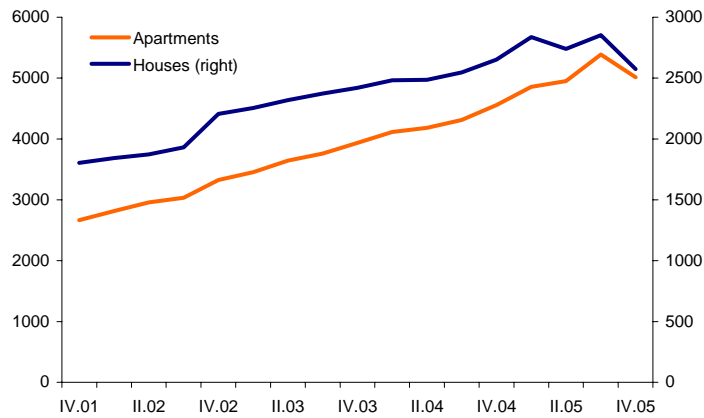
¹⁶ Tables with the median of both house and apartment transactions by 'comuna' (counties) from the CBR sample is available in the appendix.

Figure 7
Transactions real price index (HPI-T) per 'comuna' for Apartments
(December 2001 = 100, moving average)



The boom in the housing sector, as observed in the housing prices indicators, is also reflected in the number of transactions, which has increased significantly in the period under study. Between 2001:IV and 2005:IV the number of houses and apartments transacted increased by 42% and 80%, respectively (figure 8).¹⁷

Figure 8
Number of house and apartment transactions (moving average)



Source: author's calculations using data provided by ACOP (CBR).

¹⁷ This is consistent with evidence of new houses and apartments transactions, provided by Collect. See appendix.

Hedonic prices

The hedonic price is based on the hypothesis that goods do not provide utility to the consumer by themselves, but through their properties or features.¹⁸ By extension, the price of a dwelling would be explained by the value of its attributes. Given the available data, the characteristics used in the following calculations include the size of the property and the square meters of construction.

The hedonic price regression is based on a model of constant elasticity of substitution, taking the form of a Cobb-Douglas function:¹⁹

$$\text{Log}(P_{jt}) = \alpha + \beta_1 \text{Log}(MC_{jt}) + \beta_2 \text{Log}(MT_{jt}) + \varepsilon_{jt}, \quad (1)$$

where P_{jt} is the listed price of house j in quarter t , MC_{jt} the square meters of construction of the house, and MT_{jt} the size of the lot in square meters.²⁰

Once we have estimated the coefficients associated with the house's characteristics (square meters of land and of construction) by quarter and municipality, we obtain the quarterly value of the representative house for each municipality, using the medians of the characteristics identified —size of the lot and the construction— of all the observations available by municipality. Finally, to obtain an aggregate indicator, the indicators obtained for each municipality are weighted by the municipality's share in the total listed volume of houses for the respective quarter.

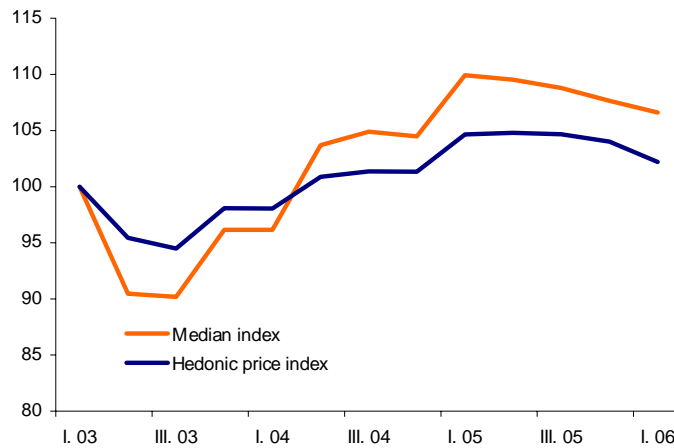
¹⁸ See Lancaster (1966).

¹⁹ Several works try to determine the functional specification between housing prices and housing characteristics. Despite these efforts, no consensus has been reached on the most representative functional form. See, among others, Rosen (1974) and Diewert (2001).

²⁰ From an economic perspective, the logarithmic functional form allows us to obtain a percentage measure of the change in prices in the face of percentage changes in the attributes (elasticities). That is, it is possible to calculate, for example, how much the price of a representative house would increase in percentage terms if there is a one square meter increase in the size of the lot or the construction. From this statistical perspective, preliminary regression results produce residuals that display a lower degree of heteroskedasticity than the residuals in linear specifications.

The results indicate that the “sample” effect produced by changes in house size is not minor, although the observed trend is similar to the trend of median house prices (figure 9).

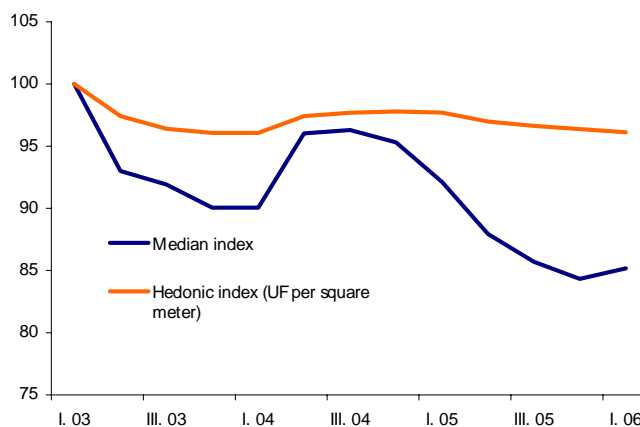
Figure 9
Median and Hedonic price indexes of houses (using Ads)
(March 2003 = 100, moving average)



Source: Authors' calculations using data provided by ACOP.

The comparable indicator for apartments is computed dividing the listed value by square meters. The differences between the two indicators, in this case, are explained by changes in the composition of the supply of relatively smaller apartments (figure 10).

Figure 10
Median and Hedonic price indexes of apartments (using Ads)
(Marzo 2003 = 100, moving average)



Source: Authors' calculations using data provided by ACOP (CBR).

Repeat sales

The repeat sales indicator is based on the sales history of a single dwelling. Using the Santiago CBR sample, we identified all the dwellings that were sold more than once between 2001 and 2004. We then calculated the price variations of the identified houses, annualizing variations in sales that did not occur in consecutive years.²¹

Table 1 shows the number of houses and apartments identified in the different years. We find a significant number of resold houses and apartments, which is notable given the short period considered. The number of transactions increases as the period is lengthened, as is to be expected.

Table 1
Number of repeated houses and apartments

Houses

| | 2001 | 2002 | 2003 |
|------|------|------|------|
| 2002 | 186 | | |
| 2003 | 174 | 285 | |
| 2004 | 166 | 247 | 401 |

Apartments

| | 2001 | 2002 | 2003 |
|------|------|------|------|
| 2002 | 86 | | |
| 2003 | 20 | 275 | |
| 2004 | 38 | 255 | 450 |

Source: Authors' calculations using data provided by ACOP (CBR).

Table 2 registers the median price change of houses and apartments. In general, the indicator becomes more robust when there are more transactions and a longer sales period. In the case of houses, the simple average of the price increase reached 4.5% in 2003 and 7.0% in 2004, which is consistent with the trend observed with the indicators presented

²¹ In the exercise, we assume that there are no changes in the quality or size of the houses over time (changes that would be produced with an extension, for example).

above²². For apartments, the median annualized price change was marginally positive.

Table 2
Median annual changes
of houses and apartments

Houses

| | 2001 | 2002 | 2003 |
|------|------|------|------|
| 2002 | 12 | | |
| 2003 | 2 | 7 | |
| 2004 | 4 | 5 | 12 |

Apartments

| | 2001 | 2002 | 2003 |
|------|------|------|------|
| 2002 | 0.7 | | |
| 2003 | 5 | 0.7 | |
| 2004 | -0.3 | 1.3 | 0.5 |

Source: Authors' calculations using
data provided by ACOP (CBR).

We also included repeat sales price estimators, following the econometric approach proposed by Case and Shiller (1987, 1989), which are an extension to Bailey, Muth and Nourse (1963), the first proposal on the subject. The method underlying these estimators consists in using information on the value of the same physical unit through time, where housing prices change as a stochastic diffusion process. This approach controls for differences in housing features in the sample, without directly estimating their contribution to total value, as the hedonic method does. Given the limited information in the CBR sample, this is the ideal approach. Before presenting our main findings, we will give a brief description of these estimators.

There are two types of estimators: the geometric repeat sales estimator (GRS) and the arithmetic repeat sales estimator (ARS). Several additional estimators are extensions to these main estimators.

²² This model has been used in measuring housing prices variations since it was proposed by Bailey, Muth and Nourse (1963); some extensions also implemented include those of Case and Shiller (1987, 1989). The worldwide most known index obtained with this method is the OFHEO (Office of Federal Housing Enterprise Oversight) of the US. It was developed by Freddie Mac and Fannie Mae and it is released on a quarterly basis. Freddie Mac and Fannie Mae are federal companies regulated by the OFHEO and their most important objective is to provide a secondary market of mortgage loans in the US.

The GRS estimator, first proposed by Bailey – Muth – Nourse (BMN), estimates an index of log prices by regressing log price changes on a matrix of dummy variables. The model can be written as follows:

$$Y_i = \sum_{\tau=1}^T \beta_{\tau} D_{i\tau} + \varepsilon_{\tau} \quad (2)$$

where $Y_i = \ln\left(\frac{P_{it}}{P_{is}}\right)$ and $D_{i\tau}$ is a dummy variable equal to 1 when $\tau = t$, -1 when $\tau = s$, and 0 otherwise. ε_i is assumed to be a random disturbance distributed $N(0, \sigma^2)$. For many repeated transactions the model may be written in matrix notation as:

$$Y = D\beta + E \quad (3)$$

If we assume, as BMN do, that the error vector is independently and identically distributed with mean vector 0 and scalar covariance matrix $\sigma^2 I$, the ordinary least squares (OLS) estimator is the best linear unbiased estimator.

An extension to the GRS estimator is the one proposed by Case and Shiller (1987, 1989), in which the error term is assumed to depend on the length of the time interval between repeated transactions, taking in consideration the likely presence of heteroskedasticity in the error term. A three-stage generalized least squares estimation is proposed in this case. In the first stage the original model of BMN is applied. The squared residuals from this model are regressed on a constant term and the interval between repeat transactions (t-s) in the second step. Finally, the fitted values from the second-stage are used as weights in a third-stage GLS regression.

Although the GRS is an understandable and simple method for obtaining a house price index it has some limitations depending on the purpose for which it is used. From a financial perspective, for example, one desires to obtain an estimate of the growth rate of an arithmetic mean value of prices of a portfolio of dwellings, in which case the GRS family of estimators results in downward-biased estimators. This, because the geometric mean is

always below the arithmetic mean for positive numbers. Arithmetic repeat sales (ARS) estimators appear as an alternative.

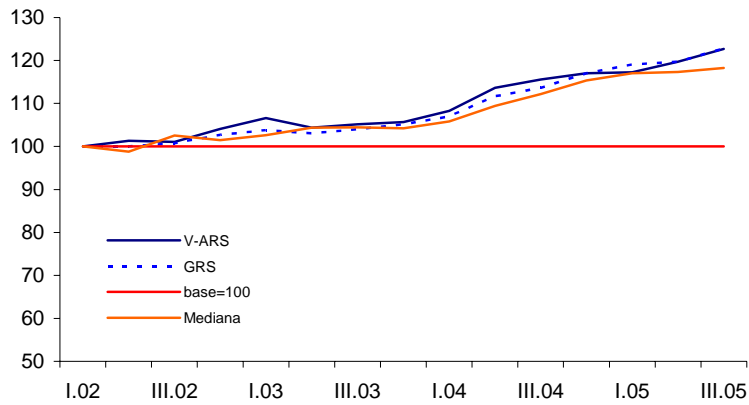
Several ARS estimators were proposed by Shiller (1991). The backbone regression can be written as follows:

$$Z = X\theta + \Gamma ,$$

where $Z_i = P_{i0}$ ($i = 1, \dots, n$) if the first sale occurred in period 0 and $Z_i = 0$ otherwise. The independent variable matrix X is obtained by replacing -1 in the dummy matrix D in equation (3) with the negative of the first transaction price and 1 with the second transaction price. The reciprocal of θ is an estimator of an arithmetic mean house price index. The simpler version of this procedure is referred to as the value weighted arithmetic repeat sales estimator (VWARS). By dividing each row of X and Z by the price of the first sale corresponding to that row each house is weighted the same, which is another type of ARS estimator. Analogously to the GRS case, a three-step GLS estimator could be obtained.

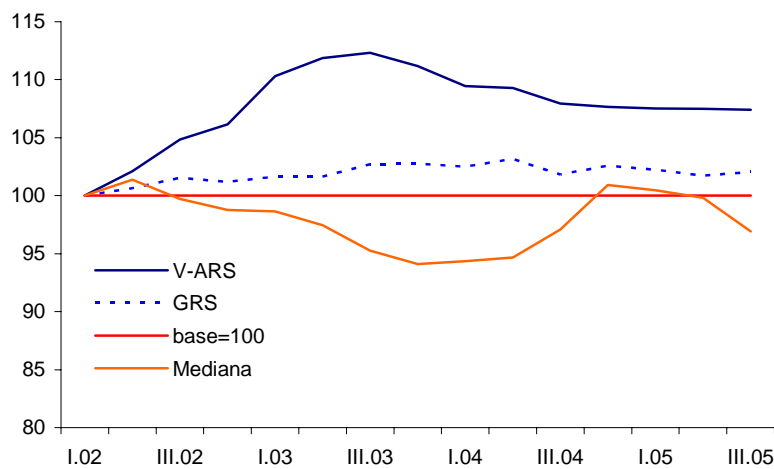
Here we present calculations for both the V-ARS and the GRS's simple version of BMN. Our sample has near of 13000 repeated sales between 2001 and 2005. According to our estimations, trends in house prices are similar to those depicted by the median price index, suggesting that during the last few years the median price index has not significantly suffered from sample changes (figure 11). However, in the apartments indexes we observe significant differences between the median price index and the repeat sales indexes, which was noted before when comparing the median price index with the hedonic price index (figure 12).

Figure 11
Repeat sales price indicators (Houses)
(December 2001 = 100, moving average)



Source: author's calculations provided by data provided by ACOP (CBR).

Figure 12
Repeat sales price indicators (Apartments)
(December 2001 = 100, moving average)



Source: author's calculations provided by data provided by ACOP (CBR).

Summing up, independent of the procedure applied in obtaining aggregate indexes for house prices in the housing sector for Great Santiago, there's strong evidence of sustained growth in house prices and a moderate one for apartments, the last 4 years. As we will see in the next section, this expansion has coincided with declining interest rates, an expansion in the mortgage industry, sustained growth of household income and favourable conditions in the labour market.

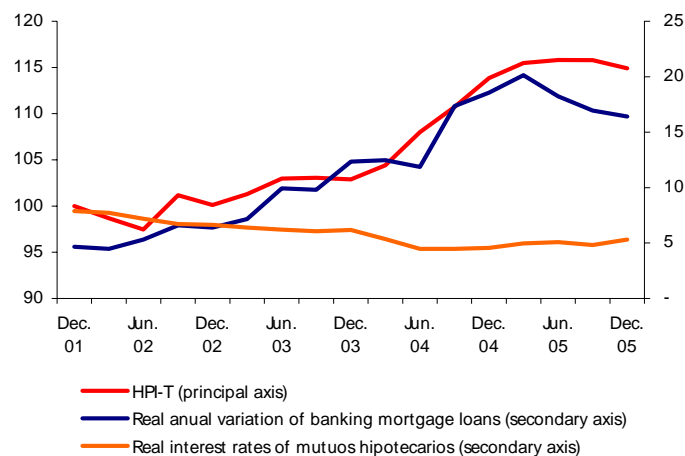
V. THE EVOLUTION OF HOUSING PRICES AND ITS FOUNDATIONS

The above evidence reveals a dynamic real estate market, reflected in a sustained increase in house prices over the past several quarters. The observed increase in housing prices, however, is not sufficient evidence that buyers are participating in price speculation. Changes in economic fundamentals could largely explain the price increases.

In particular, the recent evolution of housing prices has been accompanied by low interest rates and growth in disposable income. The low interest rate levels have helped drive the expansion of mortgage loans (figure 13). This effect is minor in the case of apartments because of the faster supply response and changes in the composition of supply.

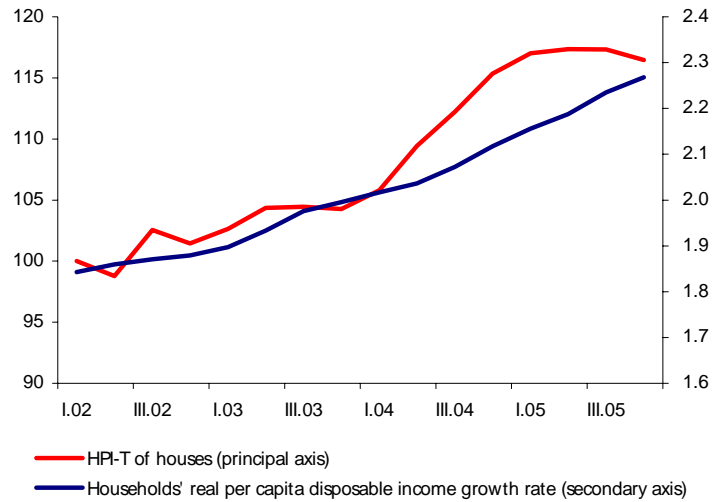
At the same time, our house sales price index (HPI-T houses), based on medians, and real disposable income per capita display a similar trend (figure 14). Consequently, the quotient of these indicators is stable, with low volatility. The correlation between these two variables is almost 97% in the 2002–2004 period, while a simple regression of the house price index against per capita income generates an R^2 of 93%.

Figure 13
HPI-T of houses, real interest rates and mortgage debt growth rate
(December 2001=100, moving average; percentage)



Sources:
SBIF.
Central Bank of Chile.
Authors' calculations using data provided by ACOP (CBR).

Figure 14
HPI-T of houses and real households' per capita disposable income growth rate
(March 2002 = 100; millions of pesos)



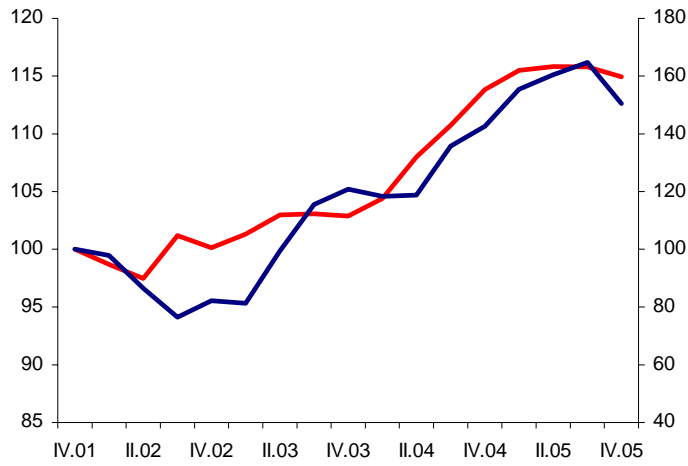
Sources:
ACOP (CBR).
Central Bank of Chile.
Authors' calculations using data provided by ACOP (CBR).

The HPI-T for houses shows a similar trend when compared to the evolution of stock prices (figure 15).²³ It is also consistent with the stylized fact that changes in stock prices precede changes in housing prices.²⁴

²³ The correlation coefficient between the IPSA and the HPI-T is 0.85. In addition, our estimates show that the IPSA Granger causes the HPI-T.

²⁴ See Borio and McGuire (2004).

Figure 15
HPI-T of houses and stock market price index (IPSA)
(December 2001 = 100, moving average)



Sources:
Central Bank of Chile.
Authors' calculations using data provided by ACOP (CBF).

The dynamism of house prices has been associated with a more active loan and stock market, which has not shown apparent signs of financial imbalances. The nonperforming mortgage loan indicator,²⁵ for example, has been registering lower rates since early 2003, reaching 0.9% in September 2005.

²⁵ Nonperforming mortgage loans over total mortgage loans.

VI. FINAL COMMENTS

The availability of real estate data is clearly limited in Chile, which makes more complex the discussion of the possible vulnerability of households and the financial sector to risks arising from real estate markets. This is particularly important in the case of Chile for two reasons. First, the international evidence suggests that housing prices affect strongly bank--based financial systems more than deeper financial systems. This is clearly the case in Chile because of the high exposure of the financial system to mortgage debt and households. Second, the negative effects deriving from housing price adjustments are greater for real assets (housing) than financial assets (stocks).²⁶ These factors raise the need for using a variety of indicators associated with the real estate sector, given its potential impact on financial stability.

This paper has proposed a set of housing price indicators for measuring the possible pressures that could be developing in the credit market. Using these price measures, we find that the sustained rise in home prices coincides with the sustained increase in disposable income per capita and the decreasing trend of long-term interest rates, factors that have strongly driven the expansion of mortgage loans. However, we cannot overlook the presence of factors that point to the beginning of strong dynamics of housing prices in Greater Santiago.

²⁶ These factors are highlighted in IMF (2003) and Debelle (2004a and 2004b).

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Appendix

Median prices by 'comuna' (UF)

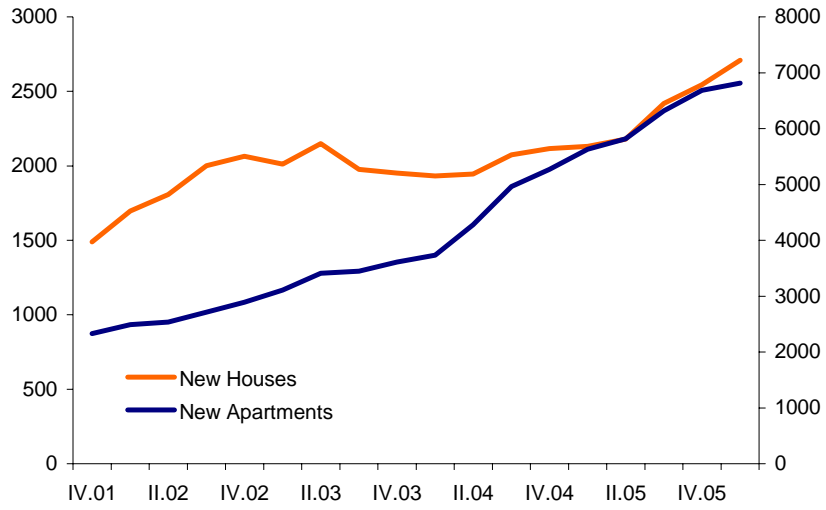
Houses

| | La Florida | Las Condes | Vitacura | Lo Barnechea | Macul | Ñuñoa | Santiago | Providencia | La Reina | Peñalolén |
|--------|------------|------------|----------|--------------|-------|-------|----------|-------------|----------|-----------|
| I.01 | 1328 | 4299 | 5065 | 7571 | 1349 | 2718 | 1707 | 3736 | 3304 | 2754 |
| II.01 | 1277 | 4110 | 5383 | 7586 | 1344 | 2529 | 1494 | 4278 | 3240 | 3278 |
| III.01 | 1264 | 4179 | 4493 | 7166 | 1435 | 1876 | 1248 | 2247 | 3119 | 2645 |
| IV.01 | 1147 | 5363 | 5251 | 7165 | 1095 | 2336 | 1767 | 3702 | 3825 | 3610 |
| I.02 | 1369 | 4428 | 5552 | 7713 | 1296 | 2311 | 1548 | 4320 | 3124 | 3172 |
| II.02 | 1260 | 3691 | 4975 | 7773 | 1412 | 2210 | 1604 | 4316 | 3561 | 1998 |
| III.02 | 1192 | 4801 | 5013 | 7571 | 1190 | 2453 | 1835 | 4157 | 3466 | 3024 |
| IV.02 | 1313 | 3585 | 5372 | 6818 | 1391 | 2440 | 1924 | 4611 | 3241 | 2968 |
| I.03 | 1503 | 4747 | 5181 | 7013 | 1224 | 2469 | 1799 | 4132 | 3528 | 3032 |
| II.03 | 1353 | 4810 | 5308 | 6623 | 1186 | 2350 | 1660 | 4196 | 3231 | 2668 |
| III.03 | 1590 | 4280 | 5903 | 7130 | 1610 | 2497 | 2192 | 4428 | 3721 | 2874 |
| IV.03 | 1534 | 4706 | 5091 | 7044 | 1475 | 2476 | 1730 | 5391 | 3300 | 2785 |
| I.04 | 1313 | 4976 | 5473 | 7455 | 1278 | 2537 | 2075 | 4383 | 3675 | 2630 |
| II.04 | 1240 | 4865 | 5620 | 7488 | 1532 | 2648 | 1988 | 4026 | 4074 | 2903 |
| III.04 | 1330 | 4731 | 5433 | 6782 | 1282 | 2644 | 1929 | 4663 | 3711 | 3492 |
| IV.04 | 1446 | 4780 | 4975 | 6751 | 1280 | 2893 | 1844 | 4742 | 4141 | 2977 |
| I.05 | 1620 | 4643 | 5800 | 7300 | 1586 | 2721 | 2145 | 4962 | 4184 | 3345 |
| II.05 | 1442 | 4616 | 5485 | 7763 | 1521 | 3173 | 1529 | 7093 | 4045 | 2967 |
| III.05 | 1583 | 5119 | 5350 | 7339 | 1509 | 3049 | 2043 | 5087 | 4357 | 4010 |
| IV.05 | 1500 | 4907 | 5600 | 8340 | 1689 | 3035 | 2357 | 4887 | 3897 | 3080 |

Apartments

| | La Florida | Las Condes | Vitacura | Lo Barnechea | Macul | Ñuñoa | Santiago | Providencia | La Reina | Peñalolén |
|--------|------------|------------|----------|--------------|-------|-------|----------|-------------|----------|-----------|
| I.01 | 1868 | 3016 | 4017 | 5319 | 1350 | 1408 | 1328 | 1989 | 1642 | 600 |
| II.01 | 1744 | 3059 | 3969 | 5627 | 1489 | 1479 | 1227 | 2020 | 1573 | 689 |
| III.01 | 1650 | 3150 | 5000 | 5554 | 1270 | 2212 | 1490 | 2290 | 2687 | 1247 |
| IV.01 | 1730 | 2982 | 5300 | 5787 | 1060 | 1895 | 1361 | 2239 | 1291 | 615 |
| I.02 | 1589 | 3310 | 4592 | 6476 | 1134 | 1726 | 1309 | 2217 | 1460 | 3983 |
| II.02 | 1724 | 2900 | 3864 | 6500 | 1000 | 1514 | 1293 | 2065 | 1444 | 3962 |
| III.02 | 1795 | 3020 | 3505 | 3983 | 1100 | 1528 | 1334 | 2250 | 1508 | 3947 |
| IV.02 | 1847 | 3355 | 3904 | 3542 | 1043 | 1564 | 1285 | 2151 | 1612 | 2117 |
| I.03 | 1650 | 2878 | 5016 | 3164 | 1025 | 1593 | 1187 | 2210 | 1264 | 778 |
| II.03 | 1591 | 2893 | 3884 | 4353 | 1250 | 1791 | 1182 | 2194 | 1570 | 646 |
| III.03 | 1552 | 2952 | 4076 | 3516 | 998 | 1830 | 1306 | 2108 | 1299 | 646 |
| IV.03 | 1436 | 3120 | 4517 | 5818 | 944 | 1795 | 1250 | 2258 | 1289 | 843 |
| I.04 | 2115 | 3000 | 4666 | 5294 | 1002 | 1724 | 1302 | 2237 | 1231 | 696 |
| II.04 | 1408 | 2977 | 4232 | 4999 | 1162 | 1950 | 1297 | 2250 | 1364 | 597 |
| III.04 | 1285 | 3125 | 4326 | 5784 | 1007 | 2124 | 1285 | 2121 | 1775 | 594 |
| IV.04 | 1580 | 3380 | 4148 | 4082 | 1077 | 2204 | 1251 | 2146 | 1462 | 710 |
| I.05 | 1782 | 3296 | 4326 | 2146 | 1030 | 2000 | 1244 | 1970 | 1510 | 835 |
| II.05 | 1822 | 2887 | 4578 | 3858 | 981 | 1992 | 1249 | 2021 | 1559 | 816 |
| III.05 | 1330 | 2870 | 4541 | 4057 | 1172 | 1919 | 1181 | 1987 | 1364 | 685 |
| IV.05 | 1293 | 2695 | 4628 | 3537 | 962 | 1722 | 1170 | 2209 | 1529 | 1035 |

Figure A
Number of new house and apartment transactions (moving average)



Source: author's calculations using data provided by Collect.