Brazilian Second and Third Tier Cities, Real Estate Markets and Productivity

1. Introduction

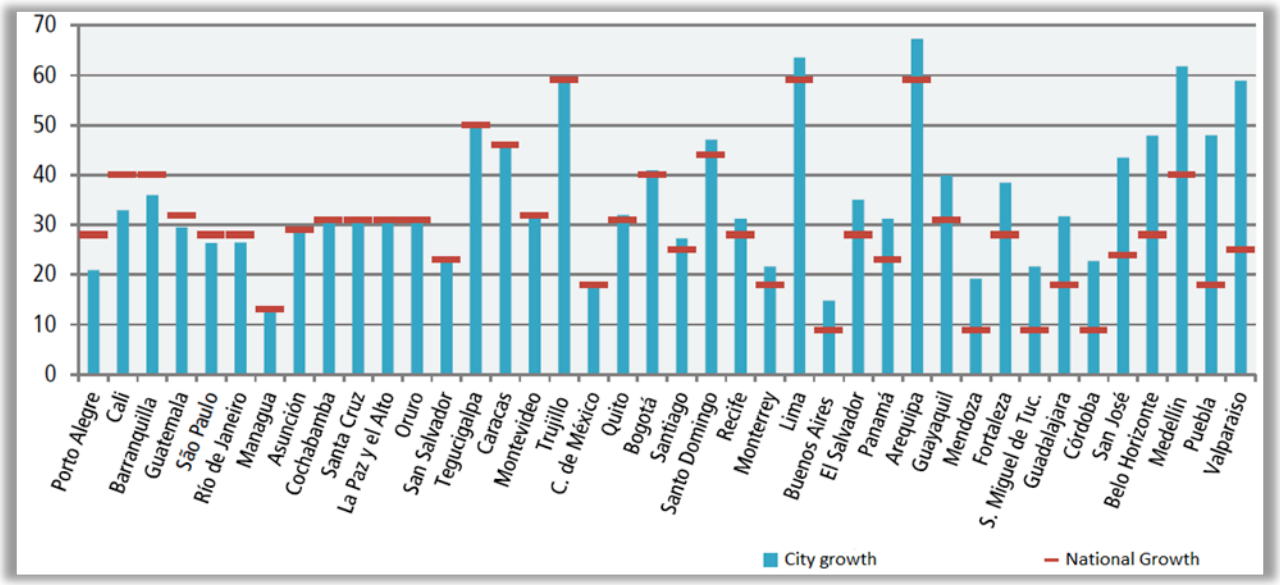
Cities and Regions are essential dimensions of the development process, although these critical dimensions are sometimes overlooked in favor of macroeconomic considerations (STORPER; SCOTT, 2003). Simple evidence is the fact that most of the countries' GDP are generated in cities, and they are the privileged site for innovation and for welfare spillover. After the 80s, a 'spatial turn' occurred in Economics, with leading economists studying the field, such as Paul Krugman, Michael Porter and Robert Barro (MARTIN, 1999). Many development institutions have recognized the important role that cities play in the growth rate of a country, as World Bank's reports, Inter-American Development Bank's reports, and USAid's reports have shown, even labeling cities as "growth machines" (TUROK, 2014). In this scenario, it is fundamental that policy makers have a comprehensive understanding of the relation between potential cities growth and the capacity of spread these benefits over the territory. As Perroux (1967) emphasized in his pioneering work, the development flows from a development pole to the whole national economy through fluxes, prices and anticipations.

There are empirical evidences that in the early stages of a country's development, a single city or a very small group of cities may grow fast in a growth pole-like pattern, operating as a driving force to the whole national economy (DINIZ; CROCCO, 2006; PARR, 1999; PERROUX, 1967). These poles buy inputs (raw material, food and other agricultural inputs) from other locations, which in turn boost the national growth through backward linkages (CACERES; SENINGER, 1980; DINIZ; CROCCO, 2006; HIRSCHMAN, 1965)[1]. In their turn, negative agglomeration effects, such as congestion, higher land rents and wages create incentives for the economic activity to flourish in other locations, forming a second tier of cities. The dynamics of this process may lead to a national urban system (BEHRENS; DURANTON; ROBERT-NICOUD, 2014). This is the basic narrative of the advantages and disadvantages of agglomeration in Economics' literature considering the initial uneven growth.

[1] The growth-pole strategy was one of the most important regional development theory in the 20th century (Parr, 1999). An empirical application of it can be found in Caceres and Seninger (1980) for the case of Central American Common Market, where they found that Guatemala had dominance over the region.

The emergence of these secondary tier metropolises is a phenomenon that has been happening in many Latin American and Caribbean countries. Chart 1 depicts this process. In Brazilian urban system, the São Paulo Metropolitan Region's primacy rate has been falling since the 80s, with a sprawl of manufacturing activities over other metropolises and intermediary cities in the Southeast, South and Mid-West regions. As Chart 1 shows, São Paulo and Rio de Janeiro grown less than the national average in the last decade, while Belo Horizonte, Fortaleza and Recife had pronounced growth rates[2].

Chart 1 - GDP per capita growth of the city and the country - LAC (2010)



Source: UN-Habitat (2012)

Regarding this broad discussion, a fundamental economic aspect to foster a more polycentric national urban system and the deconcentration process in a national scale is the housing affordability in the fasting growing metropolises and middle size cities. One peril of the development process is the secondary tier of cities getting expansive before achieving its full development potential, what might be an obstacle for firms and individuals who would like to move from the primary city to these fast growing centralities. A closely related and key discussion regarding the process of deconcentration in the national urban system is the one about urban wages premiums and human capital migration. Let's assume for a moment the a skilled worker desire to move from São Paulo or Rio de Janeiro due to the high cost of housing and the

[2] Intriguingly, Porto Alegre had the lowest growth rate among the selected Brazilian metropolises in the Chart 1.

congestion effects. In her choice, the second and third tier of cities seems to be a natural set of options, since it is able to provide at least similar job, good level of amenities, and similar way of living. It is hard to suppose as a general case that a skilled worker would move from São Paulo to the semi-arid region, the poorest part of Northeast, or to the middle of the jungle in Amazon. As Savedoff (1990, 1991) concluded, the national labor market is strongly determined by the structure of the demand for labor, what means that skilled workers are not demanded in the hypothetical alternatives locations mentioned above, but she could find a job in Belo Horizonte, Brasília, Salvador, Florianópolis or Vitória, for example. Nonetheless, this migration heavily depends on the non-primary tier cities housing affordability, as well as the choice among these cities depend on it. Obviously, cost of living is a wider variable, which includes a number of variables other than housing, but housing is the most important component on it.

Moreover, the regional price indexes in Brazil include only rents, ignoring the possibility to buy a real estate in the new city. The aggregate cost of living also ignores the nature of the new residential place, such as neighborhood, and the option between living in an apartment or in a house. If Florida (2002) rhetoric is right, that is, if the growth of cities in the 21th century relies in the capacity of the city to attracted skilled and creative workers, so the "creative class" needs to face housing market in the attractive city.

Therefore, one of the aims of this paper is to describe the Brazilian housing market regarding metropolises of its secondary and tertiary tier. We use a new dataset provided by NetImóveis Company, one of the main real estate brokers companies in the selected cities in the sample. It included not only the capital city but also some cities in the metropolitan region. This inclusion tends to be fundamental, since the commuting process is getting more and more spatially extended, with the distance between the workplace and the home achieving tens of miles. Parr (2005) defined the city-region exactly based on the commuting capacity of its residents. Furthermore, the sample includes a metropolis from each macro-region in Brazil, except North region, which has a very particular scale and pattern of occupation (the Amazon region is a part of the North region). From the best of the author's knowledge, it is the first attempt to describe the real estate market of this specific group of cities together in the literature.

Another branch of economics literature, which has a clear connection with this discussion, is the one raised by the seminal works of Bela Balassa and Paul Samuelson regarding

the effects of productivity and the prices of non-tradable goods (BALASSA, 1963, 1964; SAMUELSON, 1964). The Balassa-Samuelson effect, one of the most observed economic empirical regularities, states that countries with higher productivity tends to have higher non-tradable goods, which is translate into a more appreciated exchange rate. Given that the real estate properties are the most expansive item within a non-tradable goods list, it is intuitive to expect that places with higher productivity to have higher real estate prices. However, Balassa-Samuelson effect is generally thought as an international economics issue, not as intra-national urban system feature. Curiously, Samuelson (1964, p.148) mentioned the regional dimension in his classical paper, comparing the case of California and Vermont. Lemos (1988) had already gone deeply in this regional interpretation of Balassa-Samuelson. Latter, New Economic Geography also tried to cope with some questions of this nature. Therein, this paper also sheds some light on it, searching for empirical evidence of cities' productivity over real estate prices.

The paper is structured in four sections beside this introduction. The next section exposes a short literature review regarding Brazilian urban system and its deconcentrating process. This section justifies the selection of cities in the sample. Section 3 uses principal component analysis method to describe the housing markets of those cities and to create an index for real estate markets based on its characteristics. Then, we use cluster analysis to identify real estate market characteristics and to create typologies of cities' real estate market in Brazil. Section 4 uses the index previously created to make a regression analysis and to shed some light in the determinants of real estate prices in the selected cities.

2. Brazilian system of cities

This section makes a brief review of Brazilian system of cities and the concentration process. To sum, it is possible to say that the drop of the São Paulo's primacy rate after the 1980s is not associated with a continuous concentration, neither with a completely dispersion. Indeed, Brazilian deconcentrating process led to the formation of a "polygon", where the vertices is formed by the regional metropolises (DINIZ, 1994). The cities that compose the sample selected in this paper are some vertices of this polygon, such as Brasília, Belo Horizonte and Vitória, or are within it, such as Florianopolis. Alternatively, they are important enclaves or they are not connected to the main core of the national urban system, such as Salvador.

Moreover, Brazilian ‘march to West’ has been happening intensely since the 1960s, with Brasilia playing a key role as regional centrality and with the agribusiness (soya beans and cattle) invading the Center-West and the Amazon region. Although not making part of the core region of the country, Salvador is the third most populated city and it had an attempt of industrialization, with the industrial pole of Camaçari, localized in its metropolitan region. Figure 1 shows this sort of polygon based on (DINIZ, 1993). 23 years later, it is easy to suppose that now Brasília, Vitória and the North of the Rio de Janeiro state are included on that figure. Figure 2 shows the result of polarization analyzes based on economic linkages, environmental adjustment and political and cultural identities. In this Figure, Brazilian map is reshaped according to the macro-poles; it highlights Belo Horizonte, Salvador and Brasília as macro-poles as well as shows Vitória and Florianópolis as sub-poles within their main poles.

Figure 1 – Deconcentration axes, technopolises and the industrial polygon in the 1990s

Source: Diniz (1993)

Figure 2 – Brazilian Macro-regions and Macro-poles (2000s)

Source: Cedeplar (2008)

3. Secondary and tertiary tier cities, real estate market characteristics and hierarchy

After providing basic information about Brazilian urban system, we now turn to the current situation of aspects of the housing markets in some metropolises. This section shows the results of principal component analysis and cluster analysis. Before doing this, we explain the dataset and the methodology used.

In the last years, a number of papers in Economics have been writing concerning Brazilian real estate market (AGUIAR; SIMÕES, 2012; AGUIAR; SIMÕES; GOLGHER, 2014;

ALMEIDA, 2015; ALMEIDA; R. L. M. MONTE-MÓR; AMARAL, 2014; FURTADO, 2009; MACIEL; BIDERMAN, 2010; NADALIN, 2010; PAIXÃO, 2010; PAIXÃO; ABRAMO, 2008; PONTES; PAIXÃO; ABRAMO, 2011). However, all these works focuses in a specific city or metropolitan region, and due to the location of the authors and data availability, all them were about São Paulo or Belo Horizonte.

Given the lack of consolidated and comprehensive data on the real estate market for Brazilian metropolises, we use real estate offers data from "NetImóveis", one of the biggest real estate dealers in Brazil. It provided a unique dataset with more than 30.000 observations for the selected real estate typologies. Unfortunately, NetImóveis has an uneven coverage of the national market, and that is why the selected sample has only five metropolitan regions: Brasília, Belo Horizonte, Florianópolis, Salvador and Vitória. Certainly, it would great to have in the sample second tier metropolises such as Porto Alegre, Curitiba, Recife, Fortaleza, Belém, Manaus and Cuiabá. However, it was not possible. Within each of these selected metropolises, it was necessary to select some of the main cities. It leads to the sample exposed in Table 1.

Table 1 – Selected cities and their characteristics

Metropolitan region	Cities	Description	Population	Per Capita Income	Area	HDI
Belo Horizonte	Belo Horizonte	Capital city	2375151	32844.41	331.401	0.810
	Contagem	Industrial city	603442	37995.25	195.045	0.756
	Nova Lima	High-income suburban city	80998	109298.94	429.004	0.813
Distrito Federal	Brasília	Capital city (national capital)	2570160	62859.43	5780.00	0.824
	Águas Claras	Verticalized suburban district	135000	54054.12	31.5	-
Florianópolis	Florianópolis	Capital city (island)	421240	32385.04	675.409	0.847
Salvador	Salvador	Capital City	2675656	18264.13	692.819	0.759

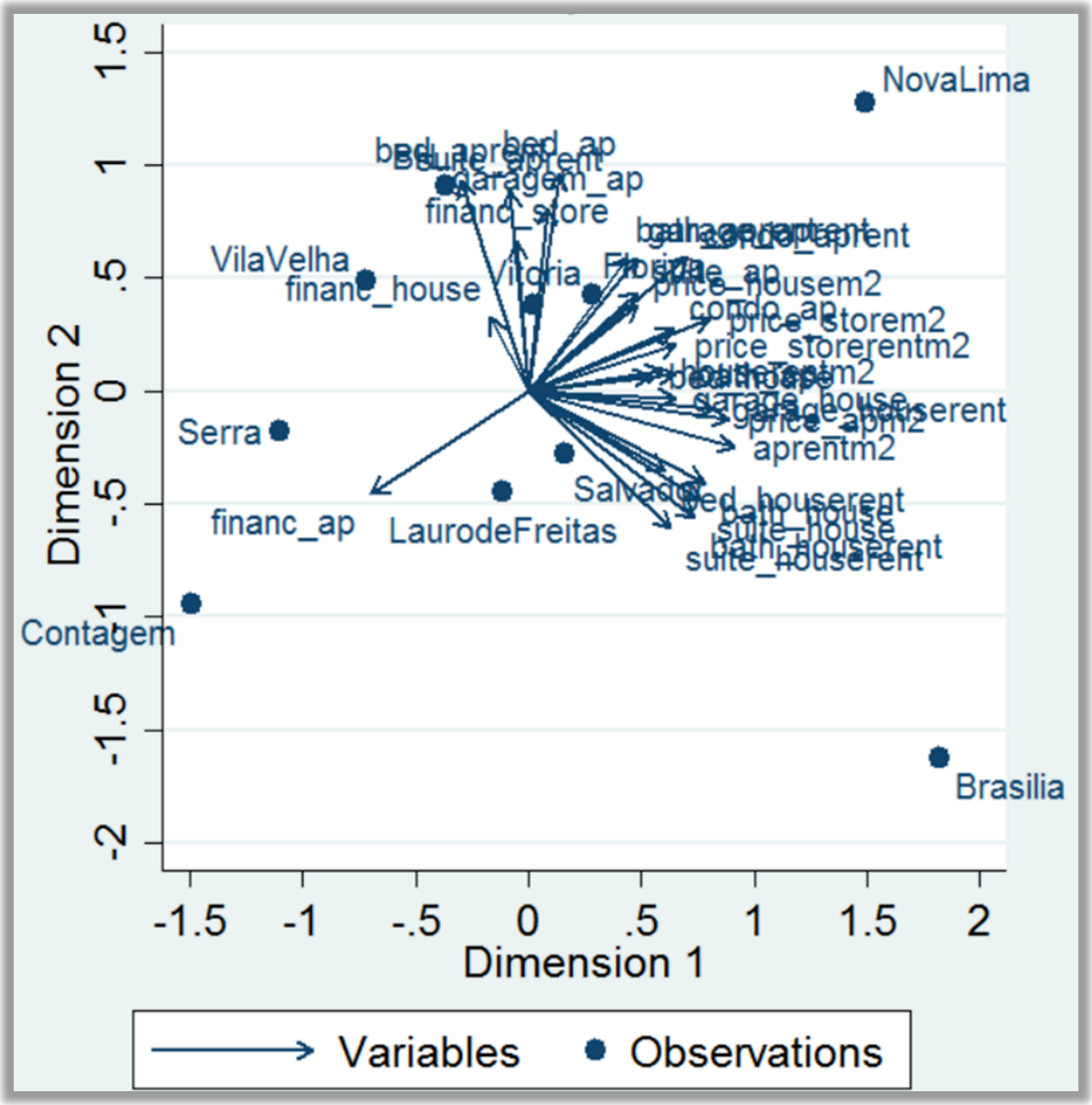
		(shore)				
	Lauro de Freitas	Suburban city	163449	28859.89	57.662	0.754
Vitória	Vitória	Capital city (island)	327801	64001.91	96.536	0.845
	Vila Velha	Twin city (shore)	414586	21914.19	209.965	0.80
	Serra	Industrial city	409267	33039.02	547.637	0.739

Source: Authors and IBGE Cities Database.

We used the principal component analysis to summarize the information presented in the original dataset. The typologies considered was apartments, lofts, kitchenettes, houses, condominiums houses, terraced houses, commercial offices, offices, stores, commercial points and hangars. Each typology has two possible situations: for sale or for rent. The set of variables was very detailed, containing information such as price per square meter, number of rooms, number of bathrooms, parking space, percentage of offers that accepts financing in the municipality, value of municipal tax ("IPTU"). This latter variable was not used due to a number of missing data or absurd values. These typologies combined with the category for sale or for rent led to 27 variables, which represented the median value for these variables – the average was not used due to extreme values. Hence, PCA was a useful tool to synthesize so much information.

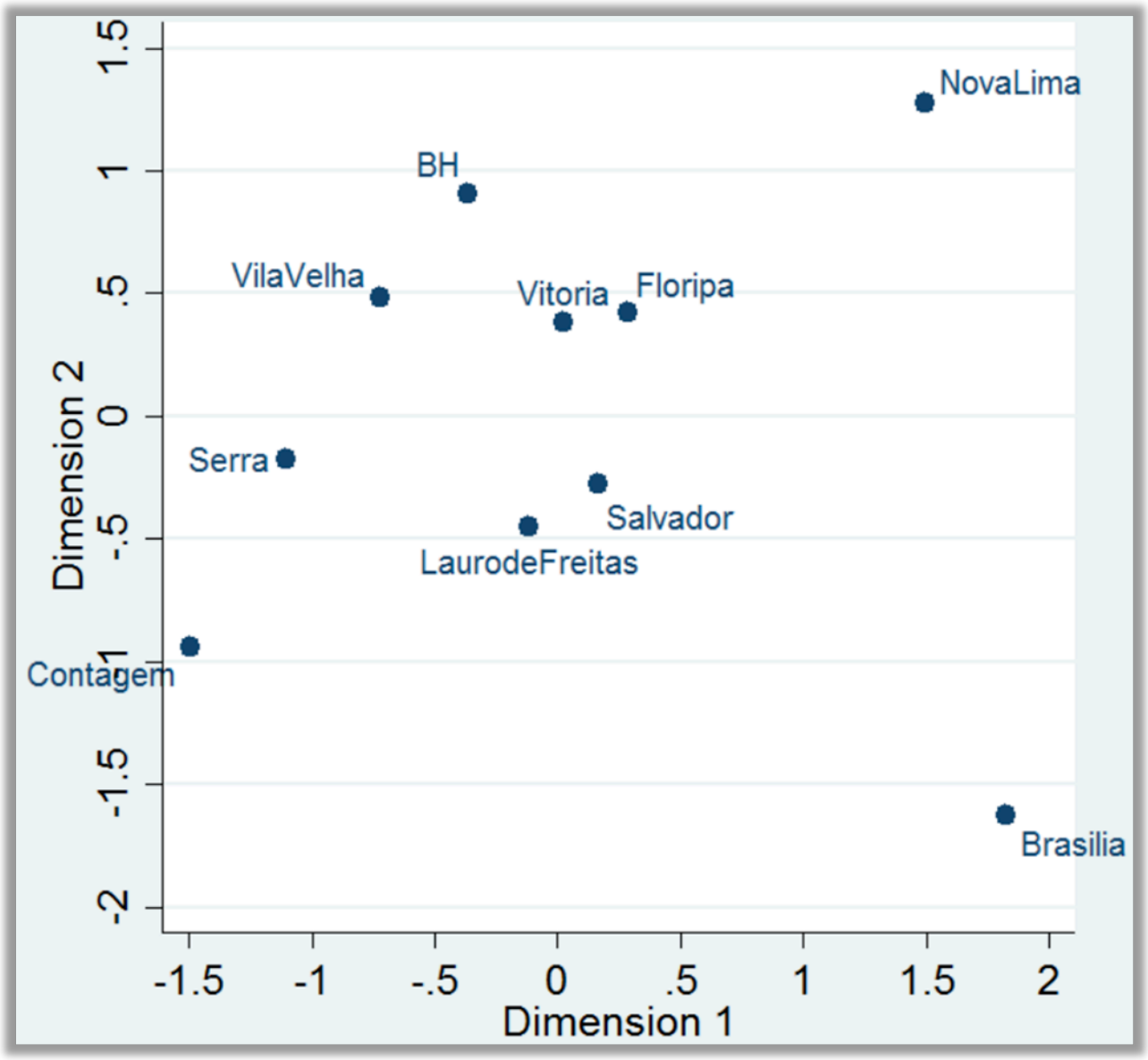
After using PCA, we selected three components, which explained around 72% of the total variance. Figure 5 shows the variables and municipalities graph for two dimensions. Unfortunately, Águas Claras had no offer for renting houses, what made the software (Stata) to exclude it automatically. Because of the number of variables used, PCA generated a hard to see graph. Therein, it is useful to see it together with Figure 5, which depicts the same graph without the variables.

Figure 3 – PCA: variables, cities and two dimensions – Brazil (2016)



Source: Authors.

Figure 4 – PCA: cities and two dimensions – Brazil (2016)



Source: Authors.

In this scenario, Figures 5 and 6 illustrate distinguishing features of the selected metropolises' real estate market. The dimension 1 carries information regarding prices and rents as well as real estate physical characteristics, such as number of bedrooms, number of bathrooms and number of suites. It is possible to say that the cities with the highest prices per square meters for residential uses have highest values in this dimension (horizontal axis). It is the case of Brasilia and Nova Lima. The former is the Brazilian capital city, and its dwellings are described as expensive houses in the so-called "*Plano Piloto*", mainly in the Lake North and South. Nova

Lima became, after the 80s, a privileged space for Belo Horizonte's elites who decided to live in a house in a gated community (ALMEIDA, 2015; COSTA et al., 2006; COSTA; PERNA, 2015). On the other side, cities such as Contagem and Serra are industrial cities, where dwellings are produced for middle class residents. Moreover, these cities still have poor areas, and the self-construction still being relevant.

The vertical axes, dimension 2 in Figures 5 and 6, carries information about apartments and stores. It is possible to say that it is an indicator of cities' verticalization. Belo Horizonte is well known for its density (more than 7000 residents per kilometers square). This verticalization sprawl to Nova Lima's borders, with a new centrality – "*Seis Pistas*" and "*Vila da Serra*" – having expensive apartments in tall buildings. That is why Nova Lima has both expansive houses (more distant from Belo Horizonte) and expansive buildings (in the border with Belo Horizonte). On the other hand, Brasília has few apartments to offer and houses are predominant. This configuration is one of the reasons that led Águas Claras to be occupied almost exclusively for buildings. Industrial and suburban cities, such as Contagem, Serra and Lauro de Freitas are less verticalized, as it is natural to expect to these sort of cities.

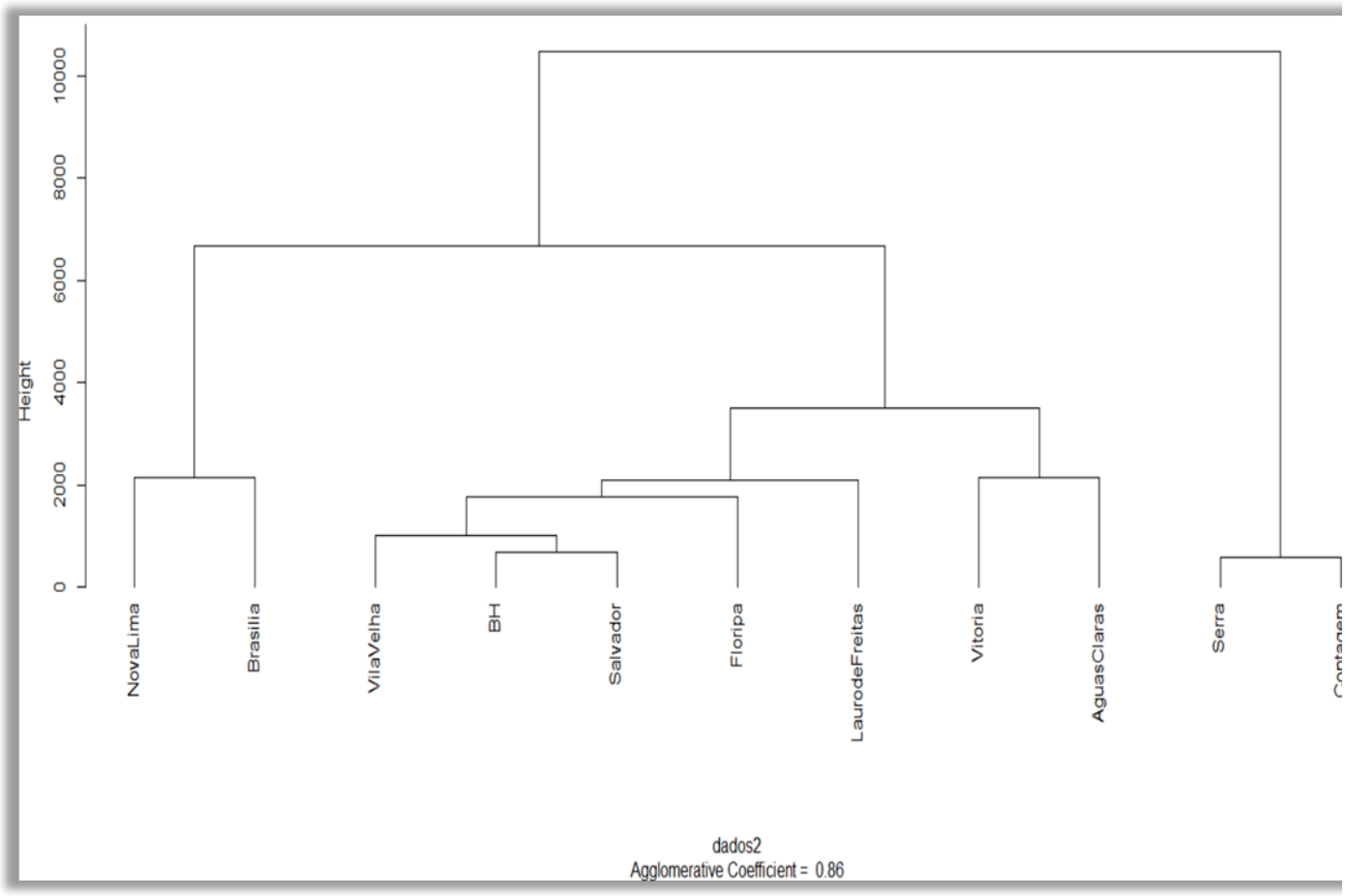
Moreover, this dataset shown some others interesting characteristics of real estate markets in these locations. Vitória and Florianópolis are quite similar. Both are capital cities, islands, located in the state with the lowest GDP and population of its region (Espírito Santo, in Southeast, and Santa Catarina, in South). Both have expansive houses, apartments and commercial spaces. Furthermore, the relation between Vitória and Vila Velha, and between Salvador and Lauro de Freitas, are similar. The non-capital cities are less expansive.

The percentage of financing variable brought another interesting result. One could expected that high income suppliers would be more used to deal with financing, but the result is the opposite: less rich cities have a higher proportion of real estate that accepts finance. In this case, the comprehension of it is straightforward. Since people have lower incomes and wealth, they are not able to buy without financing.

From Figure 6, it is natural to classify these similarities through a cluster analysis. To do this, we employed a hierarchical cluster, since we did not have previous suggestion of how many clusters we would have. Considering the full information provided by the dataset helped to have a better understanding of the similarities among these cities – better than just look in the PCA

two-dimensional graph. We used the Ward method and 27 variables. The agglomeration coefficient was 0.86.

Figure 5 – Hierarchical Cluster – Brazilian selected Cities (2016)



Source: Authors.

Figure 7 shows the dendogram or tree map for the hierarchical clustering of the selected cities. As mentioned above, Serra and Contagem, metropolitan industrial cities, have similar real estate markets. On the other extreme, Nova Lima and Brasília illustrates cities occupied by the elites, who lives in fancy houses and in some cases, expensive apartments. Vitória and Águas Claras are small area cities where the elites and the middle class lives in relatively expensive apartments. Vila Velha, Belo Horizonte, Salvador and Florianópolis have both houses and apartments. As the most populated city in each respective metropolitan region, they still having in the same territory a diversity of dwellers. Moreover, they are locally high demanded places for

stores and commercial rooms. Finally, Lauro de Freitas might be clustered together with these cities, although it has a lower position in the ranking.

4. Balassa and Samuelson meet the cities: affordability and the determinants of real estate price

This section uses the coefficients obtained in the previous section through PCA to make regression analyses on real estate prices. Furthermore, it introduces the theoretical discussion of how different levels of productivity affects non-tradable goods *within* a country, and not between countries, as proposed by Balassa's and Samuelson's seminal works. Hence, we first present the theoretical framework and secondly we discuss the estimation analysis.

Let the real exchange rate between two countries be:

$$\varepsilon = \theta \frac{P_I}{P_{II}}. \qquad (1).$$

In (1), ε is the real exchange rate, θ is the nominal exchange rate, P_I are the prices in the country I, and P_{II} are the prices in the country II. Obviously, the ways to measure each of these variables varies and we can use different types of price indices. In these terms, Balassa (1963, 1964) essentially argues that the real exchange rate is explained by the ratio of productivity in the countries. In other words, although in (1) the ratio presented is that between the pair of countries' prices, he sought a third variable (productivity) to explain what determines the exchange rate.

Balassa (1963) shows a series of three regressions in which the explained variable is the exchange rate, and each of these regressions brings different covariates: ratio of productivities, ratio of salaries and ratio of production costs (between the United States and the United Kingdom for 1950). The conclusion is that the ratio of productivity is the explanatory variable most relevant to explain the exchange rate, and the other two were not statistically significant at the 5% level of confidence depending on the specification.

Balassa (1964) focuses more directly on the question of the doctrine (and he uses exactly this word) of purchasing power parity (PPP). This doctrine has two formulations presented by the author. In its absolute version, PPP states that the ratio of prices of consumer goods for any pair of countries should tend to the equilibrium exchange rate. In its relative version, PPP doctrine states that changes in relative prices of a pair of countries indicate the need for adjustments on the exchange rate.

A weakness of the PPP doctrine is that it is based on so-called "Law of One Price", which, in turn, is based on the possibility of free factor mobility. More precisely, it relies on the belief of the freely arbitration between countries. This may be true for consumer durable goods, but it certainly does not apply to the case of services. The originality of Balassa's (1964) work lies on including services in the analysis. The main implication of this inclusion became known as the Balassa-Samuelson effect: countries with higher productivities have higher prices of services. Authors generally measure productivity through GDP per capita, indicating that higher incomes per capita are positively correlated with higher levels of services prices.

All this discussion might stand to countries, but what about cities? They obviously have different levels of productivities, but within the same country, the exchange rate is the same. Therefore, the productivity gap needs to be reflected by others ratios of prices – not the one measured by the ratio of the currencies. Moreover, among the non-tradable goods, the real estate assets are the ones with the highest prices. On the other hand, real estate prices are not included in regional prices indexes, which only include fragile estimations of rents. It means that the real estate prices are the most relevant non-tradable goods, although regional prices index does not include these goods. Then, the question we discuss through the econometric analysis is: do the real estate prices reflect the productivity gaps among cities? The hypothesis herein is that real estate prices reflect it, because they act such as an intra-national exchange rate.

To answer this question, the dataset used in this paper provided a set of 34445 observations of real estate prices in 10 selected cities mentioned in the previous section[3]. We used income per capita as a measure of cities' productivity. To control for other effects, we included the characteristics of the real estates, summarized through the PCA three components. Component c1 carries information regarding physical characteristics mainly for houses, such as the existence of suite, the number of bathrooms, bedrooms and parking spaces, and apartments rents and prices. Component c2 synthesizes information about apartments' for renting physical characteristics. Component c3 synthesizes, mainly, the variables regarding the percentage of financed houses and of financed commercial locations. We included population as another control, something to capture market potential effect over prices. IBGE provides both population (2015) and income per capita (2013) information.

[3] We excluded Águas Claras because it does not have components generated by PCA analysis.

In the regression, the dependent variable was real estate price, and the explanatory variables were c1, c2, c3, income per capita and population. The model included a constant. All these variables were statistically significant at 1% level. Due to the evidence of heteroscedasticity, which was indicated by the White's test, the estimation used a robust variance-covariance matrix.

Table 2 – Real estate prices' estimation – (2016)

Variable	Dependent Variable: price
c1	100701.80***
	(0.00)
c2	27272.26***
	(0.00)
c3	-150391.10***
	(0.00)
Income per capita	2.80***
	(0.00)
population	0.05***
	(0.00)
constant	348525.20***
	(0.00)
R^2	0.06
n	34445
Note: *** indicates that a variables was significant at a 1% level	Parenthesis informs the standard error.

Source: Authors.

Table 2 indicates that all the variables had the expect signal. Components c1 and c2, which indicates characteristics of houses, apartments and commercial locations, had a positive signal. Component c2 had a much lower marginal effect (around 27 thousands reais) than c1 (around 100 thousands reais).

Regarding the hypothesis of an "intra-national" Balassa-Samuelson (BS) effect, the income per capita coefficient had a positive signal, indicating that the higher the income per capita, higher the real estate price – exactly the interpretation we gave here to the application of BS effect. The marginal effect indicates that each R$1 increasing in cities' productivity leads to an increase of R$2.8 in real estates' prices. Considering the income per capita shown in the Table 1, it is a reasonable coefficient number, since the income per capita of these cities varies between around R$18 thousands and R$110 thousands per year.

Resident population had also a positive signal, as well as a much smaller coefficient. In this case, it is important to remember that all these metropolitan regions have more than 1 million people, and some cities have more than 2 million (Salvador, Belo Horizonte and Brasília). The constant value also might have an interesting interpretation. In the absence of all the other variables, it indicates that the average price of a real estate in this sample would be around R$350 thousands. From a theoretical point of view, this number would indicate the *absolute rent* of the property (see ALMEIDA, 2015; GUIGOU, 1982). It also might be interpreted as how the city itself generates a collective mass of values, even in the absence of improvements in the characteristics of a real estate. Furthermore, one could interpret it as evidence of agglomeration economies.

From a public policy and citizenship point of view, it illustrates how the affordability discussion still extremely relevant in the Brazilian case, not only in the megacities São Paulo and Rio de Janeiro, but in the secondary and tertiary tier of cities. A median citizen would take several years to buy the median real estate in the formal market, even if she spends the entire income on it. This sheds lights over the question of why the self-construction stills a major feature of Brazilian cities.

5. Conclusions

This paper explored the characteristics and hierarchies of Brazilian urban system of cities. PCA and hierarchical cluster show how the metropolises in the country have a very segmented spatial structure. Specific cities are destined to be the habitat of middle class and poor workers, such as Serra and Contagem. On the other extreme, the construction sector produces high-income neighborhoods for the elites in exclusionary cities, such as Nova Lima and Brasília. It is a clear illustration of the division of labor in the space. The capital cities still having relevant

roles as commercial places and still offering a diversity of real estate properties. This fact is an evidence of how the Brazilian urbanization is quite different of what happened in United States, where the inner cities became a decayed area in many metropolises and the elites flew to suburban cities.

Moreover, the work shows how the productivity of a city correlates with the real estate prices within their territories. This sort of phenomenon has been seen as one of the most often empirical regularities in Economics, famously described as the BS effect. However, the BS effect refers specifically to the relation between countries, and what this paper does is to consider it on intra-national scale.

Further improvements that may be done would include more cities in the sample. In addition, spatial explicitly techniques could be employed to capture spatial effects, such as the neighborhood relation between capital cities and its metropolitan cities. The regression analysis could also include other ways to measure productivity, where the ratio between GDP and economic active population would be a better measure.

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