Non-Durable Consumption and Real-Estate Prices in Brazil: Panel-Data Analysis at the State Level

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Abstract

Housing is an important component of wealth for a typical household in many countries. The objective of this paper is to investigate the effect of real-estate price variation on welfare, trying to close a gap between the welfare literature in Brazil and in other developed countries as U.S. and U.K. Our first motivation relates to the fact that real estate is probably more important here than elsewhere as a proportion of wealth, which potentially makes the impact of a price change bigger here. Our second motivation is the boom of the real-estate prices in Brazil in the last five years. Prime real estate in Rio de Janeiro and São Paulo have tripled in value in that period, and a smaller but generalized increase has been observed throughout the country. Third, we have also seen a recent consumption boom in Brazil in the last five years. Indeed, the recent rise of some of the poor to middle-income status is well documented not only for Brazil but for other emerging countries as well. Regarding consumption and real-estate prices in Brazil, one cannot imply causality from correlation, but one can do causal inference with an appropriate structural model and proper inference, or with a proper inference in a reduced-form setup. Our last motivation is related to the complete absence of studies of this kind in Brazil, which makes ours a pioneering study.

We assemble a panel-data set for the determinants of non-durable consumption growth by Brazilian states, merging the techniques and ideas in Campbell and Cocco (2007) and in Case, Quigley and Shiller (2005). With appropriate controls, and panel-data methods, we investigate whether house-price variation has a positive effect on non-durable consumption. The results show a non-negligible significant impact of the change in the price of real estate on welfare (consumption), although smaller then what Campbell and Cocco have found. Our findings support the view that the channel through which house prices affect consumption is a financial one.

Keywords: Real Estate Markets, Consumption; Wealth; Models with Panel Data.

J.E.L. codes: R30, E21, C23 .

1 Introduction

Housing is a very important component of wealth of a household, especially when we consider the middle-class of income for any society. In the U.S., there is research indicating that a significant portion of wealth of a family is allocated to buy real estate. Bertaut and Starr-McCluer (2002) show that, in the late 1990's, residential property corresponded to about one quarter of aggregate wealth of a family living in the U.S. Using the official statistics (U.S. Census Bureau, 2012) shows that this proportion has remained roughly stable through time, despite the recent effects of the global recession: in 2010, residential structures corresponded to 24.8% of household's net worth.

The fact that the global recession had its roots on the U.S. housing market collapse had spurred a number of studies trying to understand the links between housing prices and household welfare, or, similarly, between housing prices and household consumption; see, *inter alia*, Gan (2010), Hryshkoa, Luengo-Prado, and Sørensen (2010), and Ren and Yuan (2012). Even before the real estate market collapse, some authors recognized the importance of this issue, e.g., Case, Quigley and Shiller (2005), who work with U.S. and developed-country data, and Campbell and Cocco (2007), who work with U.K. household data. Most of these studies resort to household data to investigate the links between the housing market and consumption.

Unfortunately, in Brazil, our best household survey – PNAD, *Pesquisa Nacional por Amostra de Domicílios* – is very incomplete regarding wealth data and has no data on consumption. Perhaps this is a consequence of the fact that income inequality has dominated the welfare debate in Brazil, but one can only conjecture why our most prominent survey has neglected consumption and welfare statistics.

Previous studies have shown that real estate also represents and important portion of household wealth in Brazil, with obvious consequences to welfare. For example, Marquetti (2000) estimates wealth in Brazil between 1950 and 1998 using the perpetual inventory method. He finds that residential structures amount to about a third of the net stock of fixed capital. Moreover, its average annual growth was 8.7% between 1981 and 1998. Hoffman (1992, 2000) estimates the capital stock for six Latin American countries (including Brazil) between 1950 to 1989, finding that residential construction represents more than 20% of the net capital stock. Table 1 summarizes these results.

Table 1

Stock Composition of Net Capital in Brazil (%), 1950-1994

Years	Hoffman (1992 e 2000)			Marquetti (2000)		
	Building		Machinery and Equipment	Building		Machinery and Equipment
	Residential	Nonresidential		Residential	Nonresidential	
1950	36	21	44	51	31	18
1973	29	37	34	34	47	19
1980	26	39	35	30	49	21
1989	28	44	28	33	53	14
1994	22	61	17	34	54	12

Source: Hofman (1992, 2000) e Marquetti (2000)

Finally, Morandi (1998) estimates that household real estate as a proportion of gross private wealth has remained roughly constant (1/3) between 1970 and 1995. Compared to the importance of real estate to *net wealth* in the U.S. (1/4), results for Brazil are striking, pointing towards the importance of the real-estate market for welfare in Brazil.

The objective of this paper is to investigate the effect of real-estate price variation on welfare, trying to close a gap between the welfare literature in Brazil and that in the U.S., the U.K., and other developed countries. Our first motivation relates to the fact that real estate is probably more important here than elsewhere as a proportion of wealth, which potentially makes the impact of a price change bigger here. Our second motivation is the boom of the real-estate prices in Brazil in the last five years. Prime real estate in Rio de Janeiro and São Paulo have tripled in value in that period, and a somewhat smaller but generalized increase has been observed throughout the country. These changes are unusual, since the last major real-estate price boom in Brazil occurred in the late 1960's and early 1970's. Third, we have also seen a recent consumption boom in Brazil in the last five years. Indeed, the recent rise of some of the poor to middle-income status is well documented not only for Brazil but for other emerging countries as well, see, e.g., Neri (2008), Wilson and Dragsanu (2008), Ravallion (2009), Bhalla (2009), and Wogart (2010). Regarding consumption and real-estate prices in Brazil, one cannot imply causality from correlation, but one can do causal inference with an appropriate structural model and proper inference, or with a proper inference in a reduced-form setup. Our last motivation is the absence of studies of this kind for Brazil, which makes ours a pioneering study.[1]

As our goal is to investigate the relationship between fluctuations of house prices and consumption (welfare) in Brazil, the interesting work of Case, Quigley and Shiller (2005) and of Campbell and Cocco (2007) deserve a closer look for our purposes, and will serve as a starting point to our paper. Case, Quigley and Shiller (2005) use panel data for 14 developed countries between the late 1970's and 1990's to find a strong correlation between house prices and the aggregate consumption of households. They also repeat this exercise using U.S. state data. Campbell and Cocco investigate the response of household non-durable consumption to house price changes using micro panel data for the U.K. They estimate the price elasticity of consumption for different cohorts, finding a positive response of household consumption to an increase in house prices. This effect is bigger for older cohorts, and not significant for younger renters, showing a heterogeneous effect across groups.

The interesting feature of Campbell and Cocco (2007) is that they tried to understand the economics of how these fluctuations in house prices affect households'consumption decisions, identifying important channels that could explain changes in the latter. They build and simulate a structural model for household optimal decisions and find some channels that could lead to a positive effect. Despite that, their approachnis based on a reduced form consitent with the structural model.

They first conjecture that a reason for the existence of a positive correlation is a wealth effect: increasing real-estate prices increases the perceived value of household wealth for home owners. On a second thought, they recall that housing is a commodity. Then, its higher price is simply a compensation for higher implicit cost of housing – its imputed rent. So, if we rule out any substitution effect from housing services to non-durable consumption, the increase in the price of real estate must be exactly offset by the expected present-discounted value of rent. Hence, in expected present-value terms, there is no change in

[1] Some authors believe that what we observe here (consumption and housing booms) is just the other side of the global crisis that hit developed countries; see, for example. Laibson and Mollerstrom (2010). Although this is a fascinating issue, it is beyond the scope of the present paper.

the budget constraint for the household, leaving non-durable consumption unchanged.

Campbell and Cocco also mention that rising house prices may stimulate consumption by relaxing borrowing constraints. This happens because a house is an asset that can be used as a collateral in a loan. Thus, an increase in house prices could increase consumption not by a direct wealth effect, but because a consumer may then increase borrowing to smooth consumption over the life cycle once the price of the house has increased – refinancing, for example. They also argue that this effect is heterogeneous: young renters are "short" on housing (want to buy) whereas old owners are "long," since they want to move from a larger house to a smaller one. This idea is also present in Lustig and Van Nieuwerburg (2004).

There are other papers that investigate optimal durable versus non-durable consumption decisions with obvious relevance to the issue we want to address here; see, for example, Bernanke (1985), Ogaki and Reinhart (1998), Yogo (2006), and Issler (2013). Usually, they have a representative consumer who derives utility from consumption of non-durables and from the services provided by the current stock of durable goods. Given that real estate is a major component of these services, they provide an integrated framework to deal with this issue. Campbell and Cocco also have this feature, but they go one step beyond this literature, trying to address what reduced-form equation one should expect from this basic theoretical setup. Also, their simulations confirmed the empirical findings of reduced-form estimation. Obviously, this offers a very useful guideline for investigating whether fluctuations of house prices affect consumption (welfare) in Brazil, being the reason why we chose to follow their theoretical and empirical implementation.

Although we follow Campbell and Cocco in general, there are some limitations in our study arising from the lack of identical micro data in Brazil and the U.K. As we stressed above, PNAD does not have consumption data for households.[2] Thus, we had to resort to state-level data on consumption. Indeed, Brazil has an index of monthly consumption in another survey, PMC – *Pesquisa Mensal de Comércio*, from February 2008 through July 2012, for the states of São Paulo, Rio de Janeiro, Minas Gerais, Ceará, Pernambuco, Bahia and Distrito Federal. With that in hand, we also obtained real-estate price data from FipeZap on the capital of these states. Thus, we were able to find Brazilian data

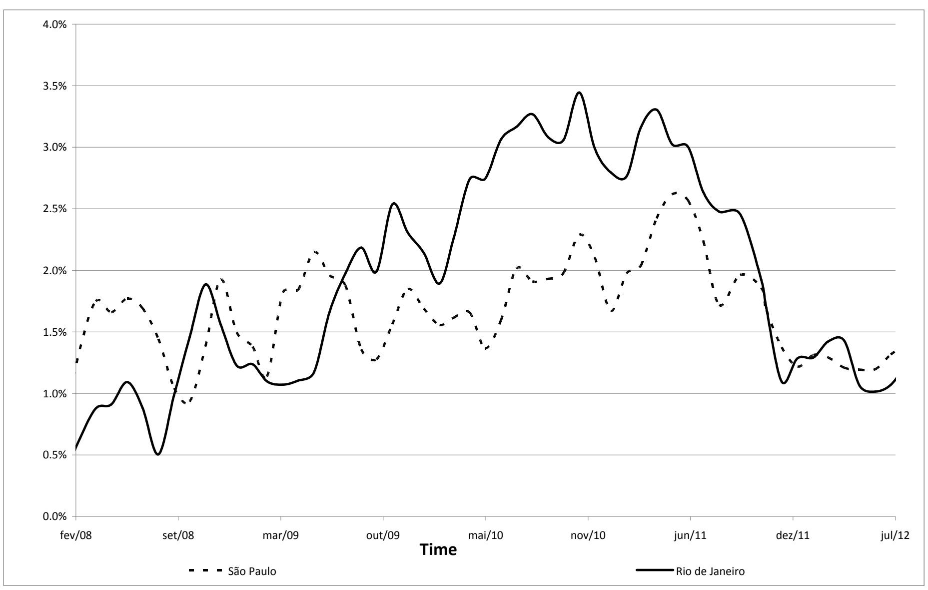
[2] Another Brazilian survey, POF – *Pesquisa de Orçamentos Familiares*, has household consumption data, but it is not collected in every year, but every 7 or 8 years apart. Older POF surveys have a specific serious problem due to high inflation, in which all price data is collected in nominal terms but inflation prior to 1995 has reached up to 80% a *month* in some cases. So, a synthetic panel using POF would have little time variation for our purposes.

for the dependent variable and the main regressor in Campbell and Cocco's reduced-form regression. We were also able to find data on other control variables as discussed below.

Our cross-sectional units are represented by Brazilian states. On that dimension, our setup gets closer to that of Case, Quigley and Shiller than to Campbell and Cocco, although we will use the same reduced-form equation Campbell and Cocco estimate in their paper. In adapting the latter framework to state cross-sectional units, we need to employ state-level demographic controls, which we have not been able to collect so far. We leave this as an extension of the current paper: obtain these control variables from PNAD household data and aggregate them to state level. We discuss this at some length below.

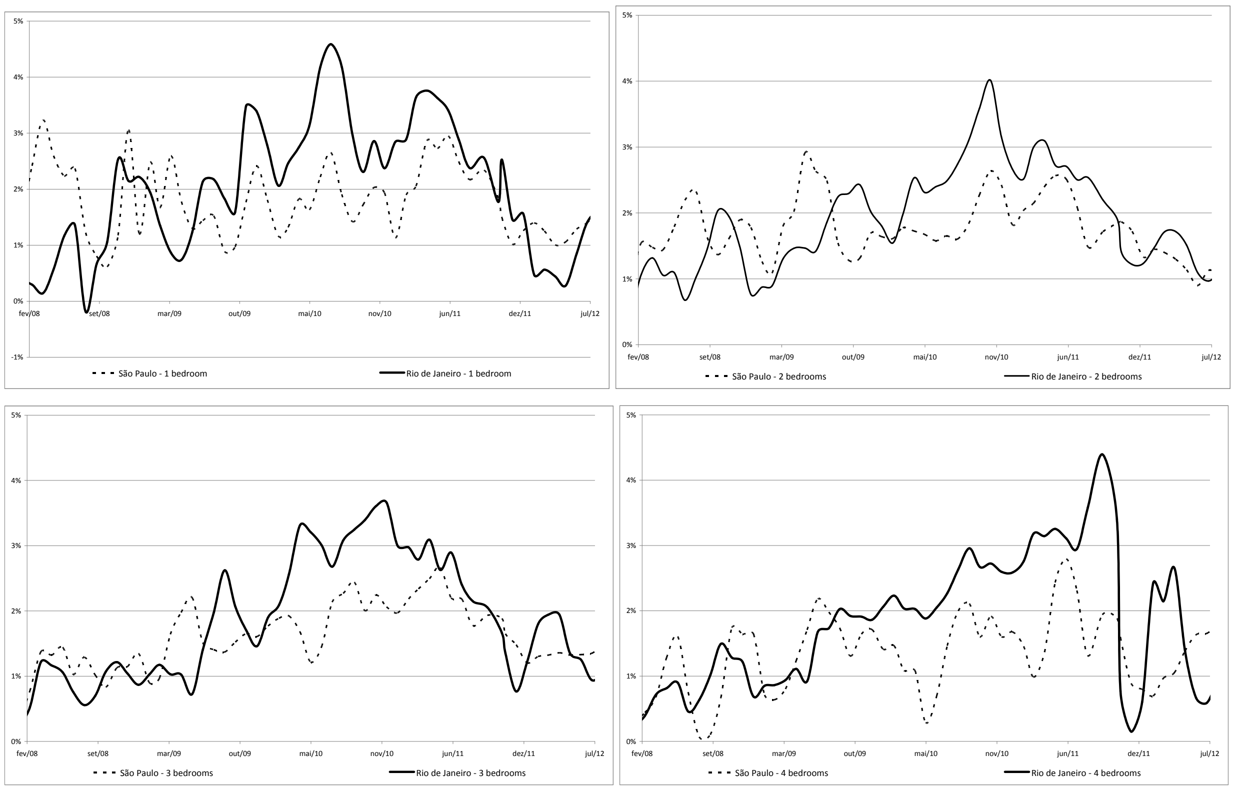
One interesting aspect of the behavior of the recent Brazilian house-pricing boom is how wide it has been, both geographically and across different real-estate units. This point can be illustrated by comparing the *monthly* growth rate of nominal house prices in the two largest cities in Brazil: São Paulo and Rio de Janeiro. Figure 1 illustrates it.

Figure 1 - Housing Price Growth Rate - Rio de Janeiro and São Paulo



First, the increase in monthly prices reaches more than 3% in some months and nowhere we observe an actual decrease in the level of real-estate prices. Second, it seems that price increases follow a similar cyclical pattern across cities. This same comparison can also be made when we analyze the nominal growth rate in prices for apartments with different sizes (number of bedrooms); see Figure 2.[3]

Figure 2 - Housing Price Growth Rate by Number of Bedrooms



There are several factors that could explain this sharp increase in real-estate prices in Brazil in the recent past. The first is the decrease in real interest rates. The Brazilian basic interest rate (Selic) was set as 17.25% a.a. by the Central Bank of Brazil in early 2006 and had decreased to 8% a.a. in the middle of 2012, while inflation had increased in this period. Thus, the reduction of the real rate of interest in Brazil was even larger. As a consequence, we observed a sharp increase in real-estate credit for this period. The second is an increase in the purchasing power of the Brazilian middle class: minimum wage has increased above inflation in the recent past and the Brazilian government adopted a myriad of social programs, all of which transferred income to poor and middle-income families. Third, the income of government, private firms, and individuals, increased due

[3] In the Appendix, we present the evolution of the house prices for each state considered in this study.

the commodity-price boom experienced in the last 10 years.

Our empirical results are as follows. First, we find a positive effect of house-price growth on non-durable consumption growth in Brazil. Second, this effect is smaller that found in the U.K. by Campbell and Cocco (2007). In Brazil, house-price elasticity estimates are in the range 0.23 to 0.27.

The remainder of the paper is organized as follows. Section 2 describes the model and the data considered. Section 3 presents the estimation methodology and the results. Finally, Section 4 concludes the paper.

2 The Model and the Data

2.1 Model

We follow Campbell and Cocco (2007) that introduce their model of housing choice, further used to simulate data. They consider that household i derives utility during month t from housing services, H_{it}, and non-durable goods, C_{it}. In particular, the authors assume time additive preferences that are separable between housing and non-durable goods consumption:

$$u(C_{it}, H_{it}) = \frac{C_{it}^{1-\gamma}}{1-\gamma} + \theta \frac{H_{it}^{1-\gamma}}{1-\gamma}.$$

Separability in preferences eliminates possible substitution effects when the price of housing services increase, and is an important feature of their setup. In each period, the agent decides not only on H_{it} and C_{it}, but also if it is optimal to rent or to buy real estate. Let small-cap letters denote variables in log. Then, (logged) real labor income is exogenous and stochastic, represented as:

$$y_{it} = f(t, Z_{it}) + v_{it} + w_{it},$$

where $f(t, Z_{it})$ is a function of time (also interpreted as age here) and of other household characteristics Z_{it}. The components v_{it} and w_{it} are two stochastic components. One is transitory and the other persistent. The transitory component is captured by the shock w_{it} – i.i.d., Normal, with mean zero and variance σ_w^2. The persistent component follows a random walk: $v_{it} = v_{it-1} + \eta_{it}$, where η_{it} is i.i.d., Normal, with mean zero and variance σ_η^2.

Formally, to model house prices, they assume fluctuations over time. So, the real house price growth rate is given by:

$$\Delta p_{it} = g + \delta_{it},$$

where g is a constant and δ_{it} is a shock that is normally distributed.

On the financial side, Campbell and Cocco assume that "there is a single financial asset with riskfree interest rate R_t, in which households may invest. Homeowners may also borrow at this rate, up to the current value of the house minus a down payment." Thus, households face a borrowing constraint given by:

$$D_{it} \leq (1-d)P_{it}H_{it}$$

where D_{it} is household's outstanding debt, d is the down payment proportion and P_{it} is the house price. Thus, at any time, the value of the house, net of down payment, debt cannot be larger than smaller than household's outstanding debt.

Campbell and Cocco allow homeowners to borrow against the value of their house at the riskfree rate. Because of this they also rule out default:

$$D_{it}\,(1+R) \leq (1-\lambda)\underline{P_{it+1}}H_{it} + \underline{Y_{it+1}},$$

where $\underline{P_{it+1}}$ and $\underline{Y_{it+1}}$ are the lower bounds in house prices and labor income in period $t+1$, respectively, and λ represents transaction costs in selling the real-estate property.

Their final baseline reduced-form regression takes the form:

$$\Delta c_{i,t} = \beta_0 + \beta_1 r_t + \beta_2 \Delta y_{i,t} + \beta_3 \Delta p_{i,t} + \beta_4 \Delta m_{i,t} + \beta_5 \Delta Z_{i,t} + \epsilon_{i,t}, \qquad (1)$$

i.e., they regress the growth rates of non-durable consumption goods ($\Delta c_{i,t}$) on the growth rates on house prices ($\Delta p_{i,t}$), controlling for real growth rate in income ($\Delta y_{i,t}$), real growth rate in household's mortgage ($\Delta m_{i,t}$), changes of demographic variables – augmented with seasonal dummies for the growth rates of non-durable consumption ($\Delta Z_{i,t}$). One additional regressor is r_t, the (log) real interest rate between periods t and $t-1$. It shows up due to standard intertemporal substitution arguments. Expected signs of the β's are the following: first, a negative standard intertemporal substitution effect for non-durables, which means $\beta_1 > 0$; then, in the sense that a positive income surprises should affect consumption positively it is identified $\beta_2 > 0$. Most of all, to fit the findings of a positive correlation between non-durable consumption and house prices found in the literature, $\beta_3 > 0$. We can test the latter with a standard one-sided t-ratio test.

After a parametrization of the model, it is simulated and they concluded that the discrepancy between simulated data and its estimation results could be assigned to measurement error. So, to assess the Brazilian case, and taking into account our data limitations, we chose to estimate the baseline equation (1) using panel data on states, not on cohorts of households. The key hypothesis to be tested in this paper is whether rising house prices may stimulate consumption of non-durable goods, and what is the magnitude of this impact.

2.2 Data

Our goal is to investigate the response of household non-durable consumption to a change in house prices in Brazil. As already mentioned, our best household survey – PNAD, *Pesquisa Nacional por Amostra de Domicílios* – is incomplete regarding wealth and consumption data. The other household survey, POF – *Pesquisa de Orçamentos Familiares*, has household consumption data but it is collected only at a 7- or 8-year interval, yielding a synthetic panel using POF useless for our purposes, since consumption data would have little time variation. Thus, we are forced to work with consumption data for Brazilian states, available from a third survey, PMC – *Pesquisa Mensal do Comércio*, collected by IBGE – Instituto Brasileiro de Geografia e Estatística.

A monthly index of disaggregated consumption data were obtained from PMC from February 2008 through July 2012. From it, we are able to construct the growth rate of total non-durable consumption with proper participation weights for the states of São Paulo, Rio de Janeiro, Minas Gerais, Ceará, Pernambuco, Bahia and Distrito Federal. For every state, we defined total non-durable consumption as the sum of the following consumer-good categories (with respective weights in parenthesis[4]): fuels and lubricants (8%), hypermarkets, supermarkets, food products, beverages and tobacco (65%); clothing and shoes (10%), pharmaceutical articles, medical, orthopedic, perfumery and cosmetics (12%); books, newspapers, magazines and stationery (2%); and other personal articles and of domestic use (3%). These participation weights were obtained from the POF survey of 2008-2009, done at the beginning of our sample. With participation weights and the growth rates of the disaggregated indices in each category and every state, we are able to

[4]PMC series which we did not consider fell on the following categories: hypermarkets (other), furniture and household appliances, office equipment and supplies, computer and communication.

compute the monthly growth rate of total non-durable consumption in every state, which is our dependent variable ($\Delta c_{i,t}$) in equation (1).

The explanatory variables in equation (1) were obtained from various sources. The risk-free interest rate considered here is Selic, the basic interest rate on loans from the Central Bank of Brazil to the financial sector. The Interbank Certificate of Deposit rate (CDI) was also used as a robustness check, but the results are very similar, therefore dropped. Selic was used as follows: $r_t = \ln(1 + R_t)$, where R_t is Selic in real terms – deflated by the Broad National Consumer Price Index (IPCA).

State income growth rates ($\Delta y_{i,t}$) used the regional data from IBC-Br – the Regional Economic Activity Index, constructed by the Central Bank of Brazil. The only state for which IBC-Br is not available is Distrito Federal (DF), and we used as a proxy the income growth rate for the Midwest region as a whole (includes Distrito Federal). An alternative series for ($\Delta y_{i,t}$) was constructed following Issler and Notini (2013). We interpolate the annual state GDP to monthly frequency using the IBC-Br as a covariate. We also test for another monthly covariables as unemployment rate and industrial production, but the first results were satisfactory. The results with this alternative approach are present in Appendix.

Regarding house-price data, ($\Delta p_{i,t}$), the source was FipeZap. In particular, we used the growth rates of the Índice FipeZap de Preços de Imóveis Anunciados. It does not contain actual transaction prices (market prices) but ask prices on advertised real-estate properties. It should be noted that, even though the data used is not the transaction prices, we believe that there is a strong correlation between the transaction and the advertised prices. Also, we belive that the error brought by this measure is not correlated with regression residuals.

Data are available for the cities of São Paulo, Rio de Janeiro (RJ), Belo Horizonte (stae of MG), Fortaleza (state of CE), Recife (state of PE), Salvador (state of BA) and Brasilia (Distrito Federal – DF). Here, we were forced to use real-estate price data for the state capital in each state, since state-wide data were not available. We should note that São Paulo and Rio de Janeiro have longer span on real-estate price data vis-a-vis other state capitals (starts in February 2008). Other state capitals have data since 2009 or 2010, making ours an unbalanced panel. Table 2 shows the sample size available for each of them. There is also a national index real-estate price but it is only available from

2010 on.

Table 2

Sample Size

State	Initial Month	End Month
RJ	feb/08	jun/12
SP	feb/08	jun/12
MG	may/09	jun/12
BA	sep/10	jun/12
PE	jul/10	jun/12
CE	apr/10	jun/12
DF	sep/10	jun/12

Although we have done an extensive search for it, we could not find Brazilian data for the growth rate of mortgage payments ($\Delta m_{i,t}$), so we employed proxies that could serve as a control for indebtedness of Brazilian families[5]: default rate for loans in the financial system and households indebtedness as a ratio to their income in the last twelve months. The set of other control variables ($\Delta Z_{i,t}$), encompasses a myriad of different series: total credit to individuals, employment in the industrial sector, etc. Following Campbell and Cocco (2007), seasonal growth-rate dummies are also included in $\Delta Z_{i,t}$, since consumption growth has a clear seasonal pattern. One key set of series we did not include here is the change in state-level demographic variables. The PMC Survey does not collect demographic data, which is mainly collected in PNAD. To deal with this problem, we interpolated the annual population of each state to monthly frequency, using linear method, and used its difference as a regressor in the alternative results of Appendix.

Finally, data sources for data on credit, default and debt are provided by Central Bank of Brazil, while the other data are provided by IBGE. Nominal series were all deflated by the Broad National Consumer Price Index (IPCA). For robustness sake, the same exercise was done with the National Consumer Price Index (INPC), but the results are almost identical.

Table 3 shows descriptive statistics for the main variables in this paper. In the top

[5] Notice that the indebtedness proxies avaliable in Brazil are all average monthly nationwide data. We could not find regional proxy series for indebtedness.

panel, it shows that the average consumption growth is high: 1.6% per month. The house price growth rate remains around 0.9% per month – higher than that of IPCA – which average monthly growth rate was 0.46%.

Table 3.A

Descriptive Statistics

Variable	Average	Minimum	Maximum
Δc	0.016	-0.26	0.42
r	0.003	-0.007	0.016
Δy	-0.001	-0.04	0.04
Δp	0.009	-0.02	0.03

The regional growth rates show that Pernambuco, Rio de Janeiro and São Paulo present the highest average of real house price growth rate. For example, in July 2010, Rio de Janeiro presented an average increase of 3.3% in the house prices versus a decrease of

−0.16% IPCA.

Table 3.B

Average for State

Variables	State	
Δc		0.015360
Δy	RJ	-0.001972
Δp		0.014594
Δc		0.015890
Δy	SP	-0.001972
Δp		0.012325
Δc		0.015432
Δy	MG	-0.000371
Δp		0.009341
Δc		0.020940
Δy	BA	-0.001827
Δp		0.000613
Δc		0.018432
Δy	PE	-0.001489
Δp		0.015017
Δc		0.016212
Δy	CE	-0.003383
Δp		0.006991
Δc		0.013709
Δy	DF	-0.002228
Δp		0.006687

3 Estimation Results and Discussion

3.1 Empirical Results

Equation 1, repeated here for the sake of completeness, was estimated using panel-data techniques with fixed effects (cross section), with its error term $\epsilon_{i,t}$ being decomposed as follows:

$$\begin{aligned} \Delta c_{i,t} &= \beta_0 + \beta_1 r_t + \beta_2 \Delta y_{i,t} + \beta_3 \Delta p_{i,t} + \beta_4 \Delta m_{i,t} + \beta_5 \Delta Z_{i,t} + \epsilon_{i,t}, \\ \epsilon_{i,t} &= a_i + u_{i,t}. \end{aligned}$$

where a_i is a random variable with no time variation and $u_{i,t}$ is a purely idiosyncratic error, although it may be dependent across time and cross-sectional units. This poses no problem in estimation, since all it requires for proper inference is some type of White-type correction in constructing parameter estimates, with their standard errors being robust to serial correlation and heteroskedasticity of unknown form.

Table 4

Regression Results of the Basic Equation

Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
Real interest rate	0.24	0.41	0.41	0.52	0.11	0.29	0.61	0.40	3.27	13.97
	(0.309)	(0.43)	(0.33)	(0.44)	(0.24)	(0.40)	(0.52)	(0.48)	(1.90)	(4.26)
Δy	0.27	0.10			0.28	0.16	0.10	0.16	-5.28	-1.91
	(0.16)	(0.10)			(0.18)	(0.11)	(0.102)	(0.109)	(5.22)	(1.79)
Δp	0.23		0.24		0.27				0.42	
	(0.11)		(0.11)		(0.11)				(0.21)	
Δpnac		0.32		0.32		0.28				0.20
		(0.111)		(0.119)		0.13				(0.53)
Δp - Δpnac							0.24	0.31		
							(0.18)	(0.18)		
Δendiv	-0.002	-0.06	-0.001	-0.06	0.001	-0.05	-0.05	-0.04		
	(0.007)	(0.02)	(0.007)	(0.022)	(0.007)	(0.01)	(0.019)	(0.018)		
Δinad	0.007	-0.006	0.007	-0.006	0.009	-0.003	-0.006	-0.003		
	(0.006)	(0.009)	(0.006)	(0.009)	(0.006)	(0.009)	(0.009)	(0.010)		
Δpessoalocup					0.0005	0.0006		0.0006		
					(0.0001)	0.0005		(0.0005)		
R^2	0.9615	0.9694	0.9610	0.9694	0.9615	0.9702	0.9696	0.9705	0.7862	0.9025
N	7	7	7	7	6	6	7	6	7	7
T	53	22	53	22	53	22	22	22	51	21
Sample Size	239	154	239	154	217	132	154	132	225	147
Balanced	No	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes

Table 4 presents estimation results of equation 1 in ten different specifications. The dependent variable is $\Delta c_{i,t}$. Variable $\Delta pnac$ is the real growth in house prices of the national index mentioned above, while $\Delta endiv$, $\Delta inad$, and $\Delta pessoalocup$ denote changes in households indebtedness ratio, default rate for loans, and employment in the industrial sector, respectively. The latter ($\Delta pessoalocup$) is not available for Distrito Federal (Brasília) but it is available for all other states.

In some cases we estimate a balanced panel, but we have unbalanced panel estimation as well. In regressions (i)-(viii) we impose *strict exogeneity* of the regressors, conditional on the unobserved effect a_i. Thus, estimation of the β's is performed using the so called *fixed-effects estimator*, which is the pooled OLS estimator on time-demeaned data. The latter eliminates a_i from the system. Since the error term is dynamically incomplete and possibly heteroskedastic, robust inference has to be conducted to account for time-depedence and heteroskedasticity of unknown form. In regressions (ix) and (x) we relax the strict-exogeneity assumption and apply instrumental-variable techniques, while keeping robust inference due to the nature of the error term. Details of estimation results are as follows:

1. In specifications (i) and (ii), the estimated coefficients for r_t, $\Delta y_{i,t}$ and $\Delta p_{i,t}$ are positive, but only that of the real growth in house prices is statistically significant. Besides, significance is stronger when the national index was used as the price regressor.

2. In specifications (iii) and (iv), the real growth in income $\Delta y_{i,t}$ was excluded and conclusions did not change.

3. In specifications (v) and (vi), we excluded Distrito Federal (Brasília) from the system, since $\Delta pessoalocup$ is not available for it. Then, we are able to include this regressor in the analysis. Once more, changes in house prices are relevant to explain changes in consumption.

4. In specifications (vii) and (viii), we experiment with the difference between the real growth in local house price and the real growth in national house price $\Delta p - \Delta pnac$. This results in a non-significant relationship between house prices and non-durable consumption.

5. For regressions (i)-(viii), we found that house-price elasticity point estimates in the range 0.23 to 0.27. Hence, an increase of 1% in house prices leads to a maximum increase of 0.27% in non-durable consumption. Such elasticity is much lower than one found by Campbell and Cocco for the U.K.: range of 0.57 to 1.58. Possibly, Brazilian households have a much higher borrowing constraint than the one facing U.K. households. This is possibly due to the fact that the U.K. financial sector is much more developed then its Brazilian counterpart.

6. For regressions (ix) and (x) we use instrumental-variable techniques, where the instruments were lags of the explanatory variables. These results show the importance of using local house prices instead of national. In the first case, we found an elasti-

city of house prices of 0.42, which is closer to the lower estimates of Campbell and Cocco, 0.57.

As a final exercise, we estimate equation 1 using only data for the two most important Brazilian states – Rio de Janeiro and São Paulo – which are the two cross-sectional units with the longest time span: February 2008 through June, 2012. Results are shown in Table 5. The estimation was done under the instrumental-variable techniques, the same techinique for regressions (ix) and (x) in Table 4. Although regional house prices are very significant in (i), the same is not true when we use the national house pricing index in (ii).

Table 5

Regression Results of the Basic Equation (SP and RJ)

Independent Variable	(i)	(ii)
Real interest rate	1.43 (0.17)	3.41 (5.78)
Δy	1.15 (0.91)	1.95 (1.26)
Δp	0.16 (0.05)	
Δpnac		0.19 (0.45)
R^2	0.9595	0.9665
N	2	2
T	51	20
Sample Size	102	40
Balanced	Yes	Yes

3.2 Discussion

First and foremost, we should emphasize that there is an unequivocal positive and significant effect of house prices on non-durable consumption in Brazil. Second, this effect is smaller that found in the U.K. by Campbell and Cocco (2007). In our view, these two results allow the evaluation of two competing explanations for the existence of the positive correlation between house prices and non-durable consumption.

Campbell and Cocco give two potential explanations for the existence of a positive correlation between house prices and non-durable consumption for households: (a) by a direct wealth effect due to the increase in real-estate prices, and (b) by relaxing borrowing constraints the household is subject to. On the absence of substitution between non-durables and durables, one should not expect (a) to be a plausible explanation. Housing is a commodity, and its higher price is simply a compensation for higher rent. So, using a present-value argument, the increase in the price of real estate must be exactly offset by the expected present-discounted value of rent. Hence, in expected present-value terms there is no change in the budget constraint for the household, and there can be no wealth effect. The second explanation (b) is more plausible since real-world consumers are subject to borrowing constraints. In this case, an increase in house prices triggers re-financing the house. The additional borrowing can be used to smooth consumption over the life cycle. This effects should be bigger the more developed the financial sector. It should also be different across households. Young renters are "short" on housing (want to buy) whereas old owners are "long," since they want to change a larger house for a smaller one.

The comparison of the results found here and in Campbell and Cocco for the estimation of equation 1, give little support for the first explanation (a) and a lot of support for the second explanation (b). First, as we argued in the Introduction, the share of real-estate in wealth is larger in Brazil than in U.S. (and probably for the U.K. as well). Hence, if explanation (a) were true, we should have found a larger house-price elasticity for Brazil, which was not the case. Second, if explanation (b) was true, we should expect a higher house-price elasticity for the U.K. vis-a-vis that of Brazil, simply because the financial sector in the former is more developed than that of the latter. These are exactly our findings.

4 Conclusions and Further Research

In this paper we examine the impact of changes in house prices on the growth rate of non-durable consumption expenditures, testing whether this effect is positive once we use appropriate controls. Our study mixes the framework of Case, Quigley and Shiller (2005) and Campbell and Cocco (2007). The interesting feature of Campbell and Cocco is that they tried to understand the economics of how these fluctuations in house prices affect households'consumption decisions, identifying important channels that could explain changes in the latter. They build and simulate a structural model for household optimal decisions and find some channels that could lead to a positive effect. On the other hand, Case, Quigley and Shiller have a data base that is closer to ours: state-level data for consumers instead of the household data employed by Campbell and Cocco.

Our first finding is that there is a positive and significant effect of house prices on non-durable consumption in Brazil. Second, this effect is smaller that found in the U.K. by Campbell and Cocco (2007). We found that house-price elasticity point estimates are in the range 0.23 to 0.27. Hence, an increase of 1% in house prices leads to an increase of about 0.25% in non-durable consumption in Brazil. This is much lower than what Campbell and Cocco found for the U.K.: ranging from 0.57 to 1.58. In our view, these two pieces of evidence point toward a financial explanation for the positive correlation between house prices and non-duarable consumption, which rely on the existence of liquidity constraints faced by households that are relaxed once the price of a house he/she owns increases.

References

[1] Bernanke, B., Gertler, M. and Watson, M. (1997). Systemic monetary policy and the effects of oil price shocks. *Brooking Papers on economic activity*, (1): 91-157.

[2] Bertaut, C.C., Starr-McCluer, M. (2002). Household Portfolios in the United States. In: Guiso, L., Haliassos, M., Jappelli, T. (Eds.), *Household Portfolios*. MIT Press, Cambridge, MA Chapter 5.

[3] Bernanke, B. (1985). "Adjustment Costs, Durable Goods and Aggregate Consumption," *Journal of Monetary Economics*, vol. 15, pp. 41–68.

[4] Bhalla, S.S. (2009). "The middle class kingdoms of India and China." Mimeo.

[5] Browning, M. and Crossley, T. (2000), "Luxuries are Easier to Postpone: A Proof ", *Journal of Political Economy*, 108 (5), 1064–1068.

[6] Cameron, A. C. and Trivedi, P. (2005). *Microeconometrics: methods and applications*". Cambridge University Press.

[7] Campbell, J.Y. e Cocco, J.F. (2007). "How do house prices affect consumption? Evidence from micro data". *Journal of Monetary Economics*, v. 54: 591-621.

[8] Case, K.E., Quigley, J. and Shiller, R.J. (2005). "Comparing wealth effects: the stock market versus the housing market",*The B.E. Journal of Macroeconomics*, v.5 (1).

[9] Gan, J. (2010). "Housing Wealth and Consumption Growth: Evidence from a Large Panel of Households," *Review of Financial Studies*, 23 (6): pp. 2229-2267.

[10] Hofman, A. (1992). "Capital accumulation in Latin America: a six country comparison for 1950-89". *Review of Income and Wealth*, v38 (4): 365-391.

[11] _______. (2000)."Standardised capital stock estimates in Latin America: a 1950-94 update". *Cambridge Journal of Economics*, v 24 (1): 45-86.

[12] Hryshkoa, D., Luengo-Prado, M. J. and Sørensen, B.. (2010). "House prices and risk sharing," *Journal of Monetary Economics*, Vol. 57, Issue 8, pp. 975–987.

[13] Issler, J.V. and Notini, H. (2013), "Estimating Brazilian Monthly Real GDP: a State-Space Approach", Mimeo. EPGE, FGV.

[14] Issler, P.F. (2013), "Durability and the Consumption Cycle," Ph.D. Thesis, Haas School of Business, University of California at Berkeley.

[15] Laibson, D. and Mollerstrom, J. (2010). "Capital Flows, Consumption Booms and Asset Bubbles: A Behavioural Alternative to the Savings Glut Hypothesis," *Economic Journal*, Volume 120, Issue 544, pp. 354–374.

[16] Lustig, H. and Van Nieuwerburgh, S. (2006). How much does household collateral constrain regional risk sharing? UCLA and NYU, unpublished paper.

[17] Marquetti, A. (2000). "Estimativa do Estoque de Riqueza Tangível no Brasil". *Nova Economia*, v. 10 (2): 11-37.

[18] Mönch, E. and Uhlig, H. (2005). "Towards a Monthly Business Cycle Chronology for the Euro Area". Journal of Business Cycle Measurement and Analysis 2(1).

[19] Morandi, L. (1998). "Estoque de Riqueza e a Poupança do Setor Privado no Brasil - 1970/95". *IPEA: Texto para discussão*. n 572.

[20] Neri, M.C. et al. (2008), "Poverty and the new middle class in the decade of equality." www.fgv.br/cps/desigualdade version 1 and 2, Rio de Janeiro, Fundação Getulio Vargas.

[21] Ogaki, M. and Reinhart, C. (1998). "Measuring Intertemporal Substitution: The Role of Durable Goods," *Journal of Political Economy*, 106(5), 1078-98.

[22] Piazzesi, M., Schneider, M. and Tuzel, S. (2007). "Housing, consumption and asset pricing", *Journal of Financial Economics*, Volume 83, Issue 3, pp. 531-569.

[23] Ravallion, M. (2009) “The developing world’s bulging (but vulnerable) ‘middle class”’, World Bank Policy Research Working Paper No. 4816.

[24] Ren, Y. and Yuan, Y. (2012) "Why the Housing Sector Leads the Whole Economy: The Importance of Collateral Constraints and News Shocks," *The Journal of Real Estate Finance and Economics*, September 2012.

[25] http://www.sidra.ibge.gov.br/

[26] U.S. Census Bureau. (2012) "Statistical Abstract of the United States: 2012. Income, Expenditures, Poverty, and Wealth," Section 13, pp. 431-470.

[27] Wilson, D. and Dragusanu, R. (2008). “The expanding middle: The exploding world middle class and falling global inequality”, Global Economic Paper No.170, Goldman Sachs.

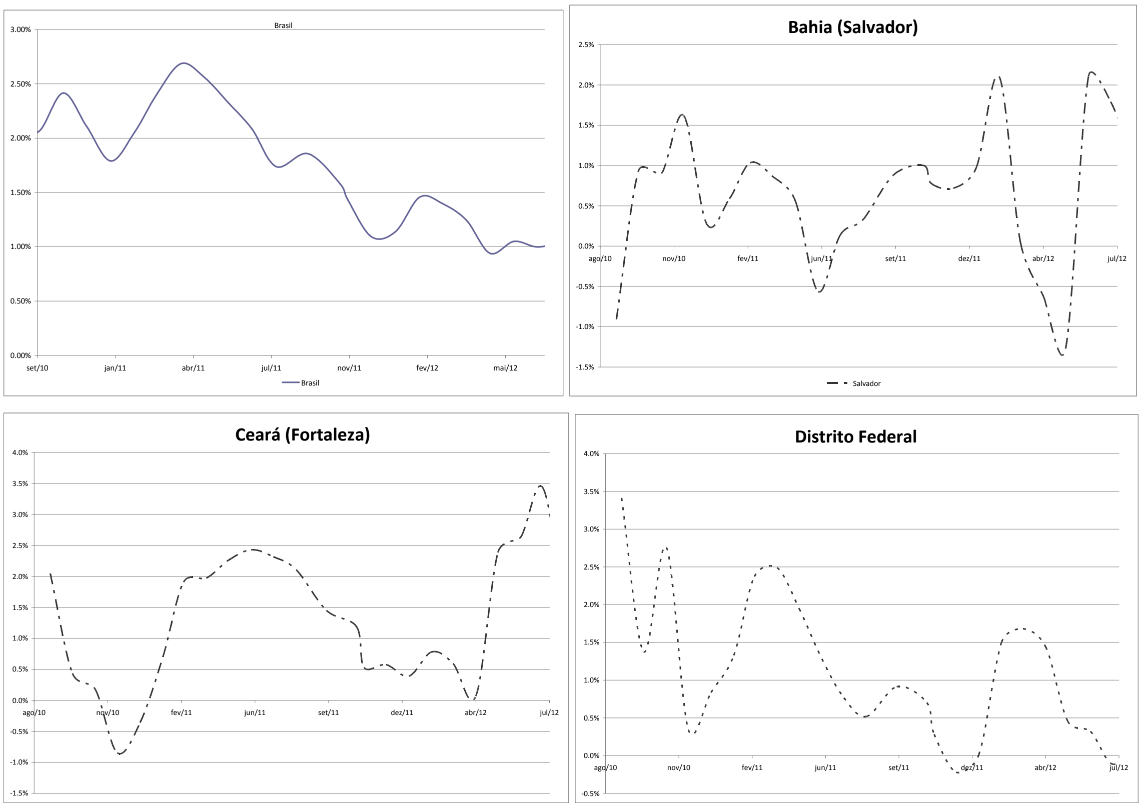
[28] Wogart, J. P. (2010). "Global booms and busts: how is Brazil’s middle class faring?." *Revista de Economia Política* [online]. vol.30, n.3, pp. 381-400. ISSN 0101-3157.

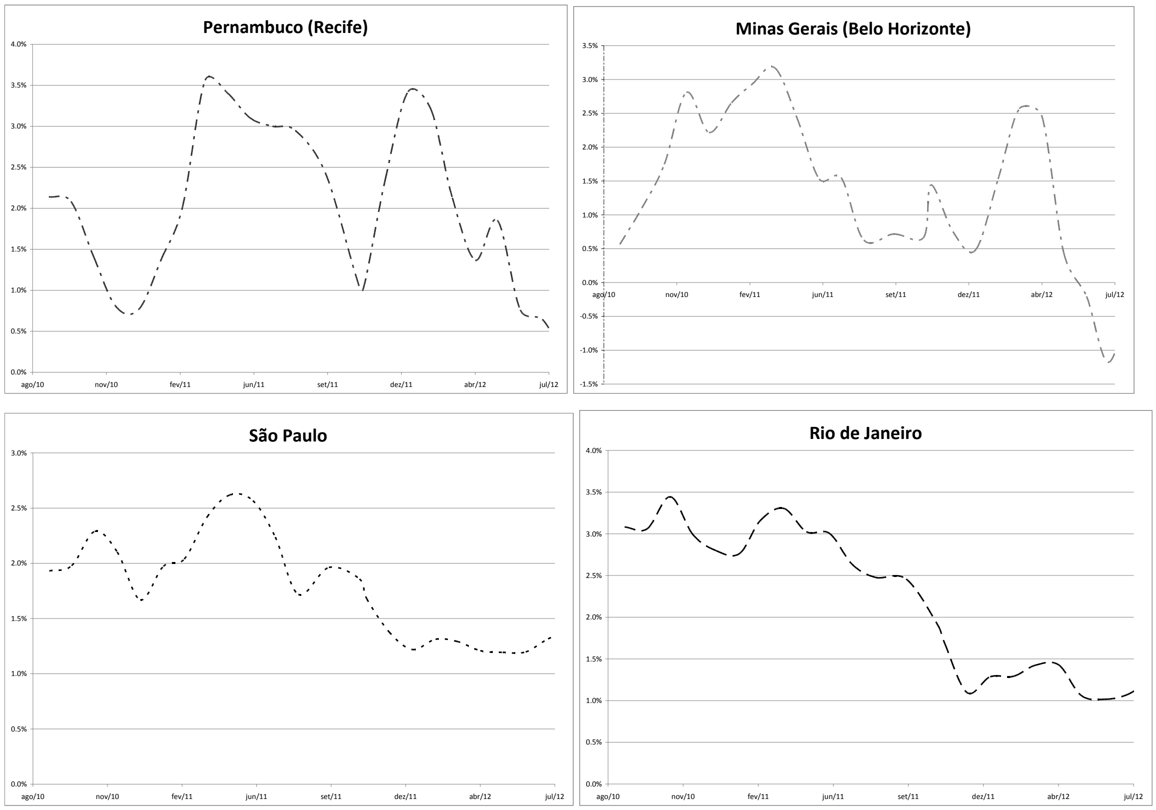
[29] Yogo, M. (2006). "A Consumption-Based Explanation of Expected Stock Returns," *The Journal of Finance*, Vol. 61, No. 2 (Apr., 2006), pp. 539-580.

[30] http://www.zap.com.br/imoveis/fipe-zap/

Appendix 1

Evolution of house-price growth rates for each state considered in this study:




Pernambuco (Recife)
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
ago/10 nov/10 fev/11 jun/11 set/11 dez/11 abr/12 jul/12
Minas Gerais (Belo Horizonte)
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
ago/10 nov/10 fev/11 jun/11 set/11 dez/11 abr/12 jul/12
São Paulo
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
ago/10 nov/10 fev/11 jun/11 set/11 dez/11 abr/12 jul/12
Rio de Janeiro
4.0%
3.5%
3.0%
2.5%
2.0%
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ago/10 nov/10 fev/11 jun/11 set/11 dez/11 abr/12 jul/12

Appendix 2

Regression results of the basic equation using interpolated income and interpolated population.

Regression Results of the Basic Equation

Independent Variable	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
Real interest rate	0.27	-0.23	0.41	-0.08	0.16	-0.19	0.54	0.36	0.19	0.36
	(0.28)	(0.42)	(0.34)	(0.45)	(0.24)	(0.42)	(0.53)	(0.52)	(0.35)	(0.50)
Δy	0.34	0.16			0.35	0.25	0.16	0.24	0.25	0.11
	(0.16)	(0.13)			(0.18)	(0.14)	(0.12)	(0.14)	(0.16)	(0.16)
Δp	0.20		0.24		0.24				0.16	
	(0.12)		(0.12)		(0.13)				(0.17)	
Δpnac		0.78		0.79		0.61				0.22
		(0.22)		(0.23)		(0.15)				(0.12)
Δp - Δpnac							0.24	0.31		
							(0.19)	(0.19)		
Δendiv	-0.003	-0.06	-0.001	-0.06	0.0005	-0.05	-0.05	-0.04		
	(0.007)	(0.02)	(0.007)	(0.02)	(0.006)	(0.02)	(0.01)	(0.02)		
Δinad	0.008	-0.008	0.007	-0.008	0.01	-0.004	-0.006	-0.003		
	(0.006)	(0.01)	(0.006)	(0.009)	(0.006)	(0.009)	(0.009)	(0.01)		
Δpessoalocup					0.0005	0.0006		0.0006		
					(0.0002)	(0.0005)		(0.0005)		
Δpopulation	-7.93E-08	-8.04E-06	3.49E-08	-7.8E-06	1.66E-07	-5,36E-06	-7.97E-07	4.17E-07	-9.11E-07	-9.36E-06
	(4.15E-07)	(3.71E-06)	(3.78E-07)	(3.77E-06)	(3.44E-07)	(1.15E-06)	(1.57E-06)	(1.68E-06)	(2.67E-07)	(4.47E-06)
R^2	0.9616	0.9696	0.9610	0.9695	0.9616	0.9703	0.9696	0.9705	0.9624	0.9693
N	7	7	7	7	6	6	7	6	7	7
T	53	22	53	22	53	22	22	22	51	21
Sample Size	239	154	239	154	217	132	154	132	225	147
Balanced	No	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes

The results obtained from interpolated data (regional income and population) can be compared to those found in section 3.1 in such aspects:

1. The coefficient of r_t is negative in the specifications with national index and without instrumental variables.

2. Significance is stronger when national index was used as the price regressor, as was found in section 3.1.

3. Estimade coefficients of $\Delta population$ are too small in all of specifications.

4. The house-price elasticity point estimates in the range 0.20 to 0.79. The upper bound is higher than in section 3.1.

Regression Results of the Basic Equation (SP and RJ)

Independent Variable	(i)	(ii)	(iii)
Real interest rate	1.28	0.52	-1.56
	(0.61)	(0.40)	(2.23)
Δy	0.27	0.23	-1.53
	(0.40)	(1.31)	(0.62)
Δp	0.11		
	(0.05)		
Δpnac		0.52	0.33
		(0.14)	(0.52)
Δpopulation	-4.56E-07	-6.49E-06	2.93E-07
	(7.88E-08)	(3.20E-06)	(6.05E-07)
R^2	0.9641	0.9734	0.9475
N	2	2	2
T	51	21	51
Sample Size	102	42	102
Balanced	Yes	Yes	Yes

The same basic equation was estimated with data from São Paulo and Rio de Janeiro only. The significance is stronger when the national index was used, as can be found comparing specifications (i) and (ii). To take advantage of the larger sample size for São Paulo and Rio de janeiro, we constructed a new national index using only data of these two states (and properly respective weights) and estimate specification (iii), but we didn't find significant coefficients.