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

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Contents

Keywords
Real estate, non-durable consumption, wealth, panel data

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R30, E21, C23

Abstract · Resumo

This paper investigates the effect of real-estate prices on non-durable consumption in Brazil. For that, we build a state-level panel of the determinants of non-durable consumption growth during the period 2008–2017. This period covers both a "boom" in real-estate prices and consumption (2008–2014) as well as a "bust" in them (2014–2017).

We estimate the effect of house prices on consumption combining the techniques and ideas from Campbell e Cocco (2007) and Case et al. (2005). In particular, we estimated the same reduced-form equation proposed by Campbell e Cocco (2007), which is derived from simulating a theoretical model of housing and consumption choice under debt constraints. Due to Brazilian-data limitations, we were unable to run panel-data regressions at the cohort level (aggregation across households on different surveys) as in Campbell e Cocco (2007). Indeed, we had to resort to data aggregated at the state level to estimate our panel-data regressions as did Case et al. (2005).

Our results suggest that changes in house prices significantly affect non-durable consumption in Brazil. The magnitudes are quantitatively close to the effects found for the U.K. by Campbell e Cocco (2007). Furthermore, we document that the effect of house prices on non-durable consumption is asymmetric, stronger in the "bust" than in the "boom" phase of the business cycle. This difference in the effects during different phases of the business cycle suggests that borrowing constraints might explain the effects of house prices on non-durable consumption.

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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 e 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. The official statistics (U.S. Census Bureau (2012) show 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), Luengo-Prado, Sorensen, e Hryshko (2009), and Ren e Yuan (2014). Even before the real estate market collapse, some authors recognized the importance of this issue, e.g., Case et al. (2005) with data from the U.S. and other developed countries and Campbell e Cocco (2007) with data from the U.K. Most of these studies resorted 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 an important portion of household wealth in Brazil, with obvious consequences to welfare. For example, Marquetti (2009) estimates wealth in Brazil between 1950 and 1998 using the perpetual inventory method and 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. Hofman (1992) 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 findings. 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), the results for Brazil are striking and point to the importance of the real-estate market for welfare in Brazil.

The goal of this paper is to investigate the effect of real-estate price variation on non-durable consumption and welfare, trying to close a gap between the consumption literature in Brazil and compare it with 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 here bigger. Our second motivation is the recent boom of the real-estate prices in Brazil during several years (2008–2014), followed by a bust in these same prices (from 2015 onward). During the boom, prime real estate in Rio de Janeiro and São Paulo have tripled in value, 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 consumption boom in Brazil from 2008 to 2014 and a bust from 2015 onward.

Table 1. Stock Composition of Net Capital in Brazil (%), 1950–1994.

Years	Hoffman (1992 and 2000) Building: Residential	Hoffman (1992 and 2000) Building: Nonresidential	Hoffman (1992 and 2000) Machinery/ Equipment	Marquetti (2000) Building: Residential	Marquetti (2000) Building: Nonresidential	Marquetti (2000) Machinery/ Equipment
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) and Marquetti (2009).

Because our goal is to investigate the relationship between fluctuations of house prices and consumption (welfare) in Brazil, we follow the well-known studies of Case et al. (2005) and Campbell e Cocco (2007). Case et al. (2005) use panel data for 14 developed countries between the late 1970's and 1990's and find a strong correlation between house prices and the aggregate consumption of households. They also repeat this exercise using U.S. state data with similar results. Campbell e Cocco (2007) 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 responses 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 e Cocco (2007) is that they used a structural equilibrium model to understand how these fluctuations in house prices affected households' consumption decisions, identifying important channels that could explain changes in the latter. With simulated data from the theoretical model calibrated to the U.K. economy, they fit a reduced-form regression of changes in consumption on changes in housing prices, income changes, real-interest rates and additional controls, finding a positive marginal effect of changes in housing prices on changes in consumption after controlling for additional important variables such as demographics, real interest rates, income, loan conditions, etc. Moreover, their approach allows quantifying these effects.

Regarding the important channels of transmission from housing prices to consumption, they first conjecture that a possible 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. However, they recall that housing is a commodity and 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 the budget constraint for the household, leaving non-durable consumption unchanged.

Campbell e Cocco (2007) 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—re-financing, 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 e Van Nieuwerburgh (2010).

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 instance, Bernanke (1985), Ogaki e Reinhart (1998), and Yogo (2006). 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 e Cocco (2007) go one step beyond this literature, trying to address what reduced-form equation one should expect from this basic theoretical setup, quantifying the marginal effect of a change in prices in non-durable consumption. Moreover, their simulations confirmed the empirical findings of the elasticities found in reduced-form estimation. This offers an useful guideline for investigating whether fluctuations of house prices affect consumption in Brazil, being the reason why we chose to follow their theoretical and empirical implementation. Hence, this paper will use this reduced form equation as our benchmark equation to estimate the correlation between house prices and consumption.

Although we follow Campbell e Cocco (2007), there are some limitations in our study arising from the lack of identical micro data in Brazil and in the U.K. As we stressed above, PNAD does not have consumption data for households.[1] 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 December 2017, for all Brazilian States. In Particular, we are intereseted in the states of Rio de Janeiro, São Paulo, Minas Gerais, Bahia, Pernambuco, Ceará, Distrito Federal, Espírito Santo, Goiás, Paraná and Rio Grande do Sul. With that in hand, we also obtained real-estate price data from FipeZap on the capital of the states mentioned above.[2] Thus, we were able to find Brazilian data for the dependent variable and the main regressor in Campbell e Cocco (2007)'s reduced-form regression. We were also able to find data on other control variables used in their study as well.

Our cross-sectional units are represented by Brazilian states. On that dimension, our setup gets closer to that of Case et al. (2005) than to Campbell e Cocco (2007), although we will use the same reduced-form equation that Campbell e Cocco (2007) estimate in their paper. In adapting the latter framework to state cross-sectional units, we need to employ state-level demographic controls.

One interesting aspect of the behaviour of the recent Brazilian house-pricing boom of 2009–2014 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

[1] 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.

[2] Although PMC is available for all Brazilian states, Fipzap is available for selected cities so we restricted the analysis to the data availability of FipZap data

prices in Brazil (Figure 1) and in the two largest cities in Brazil: São Paulo and Rio de Janeiro (Figure 2).

First, in the boom period, the increase in monthly prices reaches more than 2.5% in some months and nowhere we observe an actual decrease in the level of real-estate prices. In Rio de Janeiro it reaches more than 3%. Second, it seems that price increases follow a similar cyclical pattern across cities.[3]

There are several factors that could explain this sharp increase in real-estate prices in Brazil from 2008 to 2014. The first is the decrease in real interest rates. The Brazilian basic interest rate (Selic) was set as 17.25% per annum by the Central Bank of Brazil in early 2006 and had decreased to 8% per annum in the middle of 2012, reaching 7.5% in 2017. 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, government revenues, private-firm and individual income all increased due the global commodity-price boom experienced until 2015.

On the other hand, the bust in real-estate prices observed recently has its roots on Brazil's worst recession ever, where real GDP decreased by 8.9% from 2014.1 through 2016.12, with a very mild recovery from then on. Real-Estate prices in Rio de Janeiro were hit hardest.

Our empirical results are as follows. First, as in Campbell e Cocco (2007) we find a positive effect of house-price growth on non-durable consumption growth in Brazil after appropriate controls are accounted for. Second, this effect is quantitatively similar to the one found in the U.K. by the latter. In Brazil, house-price elasticity estimates are in the range 0.28 to 1.58, depending on whether we employ regional or national house price variation as an explanatory variable. These elasticities are comparable to the ones found by Campbell e Cocco (2007), which range from 0.57 to 1.59. Finally, going beyond Campbell e Cocco (2007), we document an asymmetric effect of house prices on non-durable consumption, which is stronger in the "bust" than in the "boom" phase of the business cycle.

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.

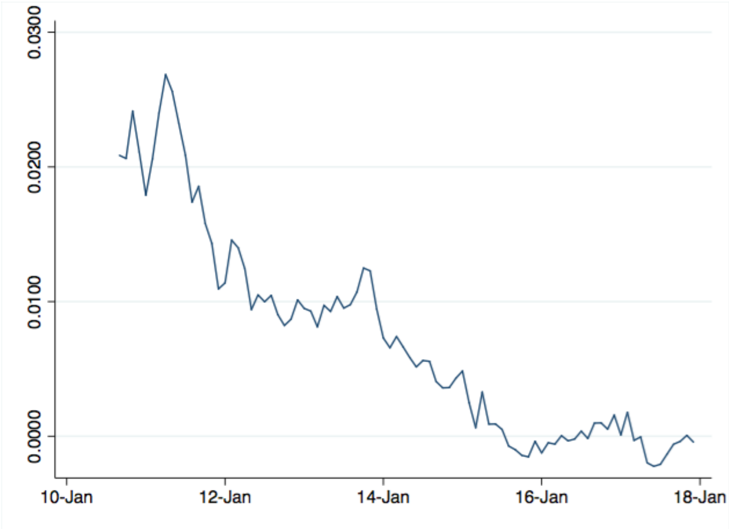
2. The Model and the Data

2.1 Model

We motivate the empirical investigation using the theoretical model of housing and consumption choice introduced by Campbell e Cocco (2007). These authors find qualitatively identical relationships between the growth in non-durable consumption, house prices, interest rates, and income using both real data and data generated from a calibrated version of this model. This implies that this model provides a useful benchmark to investigate the relationship between house prices and non-durable consumption.

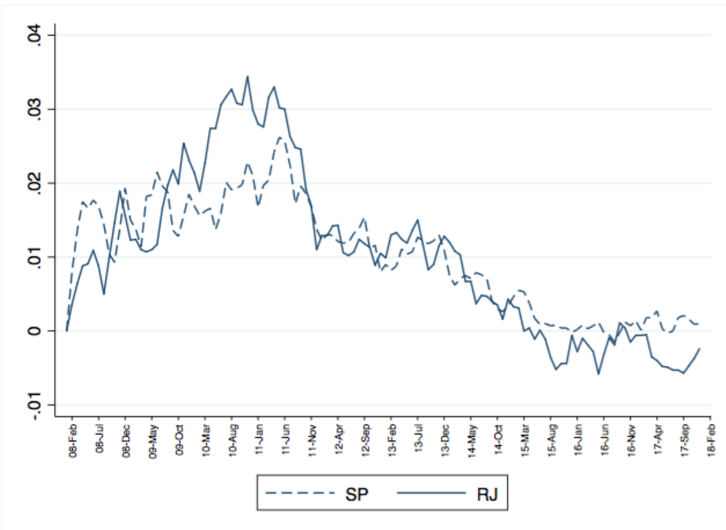
The theoretical model considers that households (indexed by i) derive utility during in each period (indexed by t) from housing services, H_{it}, and non-durable goods, C_{it}. It

[3]The Appendix presents the evolution of the house prices for each state considered in this study.



Note: The figure reports monthly real growth rates of house prices from February 2008 to December 2017.

Figure 1. Real Growth Rate – House Prices – Brazil.



Note: The figure reports monthly real growth rates of house prices in São Paulo and Rio de Janeiro from February 2008 to December 2017.

Figure 2. Real Growth Rate – House Prices – Rio de Janeiro and São Paulo.

assumes households have time additive preferences that are separable between housing and non-durable goods consumption:

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

Separability in preferences eliminates possible substitution effects coming from increases in the price of housing services. This is an important feature of this setup.

In each period, the household 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 logs. (Logged) real labor income is given by

$$y_{it} = f(t, Z_{it}) + v_{it} + w_{it}, \tag{2}$$

where $f(t, Z_{it})$ is a function of time (also interpreted as age) and 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.

The model assumes that house prices fluctuate over time. The real house price growth rate is given by

$$\Delta p_{it} = g + \delta_{it}, \tag{3}$$

where g is a constant and δ_{it} is a zero-mean normally distributed shock.

On the financial side, Campbell e Cocco (2007) assume that "left there is a single financial asset with risk-free interest rate R_t, in which households may save. 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

$$D_{it} \leq (1-d)P_{it}H_{it}, \tag{4}$$

where D_{it} is household's outstanding debt, d is the down payment proportion, and P_{it} is the house price.

It is important to note that, if house prices go up (down), this relaxes (tightens) the borrowing constraint of the household, allowing consumption to increase (decrease) beyond what we would normally have under no price increase (decrease). This leads to a positive *partial* correlation between non-durable consumption and house prices, a channel that could be identified by estimating a reduced form as shown below.

The authors allow home owners to borrow against the value of their house at the risk free rate. Because of this they also rule out default:

$$D_{it}(1+R) \leq (1-\lambda)\underline{P}_{it+1}H_{it} + \underline{Y}_{it+1}, \tag{5}$$

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 buying and selling houses.

Campbell e Cocco (2007) solve the model with parameters calibrated to represent the U.K. economy at the household level. Then, using data generated by the model, they estimate a reduced-form regression where the change in consumption is the dependent variable explained by changes in housing prices (assumed strictly exogenous in the model), interest rates, changes in income, loan conditions, and additional demographic controls. Estimation results show a positive relationships between changes in non-durable consumption and interest rates, changes in income and house prices in their pseudo-panel for different cohorts. The authors explore the results of this reduced-form estimation in their paper, where the same estimation using actual data generated qualitatively similar results.

Our main assumption here is that it is possible to analyze the effects of house prices on non-durable consumption exploring state-level data using the same reduced-form approach backed up by their structural model. Indeed, we are performing the same type of aggregation they perform, but on a larger scale: We aggregate consumption and other variables at the state level data while they aggregate by cohort. Their estimated reduced-form is the following:

$$\Delta c_{s,t} = \beta_0 + \beta_1 r_t + \beta_2 \Delta y_{s,t} + \beta_3 \Delta p_{s,t} + \beta_4 \Delta m_{s,t} + \beta_5 \Delta Z_{s,t} + \epsilon_{s,t}, \tag{6}$$

in which $\Delta c_{s,t}$ is the growth rate of non-durable consumption goods in state s and period t; r_t is the interest rate between periods t and $t-1$; $(\Delta y_{s,t})$ is the real growth rate of income in state s and period t; $(\Delta p_{s,t})$ is the real growth rate of house prices in state s and period t; $\Delta m_{s,t}$ is the growth rate in mortgage payments in state s and period t; $Z_{s,t}$ is a vector of demographic controls; and $\epsilon_{s,t}$ is a stochastic term. The theoretical model suggests the following expected signs for the regression coefficients:

$\beta_1 > 0$: since there the standard positive inter-temporal substitution effect for non-durable consumption.

$\beta_2 > 0$: since there is a positive effect of income innovations on non-durable consumption.

$\beta_3 > 0$: since there is a positive effect of house prices on non-durable consumption coming from the fact that an increase in house prices will relax the borrowing constraint of the agent.

2.2 Data

We explore state-level consumption data which is available from PMC (*Pesquisa Mensal do Comércio*). This is a monthly dataset collected by IBGE (*Instituto Brasileiro de Geografia e Estatística*). It is the best source of high frequency consumption data in Brazil since the household-level consumption data from the POF (*Pesquisa de Orçamentos Familiares*) is only collected at 7- or 8-year intervals.

A monthly index of disaggregated consumption was obtained for the period February 2008 to December 2017 (119 months). From it, we constructed the growth rate of total non-durable consumption for the states of Rio de Janeiro (RJ), São Paulo (SP), Minas Gerais (MG), Bahia (BA), Pernambuco (PE), Ceará (CE), Distrito Federal (DF), Espírito Santo (ES), Goiás (GO), Paraná (PR) e Rio Grande do Sul (RS)—a total of 11 states. For every state, we defined total non-durable consumption as the sum of the following consumer-good categories (weights in parenthesis): 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%).[4] These weights were

[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.

obtained from the POF survey of 2008–2009. From these weights and the growth rates of the indexes in each category, we are able to compute the monthly growth rate of total non-durable consumption in every state—the dependent variable $(\Delta c_{s,t})$ in equation (6).

The explanatory variables in equation (6) 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.[5] Selic was used as follows: $r_t = \ln(1 + R_t)$, where R_t is Selic in real terms—deflated using the National Consumer Price Index (IPCA).

State income growth rates $(\Delta y_{s,t})$ used the regional data from IBC-Br, the Regional Economic Activity Index—constructed by the Central Bank of Brazil. The only state in our sample for which IBC-Br is not available is Distrito Federal (DF). We used as a proxy the income growth rate for the Midwest region as a whole which includes Distrito Federal. An alternative series for $(\Delta y_{s,t})$ was constructed using the wages and employment in the formal sector available in RAIS (*Relação Anual de Informações Sociais*).

The growth rate in house prices $(\Delta p_{s,t})$ was computed using FipeZap. In particular, we used the growth rates of the "*Índice FipeZap de Preços de Imóveis Anunciados*". It does not contain actual transaction prices, but list prices on advertised real-estate properties. As is well known, list prices are a good proxy for transaction prices.

Data are available for the cities of Rio de Janeiro (state of RJ), São Paulo (state of SP), Belo Horizonte (state of MG), Salvador (state of BA), Recife (state of PE), Fortaleza (state of CE), Brasilia (Distrito Federal – DF), Vitória (state of ES), Goiania (state of Goiás) and Porto Alegre (state of RS). 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 a longer time span on real-estate price data (starts in February 2008) vis-à-vis other state capitals (data from 2009 or 2010). Thus, we have an unbalanced panel. Table 2 shows the sample size available for each of them. There is also a national index of real-estate prices but it is only available from 2010 onward.

There is no direct information on the growth rate of mortgage payments $(\Delta m_{s,t})$. Thus, we used proxies that control for indebtedness of Brazilian families: default rate for loans in the financial system, household debts and demand deposits. All these variables are collected from the Central Bank of Brazil at the state level.

The vector of control variables $(\Delta Z_{s,t})$ encompasses a myriad of different series: employment in the formal sector (from RAIS) and share of people in the working age in each state (from PNAD). Campbell e Cocco (2007) highlight the importance of demographic variables for the response of consumption to house prices. We build the working age variable interpolating the quarterly data from PNAD to create the share os people between 18 and 64 years old in each state. This quarterly data is available for 2012 onwards. Following Campbell e Cocco (2007), seasonal growth-rate dummies are also included in $\Delta Z_{i,t}$, since consumption growth has a clear seasonal pattern.

All nominal series were 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.[6]

[5]The Interbank Certificate of Deposit rate (CDI) was also used as a robustness check. The results (not shown) are very similar

[6]Available under request.

Table 2. Sample.

State	Initial Month	End Month
Rio de Janeiro (RJ)	Feb/08	Dec/17
São Paulo (SP)	Feb/08	Dec/17
Minas Gerais (MG)	May/09	Dec/17
Bahia (BA)	Sep/10	Dec/17
Pernambuco (PE)	Jul/10	Dec/17
Ceará (CE)	Apr/10	Dec/17
Distrito Federal (DF)	Sep/10	Dec/17
Espírito Santo (ES)	Jun/12	Dec/17
Goiás (GO)	Jun/12	Dec/17
Paraná (PR)	Jun/12	Dec/17
Rio Grande do Sul (RS)	Jun/12	Dec/17

Note: Sample from Fipzap.

Table 3 shows descriptive statistics for the main variables in this paper. $\Delta c_{s,t}$ is the average non-durable consumption growth per month (logged differences); $\Delta p_{s,t}$ the real monthly (log) changes in house prices; $\Delta pnac_t$ is the real growth in house prices of the national index, and $Diff\, p_{s,t} = \Delta p_{s,t} - \Delta pnac_t$, deviations from national prices growth rates; r interest rate, $r_t = \ln(1 + R_t)$, where R_t is the Selic rate in real terms (deflated using IPCA); $\Delta Inad_{s,t}$ is the default rate of credit operations of the National Financial System; $g(Wage)_{s,t}$ is the real wage growth rate in the formal sector of the economy; $\Delta y_{s,t}$ is the Regional Economic Activity Index constructed by the Central Bank (IBC-Br); $\Delta Loans_{s,t}$ refers to the growth in loans and discounted securities; $\Delta Depvista_{s,t}$ measures the growth of demand deposits; $\Delta Ocup_{s,t}$ is the growth in the share of employment in the formal sector; and $WorkingAge_{s,t}$ is the share of people aged 25–64 years old.

As shown in Table 3, the average consumption growth per month, $\Delta c_{s,t}$, is 1.1% per month. The house price growth rate remains around 0.6% per month—higher than that of IPCA—which average monthly growth rate was 0.49%.

It is important to stress that Campbell e Cocco (2007) also had to aggregate household data forming a synthetic panel, where *synthetic* individuals, aggregated across cohorts, were followed through time. State-level aggregation, although similar in spirit, is done on a much larger scale considering the number of households in each state. Both techniques rely on the law-of-large numbers to clean up idiosyncratic measurement errors at the household level.

3. Results

3.1 Fixed Effects

To estimate equation (6), we impose the following structure for the error term:

$$\varepsilon_{s,t} = a_s + u_{s,t},$$

Table 3. DESCRIPTIVE STATISTICS

This table shows descriptive statistics for the main variables in this paper: $\Delta c_{s,t}$ is the average non-durable consumption growth per month (logged differences); $\Delta p_{s,t}$ is the real monthly (log) changes in house prices; $\Delta pnac_t$ is the real growth in house prices of the national index; and $Diff\, p_{s,t} = \Delta p_{s,t} - \Delta pnac_t$, deviations from national prices growth rates; $r_t = \ln(1 + R_t)$, where R_t is the Selic rate in real terms (deflated using IPCA); $\Delta Inad_{s,t}$ is the default rate of credit operations of the National Financial System; $\Delta Wage_{s,t}$ is the wage growth in the formal sector of the economy; $\Delta y_{s,t}$ is the Regional Economic Activity Index constructed by the Central Bank (IBC-Br); $\Delta Loans_{s,t}$ refers to the growth in loans and discounted securities; $\Delta Depvista_{s,t}$ measures the growth of demand deposits; $\Delta Ocup_{s,t}$ is the growth in the share of employment in the formal sector; and $WorkingAge_{s,t}$ is the share of people aged 25–64 years old.

Variables	N	Mean	Min	Max
$\Delta c_{s,t}$	1,309	0.0108	−0.310	0.419
$\Delta p_{s,t}$	958	0.0067	−0.0356	0.0460
$Diff\, p_{s,t}$	866	−0.0002	−0.0456	0.0362
$\Delta pnac_t$	866	0.0062	−0.00223	0.0269
r_t	1,320	0.0037	−0.0040	0.0103
$\Delta Inad_{s,t}$	1,309	0.0034	−0.300	0.331
$\Delta Wage_{s,t}$	1,320	−0.0010	−0.0178	0.0137
$\Delta y_{s,t}$	1,309	0.0031	−0.170	0.248
$\Delta Loans_{s,t}$	1,309	0.0079	−0.181	0.248
$\Delta Depvista_{s,t}$	1,309	0.0050	−0.334	0.441
$\Delta Ocup_{s,t}$	781	0.0006	−0.0455	0.0523
$\Delta WorkingAge_{s,t}$	792	0.5350	0.479	0.562

where a_s is the fixed effect (constant across time periods) and $u_{s,t}$ is an idiosyncratic error term. We allow $u_{s,t}$ to be dependent across time and cross-sectional units. This requires for proper inference using some type of robust correction in constructing estimates for the standard errors.

Table 4 presents estimation results of equation (6) in five different specifications. The dependent variable is $\Delta c_{s,t}$ and the main explanatory variable of interest is $\Delta p_{s,t}$. Column 1 controls for the interest rate. Column 2 adds proxies of indebtedness. Column 3 adds control by the IBC-Br index $\Delta y_{s,t}$. Column 4 replaces the control $\Delta y_{s,t}$ by employment rates in the state, $\Delta Ocup_{s,t}$, and $\Delta Wage_{s,t}$ to check whether the results are sensitive to different measures of fluctuations in economic activity. Column 5 includes the share of people aged 25–64 to control for demographic changes within the states. The standard errors are clustered at the state-level, thereby allowing for unrestricted residual correlation within states. All columns include state-fixed effects and controls for seasonality. We impose *strict exogeneity* of the regressors conditional on the unobserved effect a_i. Thus, estimation of the marginal effects is performed using the so called *fixed-effects estimator*.

Table 4. MAIN RESULTS

This table presents estimation results of equation (6) in five different specifications. The dependent variable is $\Delta c_{s,t}$ and the main explanatory variable of interest is $\Delta p_{s,t}$. Column 1 includes a control for the interest rate growth (r). Column 2 adds bank information controls. Column 3 adds the IBC-Br index ($\Delta y_{s,t}$), while the fourth specification replace the later by controls for the the salary growth ($g_w age$) and employment rates in the state $\Delta Ocup_{s,t}$. In column 5 we add the share of people aged 25–64 to control for demographic changes within the states.

	$\Delta c_{s,t}$				
Dependent Variable	(1)	(2)	(3)	(4)	(5)
$\Delta p_{s,t}$	0.359	0.371	0.354	0.413	0.285
	(0.065) ***	(0.086) ***	(0.085) ***	(0.167) **	(0.134) *
r_t	1.679	1.654	1.615	1.715	2.153
	(0.131) ***	(0.150) ***	(0.144) ***	(0.224) ***	(0.227) ***
$\Delta Inad_{s,t}$		−0.031	−0.031	−0.015	−0.017
		(0.019)	(0.018)	(0.020)	(0.019)
$\Delta Loans_{s,t}$		−0.031	−0.029	−0.059	−0.088
		(0.082)	(0.078)	(0.070)	(0.065)
$\Delta Depvista_{s,t}$		−0.026	−0.026	−0.005	−0.003
		(0.018)	(0.017)	(0.022)	(0.022)
$\Delta y_{s,t}$			0.086		
			(0.016) ***		
$\Delta Ocup_{s,t}$				0.041	0.055
				(0.122)	(0.113)
$\Delta Wage_{s,t}$				0.879	0.434
				(0.742)	(0.830)
$WorkingAge_{s,t}$					−0.592
					(0.169) ***
Constant	−0.237	−0.239	−0.236	−0.228	0.090
	(0.007) ***	(0.006) ***	(0.007) ***	(0.006) ***	(0.089)
Observations	956	956	956	747	747
R^2	0.920	0.920	0.922	0.913	0.914
Number of States	11	11	11	11	11
Month FE	Y	Y	Y	Y	Y

Notes: The standard errors are clustered at the state level, allowing for unrestricted residual correlation within states. All columns include state-fixed effects and controls for seasonality.

In line with the theoretical prediction of the simulations in Campbell e Cocco (2007), the results show that changes in the growth rate of house prices ($\Delta p_{s,t}$) are positively correlated with changes in growth rates of non-durable consumption ($\Delta c_{s,t}$) using proper controls. This effect is economically and statistically significant. One percent increase in house prices is associated with an increase in 0.285–0.413 percent in non-durable consumption. The effect is robust across specifications. The evidence further indicates that Δr_t positively influences non-durable consumption. This indicates there is a standard inter-temporal substitution effect operating for non-durable goods consumption. Income growth $\Delta Wage_{s,t}$ and $\Delta y_{s,t}$ are also positively correlated with consumption as predicted by the theoretical model. However, the effect is statistically significant only for $\Delta y_{s,t}$.

Table 5 analyzes whether the relationship between house prices and non-durable consumption is driven by national or regional trends. Odd columns repeat the specification from Table 4, column 4 using the real growth in national house price $\Delta pnac_t$ and $Diff\, p_{s,t} = \Delta p_{s,t} - \Delta pnac_t$ as measures of house prices. Even columns repeat the specification from Table 4, column 6 using these measures of house prices. The results point out to a strong and statistically significant effect of national prices on non-durable consumption and a weak and non-significant effect of the incremental price changes observed in the states on non-durable consumption. The effect of national prices is typically more than three times larger than the effect of regional prices.

3.2 Instrumental Variables

One potential problem of the results presented in tables 4 and 5 is that the house-price series are constructed using list prices observed only in the state capitals and do not have statewide coverage. This introduces measurement error which might potentially attenuate the results obtained. Table 6 uses an instrumental-variable approach to deal with this issue. We instrument the growth of housing price with the lag of the growth of mortgages in each state. The different specifications mimic the ones used in Table 4.

The evidence from Table 6 suggests that the OLS estimates understate the importance of housing wealth on consumption. The instrumental variables coefficients of the effect of house prices on non-durable consumption are above unity while the OLS coefficients presented in Table 4 range between 0.2 and 0.4. These instrumental variable estimates are statistically significant in all but one specification. The point estimates are close to the ones reported by Campbell e Cocco (2007) for the U.K. These authors find elasticities ranging from 0.57 to 1.58 while here we find elasticities ranging from 1.04 to 1.59 for Brazil. Table 7 replicates this exercise using three lags of mortgage as instruments. The results do not change.

3.3 Heterogeneity during the Business Cycle

We now turn into interpreting the evidence presented linking house prices and non-durable consumption. Campbell e Cocco (2007) describe three potential explanations for the existence of a positive correlation between house prices and non-durable consumption. First, changes in house prices might be simply proxying changes in expectations regarding economic growth. Second, changes in house prices generate a direct wealth effect. Third, changes in house prices might relax or tighten borrowing constraints the household is subject to.

Table 5. National versus Regional Price Variation

This table presents estimation results of equation (6) in four different specifications. The dependent variable is $\Delta c_{i,t}$ and the main explanatory variable of interest is $\Delta pnac_t$. Column 1 includes all the controls included in the last column of Table 4 except for the control on $WorkingAge_{s,t}$, which is included in column 2. Columns 3 and 4 follow the same structure of the previous columns but we are also interested in understand the relation between consumption and $Diff\,p_{s,t}$.

	$\Delta c_{s,t}$			
Dependent Variable	(1)	(2)	(3)	(4)
$\Delta pnac_t$	1.376	1.287	1.383	1.271
	(0.284) ***	(0.368) ***	(0.285) ***	(0.355) ***
r_t	2.230	2.252	2.217	2.244
	(0.210) ***	(0.232) ***	(0.211) ***	(0.230) ***
$\Delta Inad_{s,t}$	−0.013	−0.014	−0.014	−0.014
	(0.020)	(0.020)	(0.020)	(0.020)
$\Delta Loans_{s,t}$	−0.089	−0.091	−0.089	−0.091
	(0.058)	(0.058)	(0.058)	(0.059)
$\Delta Depvista_{s,t}$	−0.003	−0.002	−0.003	−0.002
	(0.022)	(0.022)	(0.022)	(0.022)
$\Delta Ocup_{s,t}$	0.029	0.031	0.029	0.032
	(0.117)	(0.114)	(0.117)	(0.114)
$\Delta Wage_{s,t}$	−0.050	−0.040	−0.061	−0.049
	(0.839)	(0.846)	(0.845)	(0.851)
$Diff\,p_{s,t}$			0.109	0.116
			(0.134)	(0.132)
$WorkingAge_{s,t}$		−0.079		−0.100
		(0.197)		(0.193)
Constant	−0.233	−0.191	−0.233	−0.179
	(0.006) ***	(0.105)	(0.006) ***	(0.103)
Observations	747	747	747	747
R^2	0.914	0.914	0.914	0.914
Number of States	11	11	11	11
Month FE	Y	Y	Y	Y

Notes: The standard errors are clustered at the state level, allowing for unrestricted residual correlation within states. All columns include state-fixed effects and controls for seasonality. We impose *strict exogeneity* of the regressors, conditional on the unobserved effect a_s. 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 heteroscedastic, robust inference has to be conducted to account for time-depedence and heteroskedasticity of unknown form.

Table 6. INSTRUMENTAL VARIABLES (1)

This table presents a robustness check using an instrumental-variable approach. We instrument the growth of housing price with the lag of the growth of mortgages. Column 1 includes a control for the interest rate growth. Column 2 adds bank information controls. Column 3 adds control for the growth in the employment rates and wages in the formal sector. Column 4 adds control for demographic changes within the states.

	$\Delta c_{s,t}$			
Dependent Variable	(1)	(2)	(3)	(4)
$\Delta p_{s,t}$	1.037	1.117	1.588	1.318
	(0.324) ***	(0.349) ***	(0.749) **	(1.235)
r_t	1.922	1.851	2.084	2.178
	(0.422) ***	(0.422) ***	(0.514) ***	(0.484) ***
$\Delta Inad_{s,t}$		−0.030	−0.018	−0.018
		(0.027)	(0.031)	(0.031)
$\Delta Loans_{s,t}$		−0.099	−0.091	−0.095
		(0.067)	(0.078)	(0.076)
$\Delta Depvista_{s,t}$		−0.028	−0.003	−0.003
		(0.019)	(0.023)	(0.022)
$\Delta Ocup_{s,t}$			0.031	0.038
			(0.172)	(0.171)
$\Delta Wage_{s,t}$			−0.310	−0.250
			(1.043)	(1.101)
$WorkingAge_{s,t}$				−0.221
				(0.495)
Constant	−0.242	−0.243	−0.234	−0.115
	(0.004) ***	(0.005) ***	(0.007) ***	(0.271)
Observations	954	954	747	747
Number of States	11	11	11	11
Month FE	Y	Y	Y	Y

Notes: The standard errors are clustered at the state level, allowing for unrestricted residual correlation within states as in Table 4 and all columns include state-fixed effects and controls for seasonality.

Table 7. Instrumental Variables (2)

This table presents a robustness check using an instrumental-variable approach. We instrument the growth of housing price with the lags of the growth of mortgages (3 lags). The first column includes a control for the interest rate growth. Column 2 adds bank information controls. The third column adds control for the growth in the employment rates and wages in the formal sector. Column 4 adds control for demographic changes within the states.

	$\Delta c_{s,t}$			
Dependent Variable	(1)	(2)	(3)	(4)
$\Delta p_{s,t}$	0.902	0.998	1.496	1.088
	(0.254) ***	(0.273) ***	(0.529) ***	(0.842)
r_t	1.873	1.811	2.055	2.172
	(0.413) ***	(0.415) ***	(0.484) ***	(0.479) ***
$\Delta Inad_{s,t}$		−0.028	−0.018	−0.018
		(0.026)	(0.031)	(0.031)
$\Delta Loans_{s,t}$		−0.094	−0.088	−0.094
		(0.064)	(0.076)	(0.075)
$\Delta Depvista_{s,t}$		−0.028	−0.003	−0.003
		(0.019)	(0.022)	(0.022)
$\Delta Ocup_{s,t}$			0.032	0.042
			(0.171)	(0.169)
$\Delta Wage_{s,t}$			−0.217	−0.098
			(0.891)	(0.918)
$WorkingAge_{s,t}$				−0.303
				(0.371)
Constant	−0.241	−0.243	−0.234	−0.069
	(0.004) ***	(0.005) ***	(0.006) ***	(0.203)
Observations	950	950	747	747
Number of States	11	11	11	11
Month FE	Y	Y	Y	Y

Notes: The standard errors are clustered at the state level, allowing for unrestricted residual correlation within states as in Table 4 and all columns include state-fixed effects and controls for seasonality.

Regarding alternative reasons to find a positive correlation between house prices and non-durable consumption, we must stress that, in tables 4 through 7, we are controlling for either income or labor income growth, as well as for employment rates and credit-market conditions in each state. Controlling for income (labor income) growth is equivalent to control for the sum of expected income (labor income) growth and an unexpected shock. Because income (labor income) has positive serial correlation, it also controls in part for future income (labor income) growth. Credit-market conditions are captured by changes in demand deposits and the growth rate of loans and discounted securities.

When analyzing potential wealth effects, Campbell e Cocco (2007) note that if a home owner lives in the house, then welfare gains will be exactly offset by the present expected value of imputed rents. Indeed, in their structural model, house prices affect non-durable consumption by relaxing the agent's borrowing constraints once a price increase is observed. To try to disentangle these mechanisms, we test whether the effects of house prices on consumption are different in the "boom" and "bust" phases of the business cycle. Borrowing constraints are typically tighter in recessions (Bernanke & Gertler, 1989; Kashyap & Stein, 2000). Thus, we expect this test to indicate the importance of this mechanism.

We implement this test by estimating equation (6) including an interaction between $\Delta p_{s,t}$ and a dummy variable which is one when the economy is in recession ($Bust_t$) and zero when it is not ($Boom_t$). Based on reports from the CODACE (*Comitê de Datação de Ciclos Econômicos*) on the state of the economy, we define the period between July 2014 and the December 2016 as the "bust" period. All other months are "boom" periods.

Table 8 reports the results. The different specifications mimic the ones used in Table 4. The effect of house prices on non-durable consumption is statistically significant during "booms" and "busts". However, the evidence indicates the effect of house prices on non-durable consumption is bigger during "busts" than during "booms". The point estimates range between 0.56 and 0.64 during the crisis and between 0.21 and 0.32 outside the crisis. This asymmetric effect during "booms" and "busts" is consistent with the idea that borrowing constraints are tighter during recessions and drive the relationship between house prices and consumption observed in the data.

We use the elasticities reported in Table 8 to gauge the importance of changes in house prices in explaining the behavior of consumption during the crisis. For example, in the state of Rio de Janeiro, house prices fell 7.68% from July 2014 to December 2016. This implies a reduction in non-durable consumption of 4.31–4.91% coming from the reduction of house prices, *ceteris paribus*. Since non-durable consumption in Rio de Janeiro fell by 12.62% in this period, this suggests that non-durable consumption would have fallen just between 7.70% and 8.32% in the absence of the changes in house prices. In the state of São Paulo, in turn, house prices rose 4.37% in the period, implying an increase in non-durable consumption from 2.44 to 2.80% coming from changes in house prices. Since non-durable consumption in the state fell 1.47%, this suggests that non-durable consumption would have fallen between 3.92 and 4.27% in the period in the absence of changes in house prices. These counterfactual exercises indicate that regional heterogeneity in the behavior of house prices is important in explaining the behavior of non-durable consumption across states during the last recession.

Table 8. HETEROGENEITY DURING THE BUSINESS CYCLE

This table follows the same structure of Table 6 but explore the time variation to estimate equation (6). $\Delta p * Bust_t$ allows to estimate differential effects after and before the economic crisis faced by Brazil in 2014 (before and after july 2014).

	$\Delta c_{s,t}$			
Dependent Variable	(1)	(2)	(3)	(4)
$\Delta p_{s,t} \times Boom_t$	0.216	0.231	0.321	0.215
	(0.060) ***	(0.079) **	(0.141) **	(0.119)
$\Delta p_{s,t} \times Bust_t$	0.628	0.644	0.625	0.560
	(0.317) *	(0.315) *	(0.357)	(0.347)
$Bust_t$	−0.007	−0.007	−0.007	−0.005
	(0.001) ***	(0.002) ***	(0.002) **	(0.002) *
r_t	1.805	1.764	1.821	2.163
	(0.146) ***	(0.142) ***	(0.190) ***	(0.217) ***
$\Delta Inad_{s,t}$		−0.026	−0.010	−0.014
		(0.018)	(0.019)	(0.019)
$\Delta Loans_{s,t}$		−0.051	−0.063	−0.086
		(0.077)	(0.066)	(0.064)
$\Delta Depvista_{s,t}$		−0.029	−0.006	−0.004
		(0.020)	(0.023)	(0.022)
$\Delta Ocup_{s,t}$			0.004	0.029
			(0.126)	(0.118)
$\Delta Wage_{s,t}$			0.292	0.101
			(0.892)	(0.928)
$WorkingAge_{s,t}$				−0.520
				(0.141) ***
Constant	−0.234	−0.235	−0.225	0.053
	(0.007) ***	(0.006) ***	(0.006) ***	(0.073)
Observations	956	956	747	747
R^2	0.921	0.921	0.913	0.914
Number of States	11	11	11	11
Month FE	Y	Y	Y	Y

4. Conclusion

This paper examines the impact of changes in house prices on the growth rate of non-durable consumption expenditures in Brazil using the framework proposed in Campbell e Cocco (2007) with the data structure consistent with that of Case et al. (2005). We use the theoretical model developed by Campbell e Cocco to motivate the use of a reduced-form regression approach implemented in their paper. This reduced-form regression arises from simulating their structural model of consumption and housing choice under a debt constraint related to housing values, where parameters are calibrated to fit the U.K. environment in a synthetic panel of households.

Since Brazil does not possess any database with panel data on consumption, but one can create a synthetic panel using data on consumption for Brazilian states, we chose to use the same data setup employed by Case et al. (2005) on another well-known study of housing. Using state-level data on house prices and non-durable consumption, we estimated the reduced-form regression proposed in Campbell e Cocco (2007) with a monthly state-level unbalanced panel to examine the relationship between house prices and non-durable consumption using a myriad of appropriate controls.

We find a positive and significant effect of house prices on non-durable consumption in Brazil. The magnitude of the effect we document is close to the magnitude of the effect documented by Campbell e Cocco (2007) using data from the U.K. Taking to heart the theoretical model proposed by Campbell and Cocco, a potential explanation for this positive and significant elasticity is the fact that house-price increases relax the borrowing constraint faced by the representative agent, allowing an increase in non-durable consumption in turn (and vice-versa). For the sake of completeness, we have also discussed why alternative explanations are not as plausible as relaxing the agent's borrowing constraint.

We also go one step further than Campbell and Cocco and document that the effect of house prices on non-durable consumption is asymmetric—stronger in "bust" periods than in "boom" periods of the business cycle. This is also consistent with that idea that borrowing constraints drive the results, since the latter are typically tighter during recessions.

It is possible to offer an alternative explanation for our econometric results coming from an omitted variable in our regressions. We find unlikely the existence of a plausible alternative explanation, since our marginal effects were obtained employing a variety of important controls that are potential omitted-variable candidates: demographics, real interest rates, income (labor income), loan conditions, etc.

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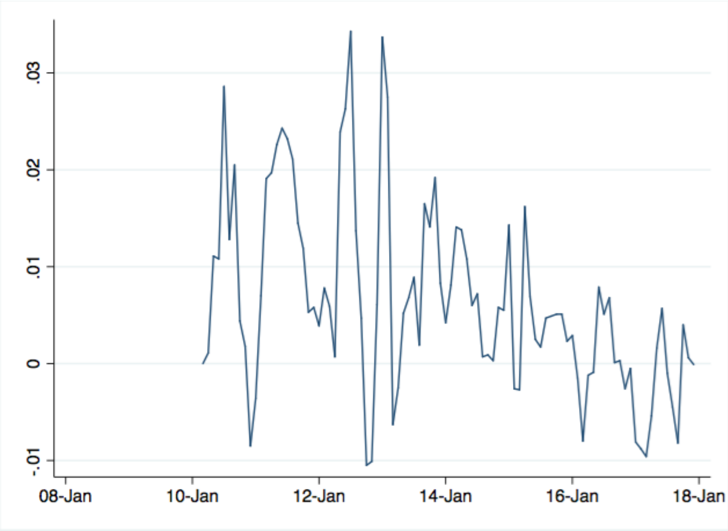
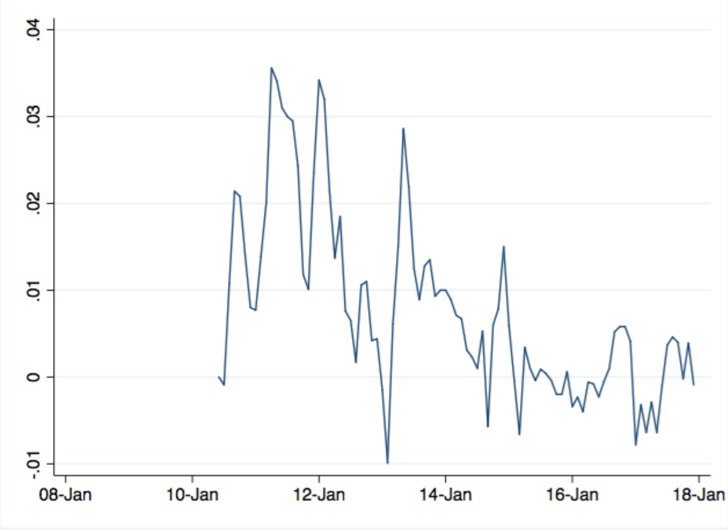
Appendix.



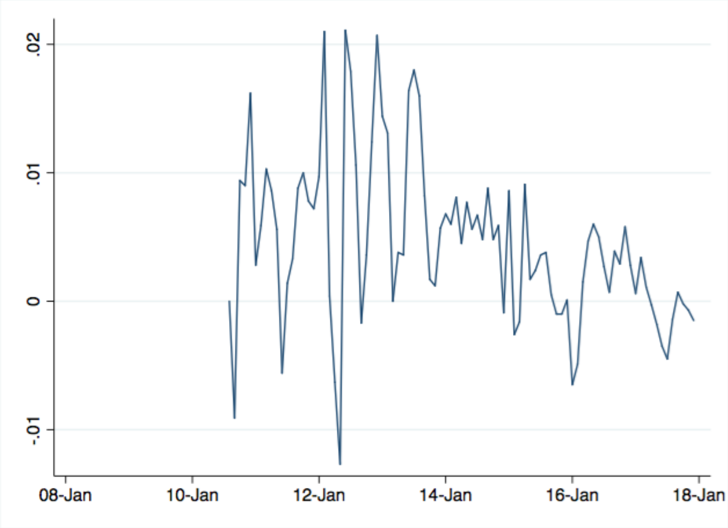
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-1. Real Growth Rate – House Prices – Ceará.



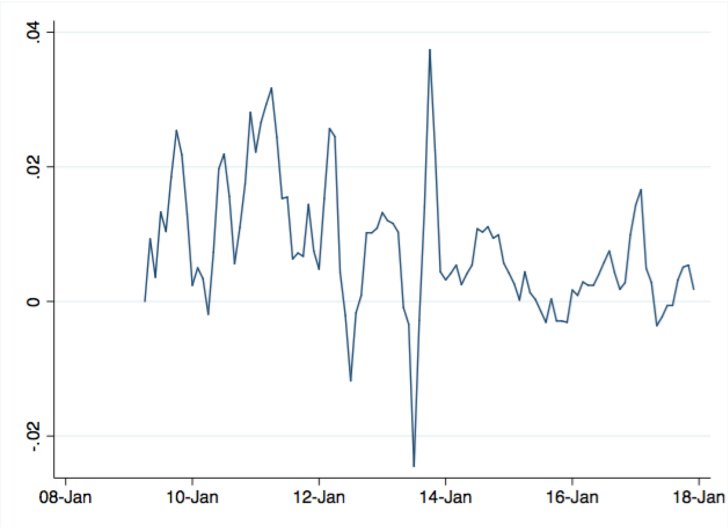
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-2. Real Growth Rate – House Prices – Pernambuco.



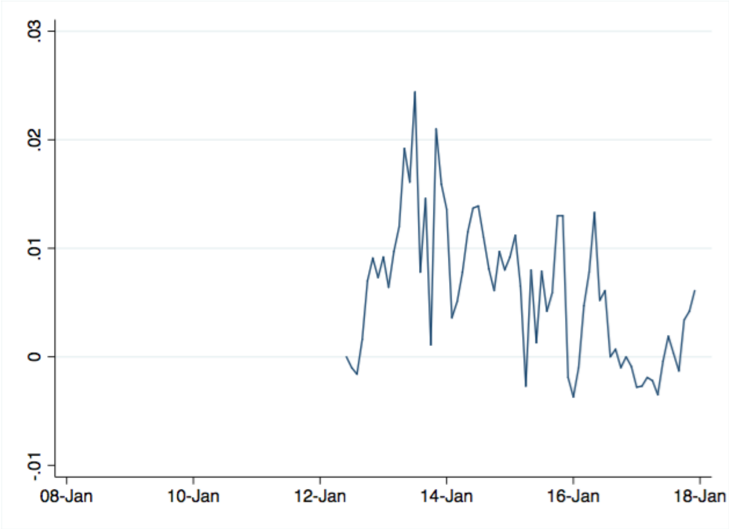
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-3. Real Growth Rate – House Prices – Bahia.



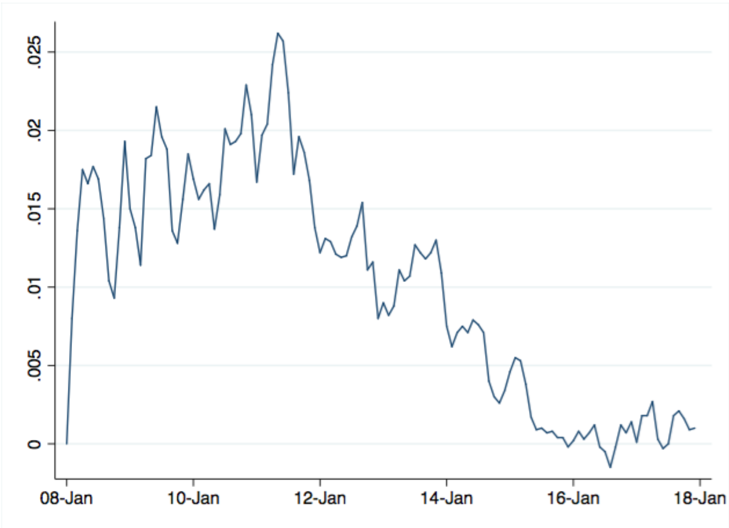
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-4. Real Growth Rate – House Prices – Minas Gerais.



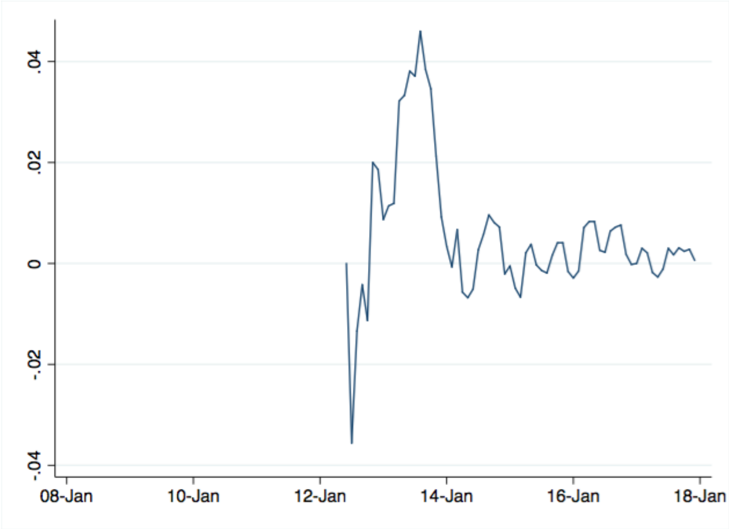
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-5. Real Growth Rate – House Prices – Espírito Santo.



Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-6. Real Growth Rate – House Prices – São Paulo.

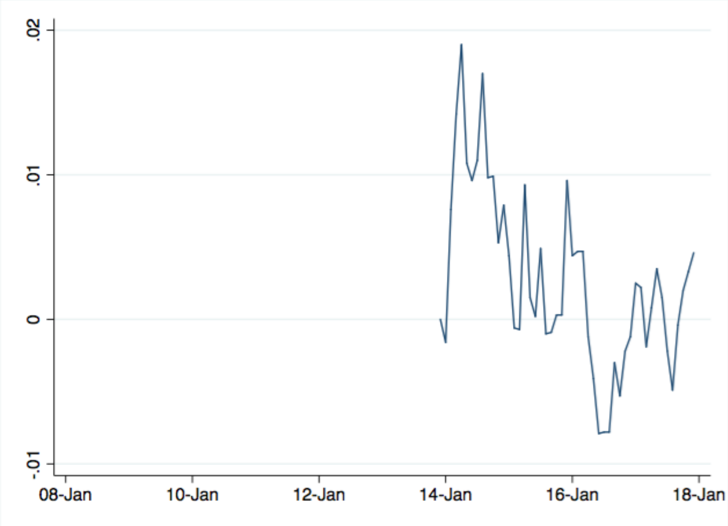


Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-7. Real Growth Rate – House Prices – Paraná.

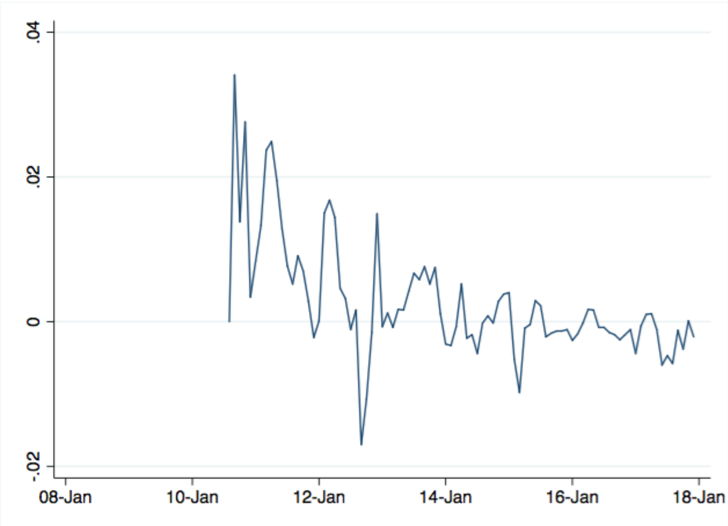
Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-8. Real Growth Rate – House Prices – Rio Grande do Sul.



Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-9. Real Growth Rate – House Prices – Goiás.



Note: The figure reports monthly real growth rates in house prices from February 2008 to January 2018.

Figure A-10. Real Growth Rate – House Prices – Distrito Federal.