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The Socioeconomic Impacts of Low Income Housing Programs in São Paulo State, Brazil

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The public policies programs for low-income housing in Brazil started in the 1930s, and most recently the well-advertised program "My House, My Life" by the Federal government had on its goals to improve the quality of life of poor people, to reduce the housing deficit and to foster the economy. The question raised by this paper is how important was the contribution of the program for the economic growth observed in the Brazilian economy in previous years? In a way to shed light on this question, the case of the low-income housing programs in the state of São Paulo is take as an example. The State program being a joint venture among the federal, state and municipal governments. To do so, a specific interregional input-output model is estimated for two regions, São Paulo and Rest of Brazil, with the insertion in the model of 6 different typologies of low income housing, ranging from a single house to building complexes. The impacts are measured in terms of GDP, tax collection and employment in the State of São Paulo and in the Rest of Brazil, showing that depending on the housing typology, the impacts in the economy are different, and that part of the investments made returns to the government in terms of tax collection. As results, the programs affects the state economy system for expanding the demand for inputs for the construction of new buildings (direct effect); demand in other sectors due to the initial shock (indirect effect); and the income of families - as more labor is required and therefore widens the aggregated wage – it extends the demand for goods and services in the economy (induced effect).

Keywords: Low Income Housing; Housing Public Policies; Socioeconomic Impacts; Input-Output; Brazil; São Paulo State.

JEL Codes: R30; R15

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I. Introduction

Construction is an important sector to economic development. This affirmative is supported, for example, when we take into account the construction sector composition in added value, labor absorption and gross fixed capital formation as well as its high participation in the industrial production gross value (Chenery, 1960). Further, this sector provides the public and physical infrastructure to many productive activities in the private sector (Polenske and Sivitanides, 1989). Therefore, the sector is able to influence capital productivity through infrastructure supply and production of capital goods (Hirschman, 1958; and Perobelli, Campos, Lazarini and Valle, forthcoming).

Among the activities of construction sector, is possible to list the construction of hospitals, schools, offices, homes, urban infrastructure (including water supply, sewerage, drainage), roads, ports, airports, railways, energy infrastructure systems, irrigation and agricultural systems and telecommunications systems. Due to the heterogeneity within this macro sector and the multiple approaches possible to be underline, the option in this work is to understand the impact of low income housing in the economy of Sao Paulo (SP) and the rest of Brazil (RB).

Analyzing Brazilian housing issue, housing became a social right only in 2000, by Brazilian Constitutional Amendment 26. However, the Universal Declaration of Human Rights considers housing as a fundamental human right since 1948.

Housing has an important participation in the welfare of individuals and families, not only to the good *per se*, but due to the access to other goods and services that households demand, for example public transport, sanitation, public health and safety. Moreover, better housing conditions has direct impact on long-term human capital (Rothweel and Massey, 2015), which also impacts on firm productivity.

Historically, in Brazil, a plenty of public policies[1] invested in the construction sector in order to improve the infrastructure and to promote economic growth. These efforts allow demonstrating the link between industrialization and urbanization and the construction industry. Specifically in circumscribing the housing issue, we can highlight, across Brazilian economy history, the decree-laws in Vargas period (1930-1945), the *Sistema Financeiro de Habitação*[2] (SFH), *Banco Nacional de Habitação*[3] (NHB) and, most recently, *Minha Casa, Minha Vida*[4] Program (MCMV). All these public policies were promoted at the federal level of government.

[1] Import Substitution Process; Economy Action Program of Government; "Goals Plan" (Plano de Metas); I and II Nationl Development Plan (Plano Naiconal de Desenvolvimento – PND); Growth Accleration Program (Programa de Aceleração do Crescimento – PAC); "My House, My Life Program" (Programa Minha Casa, Minha Vida – MCMV)
[2] In free translation: Housing Financial System.
[3] In free translation: National Housing Bank.
[4] In free translation: My House, My Life Program.

Although public policies promoted at federal level may have multiple foci on the range class, the creation in 1949 of *Companhia de Desenvolvimento Habitacional e Urbano*[5] (CDHU) was focused on low-income housing at the state level (São Paulo). In the period 1966-2014, the CDHU released 330.621 low-income house units (HU) using public funding as subsidies. In 2009, the CDHU built 27.927 UH (Brasil, 2009).

These kind of public policies aim to reduce housing deficit in the country. According to Census (2010), 84% of Brazilian population lives in urban centers, which deepens the need for targeted policies to the housing issue. For the Sao Paulo municipality, 1% of the population lived in slums in 1970 and in 1995 this figure increased to 20% (*Instituto da Cidadania*, 2000). According to Lima Neto, Furtado and Kruse (2013), the composition housing deficit in Brazil is concentrated mainly among the most vulnerable families, that is, 73.6% of the total deficit corresponds to households with up to three minimum wages. Meanwhile, for the range between three and ten minimum wages, the composition is 21% of the total housing deficit. These data are for the year 2012, where the total deficit of the country was at a level of 5.53 million households.

Highlighted the house importance and housing deficit concentration in the most vulnerable families, this research is relevant due to the proposes of an inter-regional input-output model underlining low-income housing by typologies (e.g., apartment with and without elevator, simple house, low-income house complex and low-income buildings complex with and without elevators). The already existing researches in input-output literature have focused on macro-construction industry without concerns about the activities heterogeneity inside the construction sector, such as infrastructure, real estate (house of different standards, corporate, sheds, etc.), maintenance and repair, etc. Seeking to overcome this fragile, in this paper we propose to provide focused and detailed information about housing typologies.

A necessary condition to justify the application of public policy is it has real effects on market outcomes. Taking this into account, the mainly objective of this research is to answer: a) what is the impact on jobs, production, taxes (ICMS[6] and IPI[7]) and GDP? Further, is possible to answer: a) what is low-income housing interaction structure among the other productive sectors of the economy? and b) what is the spillover to the rest of the country when Sao Paulo state invests in low-income housing?

To be able to answer these questions, we will use Brazilian inter-regional input-output matrix for 2009 year. According to Bon (1988), the use of input-output modelling becomes important to provide a structure able to study the direct and indirect resource as well as their interdependencies.

[5] In free translation, Housing and Urban Development Company.
[6] It is a state tax that charges on goods and service circulation.
[7] It is a federal tax that charges on industrialized goods.

This methodology allows evaluating the sector under three ways: a) potential for job creation; b) role in the economy and c) identification of the supplier structure.

In addition to this introductory section, the paper is organized in five sections. The next section provides a brief review of the literature, emphasizing the micro and macroeconomics focus. The third section is a short historical overview of low-income housing and of public policies implemented at federal level and at Sao Paulo state level. The fourth section provides the input-output, generators and linkages methodology to evaluate the low income housing industry. The fifth section is reserved for discussion of the results from the modeling proposed. In the last section, some final remarks and possible extensions are made.

II. Housing market: a brief review of the literature

Public policies directed to the housing sector have been the focus of a series academics search. Some reasons have been raised as justification for interventions in this sector are macroeconomic or microeconomic policy order.

Under microeconomics order, Hirschman (1958) points out the relation between social fixed capital (public investment) and directly productive activities (private investment). In the economics literature is well-documented that housing bottlenecks directly affects firms' productivity. In this sense, housing correlates the labor market access to labor supply and provides access to goods and services in urban areas (Alonso, 1964; Muth, 1969; Mills, 1967; Fujita and Ogawa, 1982; Anas and Kim, 1990).

Further, the accesses to house goods is too expensive. Quingley and Raphael (2004) point out the average family spend 25% of their incomes on housing. Thus, this good has a large proportion on household budget and large proportion of population in urban areas faces some restriction to have access to good places for living. Murray, 1983, 1999; Susin, 2002 and Sinai and Waldfogel, 2004 pointed out the impact on the stock and on the house construction by private market in United States due to housing public policies developed by the federal government[8].

Other authors drove the focus of housing issues for an aggregated evaluation analysis, e.g., macroeconomic order. Greenwood and Hercowitz (1991) point out to the high share of the residential stock compared to business capital, and to the high participation of housing industry investment on the American total investment. Leung (2004) wrote a survey considering the role of housing and its relationship with macroeconomics issues. Taxes and housing are one of the points that literature has expended efforts. The justification to this field of analysis stems from the

[8] The housing American program is based on vouchers mechanisms for rent payment of low-income families. Instead of, the housing Brazilian program under analyses in this research, low-income families receive an allowance to purchase personal houses.

importance of good in government budget, due to the magnitude and immobility of real estates. Volatility and business cycles are other issues evaluated by this approach. Some researchers have paid attention to the effects of quantity variation and cycles and to issues related to price volatility. Other important section in the survey is long cycles in the real estate.

Microeconomics approach has given greater focus on affirmative policy mechanisms developed by government. The research set within macroeconomics order, even though they have based on theoretical general equilibrium models, empirical approaches have been based on partial equilibrium methods. Few academics papers have considered empirical methods able to evaluate the impact on the economy system when housing public policy is applied.

Considering empirical methods of general equilibrium (such as input-output model), international literature (and the Brazilian literature) has focused primarily on construction industry, disregarding all inherent heterogeneity, as pointed out in the introductory section.

Thus, the academic articles can be divided into two mean categories: first, those who seek to understand the internal structure of the country's economic system and the relationship between construction industry (as a whole) and other sectors of the system (Bon, 1988; Rameezdeen et al., 2005; Texeira and Carvalho, 2005; Texeira, 2008) and second, those that aim to understand the stage of development which is the economy (Bon and Minami, 1986; Bon and Pietroforte, 1990; Bon, 1999; Bon, 2000; Song et al. 2005; and Ilhan and Yaman, 2011; Perobelli, Campos, Lazarini and Vale, forthcoming).

Although Pietroforte and Bon (1999) and Pietroforte, Bon and Gregori (2000) do not identify the typologies of housing, theses authors taken into account the division of construction macro-sector after split this sector into housing sector and rest of construction industry. In this approach, the construction sector is subdivided, including in the input-output matrix the housing subsector and non-residential sector (complementary part after disaggregate the macro-construction sector). These studies evaluate the role of construction in economy of Italy.

In the first study, the authors make a historical assessment of the housing sector, considering an input-output system with seven sectors (agriculture, manufacturing, services, transportation, and government, housing and non- housing) for the years 1959, 1965, 1975 and 1985. As a result, they point out to the low backward linkage (0.2 to 0.6)[9] and low forward linkage (0.05 to 0.1)[10] to the housing sector over the years. Type I multipliers of GDP are between 1-1.2 throughout the study period.

[9] Lower and upper bound backward linkage through the years.
[10] Lower and upper bound forward linkage through the considered years.

Considering the regional heterogeneity in Italy, Pietroforte, Bon and Gregori (2000) fit the input-output model to north and south region of the country. The authors use two input-output matrices separately, taking into account just seven sectors (agriculture, manufacturing, services, transportation, and government, housing and non- housing). As result, backward linkage ranges between 0.46-0.54 (north region) and between 0.46-0.56 (south region). In terms of forward linkage, it ranges between 0.03-0.10 (north region) and between 0.03-011 (south region). The GDP multipliers range between 2.07-2.22 (north region) and between 2.22-2.42 (south region).

The authors stress out some factors that justify the low backward and forward linkage in Italy economy: significant inflationary difference between labor and cost of input; low rate of investment in construction equipment; growth of labor-intensive feature of this subsector and geographical dispersion and small projects that inhibit gains from economies of scale and investment in mechanization and prefabrication. Already low forward linkage indicator stems from the fact that the construction of housing consumes intermediate goods and produce directly to final demand (Pietroforte and Bon, 1999). This indicator is supported by the empirical literature (Bon, 1992; Pietroforte and Bon, 1999), that is, the forward linkage tends to be greater just in developed economies due to increasing demand for maintenance and repair.

III. Background and Mechanisms of Housing Policies in Brazil and São Paulo State

This section is reserved for discussion of public housing policies, shedding light on the mechanisms and channels used to promote social housing. Shortly we discuss the policies developed by the Federal government since from the Old Republic (1889-1930) to the present MCMV Program. Later, the focus is on the social housing policies in the state of São Paulo and on how federal policies have been linked to state public policies.

In the period of the Old Republic, public policies related to housing were mainly driven by market mechanisms (Rolnik, 1981). From the 1940s of last century, the federal government creates the *Fundação Casa Popular* (FCP)[11] to develop public policies to encourage low-income housing supply (Bonduki, 1994) (Brasil, 2011). Such policies were related to training strategies and to strengthening the urban-industrial society (Oliveira, 2002).

From 1964, housing policies proceed in a more structured way: creation of the SFH, the *Banco Nacional de Habitação*[12] (BNH) and the *Fundo de Garantia do Tempo de Serviço*[13] (FGTS). Since 1970, the interest rate spread imposes some restrictions on the credit supply targeted to low-income market and it discouraged the public incentives (Yoshimura, 2004).

[11] In free translation: Low-Income House Foundation
[12] In free translation, National Housing Bank.
[13] In free translation, Guarantee Fund for Employee. This fund is compounded by taxing worker salary in a rate of 8%.

The crisis in the late 70's directly impacted the balance of SFH. In 1986 the BNH was abolished and its functions were redistributed among ministries, banks and advices. In 1986-2003 interregnum several changes occurred with regard to public policies directed to housing (changes of ministries and different performances of the bank *Caixa Econômica Federal* - CEF), but little has been directed by the direct initiative of the federal government (Brasil, 2012). This was a period of macroeconomic instability (inflation, external vulnerability, deficit of public accounts) and political crisis (impeachment of the president in 1992). In 1994 the shortfall estimated at SFH was 20 billion dollars (Azevedo, 1996 apud Yoshimura, 2004). As result, the two housing programs, *Habitar-Brasil* and *Morar-Melhor*, launched in the period 1994-2002 did not meet the expectations due to fiscal adjustment of macroeconomic policy.

It is from 2003 that the housing sector back to have visibility at the federal government level. In the same year the Ministry of Cities was created and, in the next year, was approved the *Política Nacional de Habitação*[14] (PNH). These new public policies constitute an enlarged and integrated concern for the urban development of cities. The objectives of PNH are, in general, universal access to housing, promote urbanization, regularization and integration of precarious settlements, strengthen the state's role in the management and regulation, make the priority housing issue at different levels of government, expand productivity and improve the quality of housing production and encourage the generation of employment and income (Brasil, 2004; 2011).

Among the financing instruments of PNH, the *Sistema Nacional de Habitação*[15] (SNH) is divided into two, namely, the Sistema *Nacional de Habitação de Interesse Social*[16] (SNHIS) and the *Sistema Nacional de Habitação de Mercado*[17] (SNHM), whose destination of the funding differs depending on consumer income and developer resources (Brasil, 2012). While the first one has focused on low-income consumers (up to three minimum wages), the second one focuses on families with higher purchasing power and therefore have access to the private market. The CEF was in charged to transfer the resources related to PNH, according to Decree Law 6.962 of September 2009.

This entire institutional framework started from 2003 is strengthened in 2007 with the creation of the *Programa de Aceleração do Crescimento* (PAC I)[18]. The housing sector stands out because of the objectives of the PNH and the interest in encouraging the construction sector to stimulate

[14] In free translation, Housing National Policy.
[15] National System of Housing (in a free translation).
[16] National System of Social Interest Housing (in a free translation). Under this new regulation mark, the states, municipalities and Federal District should create a housing fund for social interest and should elaborate a housing plan in your sphere management to have access to federal fund – FSHIS – (Federal Law, nº 11124 – June 16th, 2005).
[17] Market National Housing System (in a free translation). The main developer of this market is the Brazilian Savings and Loan System.
[18] Growth Acceleration Program (in a free translation). It is an investment program developed by the federal government and it has been used as countercyclical policy.

economic growth. In the same period, the real estate credit back to be part of the private bank credit line, mainly due to increased legal certainty[19]. In short, PAC becomes the mechanism that submits to your order all infrastructure programs, including FNHIS.

Within this context of social policy, MCMV I program[20] comes into force in 2009 and it was not linked to PAC I Program. Subsequently, in the second phase of the program (MCMV II), it becomes part of the PAC II[21]. In general, the MCMV I aims to implement the PNH, in SNHIS or SNHM aspect. The funding source to finance this program is the federal Treasury, but the MCMV has received resources from FSHIS (Bonduki, 2009; Balbim, Krause and Lima Neto, 2013; Costa, 2013).

During these two phases of MCMV, the credit provided by direct subsidies followed household income rules and the credit amount for the purchase of residential properties was increased as well as the house value eligible to be subsided. At the same time, cutting in the interest rate was possible due to the creation of the *Fundo Garantidor da Habitação*[22] (FGH). This fund has the function to cover eventually default in case of unemployment or other occurrences (Cardoso, Aragon and Araujo, 2011), reducing the uncertainty on the loan.

Given this digression on the housing policy at the federal government level, it is essential to consider the state level public policy measures and to underline the relationship between the federal and state level housing policies. For state level of analysis, the discussion is restrict to social housing, given the focus of this research.

Oliveira (2002) points out that the housing policy developed by the São Paulo state government had been integrated into the national housing system until mid-1980. Evidently, the macroeconomic instability period had declining impacts on low-income housing policy in the state level. Due to the fragility of the state housing policy and the administrative discontinuities, added to the low degree of planning and weak integration with other urban policies, local practices have been strengthened with regard to combating housing deficit (Cardoso, Aragon and Araujo, 2011).

Under fostering low-income housing policy, in 1949 the state of São Paulo created the so-called CDHU. CDHU is a state government company and it is linked to the Housing Department. From the point of view of financing, Oliveira (2002) divides the CDHU financial history in three stagThe

[19] Federal Law nº 10.931/2004.

[20] This program is managed by the Ministry of Cities and operated *by Caixa Econômica Federal* bank. The program seeks to subside low income families up to R$ 1600,00 (in the first phase of the program). MCMV program was created by Provisional Measure No 459 in 15 March 2009. The program was regulated by the Decree No 6819 in 14 April 2009 and in 7 July 2009 it became a law (Federal Law 11917). In 2011 the second phase of MCMV program was launched (MCMV II) – Federal Law 12424 in 16 June 2011. In this last phase, the subside was drive to low income families with monthly income up to R$ 4600,00. Other important extension of the MCMV II is to provide subside to housing improvements. Is important to underline, in this research we are focus on the MCMV I.

[21] The MCMV II is one of the six axes of PAC II.

[22] Guarantee Fund Housing (in a free translation).

first one (1967-1983) was linked to the federal apparatus; the second one (1984-1989) is considered as a transition period, and the third one (1990-2000) binds the housing finance to state resources. In this last phase, the state funds stemmed from the rise in state taxation on services and goods (from 17% to 18%)[23] and from the determination of opening extra credits to the capital increase of *Caixa Econômica do Estado de São Paulo*[24] (CEESP), according to the State Law 6.556 of November 1989. Additionally, funds from the State Treasury (General Revenue of the State) and alternative financial instruments, such as Housing Lottery. All these mechanism composed the CDHU housing fund.

From the mid-2000s, house supply and financing of low-income housing in the state level faced with the return of development to public housing policies driven by Federal government, such as programs related to PNH and MCMV. In this context, the State Law 12.801 of January 2008 establishes the necessary conditions for the implementation of state housing policy in states. Thus, the institutional process had been established after the creation of the *Conselho Estadual de Habitação*[25] (CEH) and *Fundo Paulista de Habitação de Interesse Social*[26] (FPHIS), allowing the state to have access to FNHIS resources (federal resources).

Although the federal government has created funding mechanisms to low-income housing as aforementioned, the share of federal source in the estate fund does not exceed the 8% mark. In term of financing source composition, the resources derived from the PAC/FNHIS represent 7.2% (2010), 7.4% (2011), 4.4% (2012) and 1.5% (2013). The share of state level resources is 78%, 75%, 78.3% and 84.6%, respectively. The complementary part of this composition is resource derived from other sources, such as the Housing Department, the Inter-American Development Bank, the Credit Operation and Bank of Brazil (this bank only had contributed in 2013). In monetary terms, the total amount allocated in CDHU fund for each of those years, in current price, were US$ 728.9 million, US$ 8813.7 million, R$ 586.7 million and R$ 473.1 million, respectively (Brasil, 2015). These funding compositions demonstrate the low-income housing policy dependence to São Paulo state financial recourse.

Clearly, the discussion about housing public policies are associated with the housing deficit issue. Thus, the housing policies developed in Brazil have taken parallel to the urbanization of cities (Valladares, 1983). This process accelerated since 1950 with the rural exodus, the acceleration of industrialization and fast population growth in Brazil. This process required the expansion of housing supply (Santos, 1999; Cardoso Melo and Novais, 1998). Regarding the state of São Paulo,

[23] This increasing of 1% was set to finance public housing, which became known as ICMS-Housing. ICMS is the Portuguese acronym for Imposto sobre Circulação de Mercadorias e Serviços. This tax is levied on the circulation of goods and services in Sao Paulo only. In 2000 the collection was around R$ 780 million – current prices.
[24] CEESP was a public bank and it does not exist anymore.
[25] State Housing Council (in a free translation).
[26] Sao Paulo State Fund for Social Housing (in a free translation).

the heavy inflow of migrants made the annual migration rates above the national average between 1930 and 1970 (Cano, 1997).

About the migration process and public housing policies, Bonduki (2009) indicates for a not focused policy along BNH period (1964-1986) and along 1990s housing programs. During this period, the measures were not able to act on reducing the concentrated housing deficit among lowest-income families (up to three minimum wages). In the interregnum from 1994 to 2003, only 8.4% of the funds were directed towards for lowest-income families and in this band was concentrated 83.2% of Brazilian housing deficit in this period (Bonduki, 2009). Between two MCMV phases, housing deficit decreased from 5.59 million households (2007) to 5.52 million households (2012). According to Lima Neto, Furtado and Krause (2013), this reduction is simultaneously to the increasing in the total number of housing in the country.

In a recent assessment of the state of São Paulo, in 2007 the total housing deficit (absolute) was 1.10 million households, while the relative deficit (total deficit divided by total households) was 8.8%. In 2012, the total deficit amounted was reduced to 1.11 million households and the relative deficit rate decreased to 7.9%. Thus, the expansion of the total housing deficit was 0.6 % and the fall of the relative deficit was 10.2 %. In this context, is possible to notice the existence of consumer for absorption of new houses for low-income families due to this high housing deficit rate at state level. However, house supply must be focusing on low-income.

IV. Database and Methodology

a. Database

In this research, we use the input-output matrices from the University of Sao Paulo Regional and Urban Economics Lab. The year in analysis is 2009. In this economics system, the sectorial matrix is divided in 56 economic sectors and is taken into account 80 goods. Is important to say we are using constant prices to 2000. The matrix were built using national accounts from *Instituto Brasileiro de Geografia e Estatística*[27] (IBGE) following Guilhoto and Sesso Filho (2010) and Guilhoto, and Sesso Filho (2005) methodology.

To achieve the proposed objective, we added a new sector in the input-output matrix aforementioned. This sector represents some housing typologies. We split the low-income housing into six housing typologies such as apartment with two bedrooms and elevator (Type I), apartments with two bedrooms and no elevator (Type II), housing complex with elevator (Type III), housing complex buildings with elevator (Type IV), houses complex (Type V) and low-income houses (Type VI). Each one of this housing typology is reflecting the input purchase and production factors payment.

[27] Brazilian Institute of Geography and Statistics

For the construction of housing typologies, we used data from the CEF bank. From these data, it is possible to identify the pattern of consumption of inputs according to housing typology to be built. Additional data come from Brazilian Social Accounts. Table 1 shows the cost structure composition (inputs, labor and other) by house typologies.

Table 1: Share of Input in Cost Structure

House Typologies	Cost Structure			
	Input	Labor	Other	Total
Type I	40.6%	36.1%	23.3%	100%
Type II	39.6%	37.2%	23.2%	100%
Type III	41.0%	35.4%	23.7%	100%
Type IV	39.6%	36.6%	23.8%	100%
Type V	40.8%	34.1%	25.0%	100%
Type VI	37.5%	39.3%	23.2%	100%
Construction sector	49.5%	23.6%	26.9%	100%

Source: Caixa Econômica Federal (CEF)

In the macro-sector of construction, 49.5% of the costs derived from the purchase of inputs and 23.6 % is due to wage payments. The Type III has the highest allocation of resources (41%) on inputs, while the lower share of inputs on the cost structure is due to the construction of Type VI (37.5%). On labor use, the construction of the Type VI demands more resources for wage payments (39.3%), while the Type V faces the lower allocation for labor (34.1%).

Table 2: Input by Typologies

Input	Type I	Type II	Type III	Type IV	Type V	Type VI	Construction
Non-metallic mineral products	30,4%	31,9%	31,2%	32,3%	38,8%	33,9%	35,7%
Wood and Furniture	12,5%	12,6%	11,7%	12,1%	15,4%	20,1%	4,9%
Other metallurgical products	14,8%	17,6%	15,2%	16,6%	14,7%	19,9%	8,2%
Other minerals	5,4%	4,7%	6,3%	5,5%	6,3%	5,9%	4,1%
Rolled steel	6,7%	6,4%	6,4%	7,0%	3,8%	5,2%	7,1%
Electric materials	3,5%	8,7%	3,2%	8,2%	3,7%	4,2%	3,1%
Paints	3,7%	4,1%	3,7%	3,9%	2,6%	3,6%	6,4%
Non-ferrous metal products	1,6%	3,8%	1,5%	3,6%	2,5%	3,4%	0,6%
Plastic articles	2,4%	1,6%	2,3%	1,6%	2,0%	2,2%	4,3%
Electronic equipment	0,3%	2,1%	0,6%	2,2%	4,8%	1,0%	0,3%
Other chemicals	0,1%	1,0%	0,1%	0,9%	0,3%	0,4%	0,6%
Natural yarns	0,1%	0,1%	0,1%	0,1%	0,2%	0,2%	0,0%
Other refining products	0,1%	0,1%	0,1%	0,1%	0,4%	0,0%	1,0%
Total	81,7%	94,8%	82,7%	94,0%	95,4%	100,0%	76,2%

Source: Caixa Econômica Federal and Brazilian Social Accounts

Table 2 shows the main inputs demanded in composition terms for the construction of each of the six typologies aforementioned. The classification of products is in line with the 80 products specified in Brazilian Input-Output System. The Type I and Type III are the typologies with highest

demanding for different goods, while the Type VI has in the thirteen inputs listed in the table all its need exhausted for the construction. In the macro-construction sector, these thirteen leading inputs represent 76.2% of the demanded inputs. These compositions demonstrate the heterogeneity of the building sector in respect of each construction typology and is possible to extend the analysis to the heterogeneity among different construction kinds inside the same macro-sector, as we mentioned above.

b. Methodology

The following interregional model is based on Miller and Blair (1985). Take the superscripted representing the two regions of interregional model, where r and s represent the Rest of Brazil and Sao Paulo, respectively. The matrices Z_{ij}^{rs} and Z_{ij}^{sr} represent intersectoral and interregional intermediate consumption flows, for $r \neq s$; if $r = s$, then the matrices represent intersectoral and intraregional consumption flows. That is, the cash flow of the sector i of region r for the sector j for the region s – when i is the input and j is the output.

The matrix form, assume

$$Z = \begin{bmatrix} Z^{rr} & Z^{rs} \\ Z^{sr} & Z^{ss} \end{bmatrix} \quad (1)$$

Considering Leontief (1965) approach, the theoretical representation of the model is given by:

$$X_{ij}^{rr} = Z_{11}^{rr} + \cdots + Z_{ij}^{rr} + Z_{11}^{rs} + \cdots + Z_{ij}^{rs} + FD_{ij}^{r} \quad (2)$$

Where FD is the final demand and X is the total production.

The regional technical coefficients can be written as:

$$a_{ij}^{nm} = \frac{Z_{ij}^{nm}}{X_j^m} \quad (3)$$

Where, $n = r, s$ and $m = r, s$ are region of the model; a_{ij}^{nm} are technical coefficients of production, representing the ratio of sector j purchasing in the region m from sector i in the region n.

Substituting (3) into (2) the solution of the system is given by:

$$\begin{bmatrix} X^r \\ X^s \end{bmatrix} = \begin{bmatrix} B^{rr} & B^{rs} \\ B^{sr} & B^{ss} \end{bmatrix} \begin{bmatrix} FD^r \\ FD^s \end{bmatrix} \quad (4)$$

Where, $B = (I - A)^{-1}$ is the Leontief inverse matrix that can be partitioned into sub-matrices as discussed above and A is the regional technical coefficient matrix.

To assess the impact of housing typology on employment, wages, output and taxes we will calculate the mean economic indicators in this methodology, such as multipliers type I and multipliers type II.

From the Leontief matrix coefficients, is possible to estimate for each sector of the economy the direct and indirect generated amount of employment, wages, output and taxes (macroeconomics variables) for each unit produced for final demand. Mathematically:

$$GV_j = \sum_{i=1}^{I} b_{ij} v_i \quad (5)$$

Where, GV_j is the total impact (direct and indirect) on macroeconomics variables; b_{ij} is the *ij-th* element of Leontief inverse matrix; and v_i is the direct coefficient on the variable in question (employment, taxes, wages and added values) and it is calculated as $v_i = V_i/X_i - V_i$ is one of these macroeconomics variables.

The ratio between the direct coefficient and its respective coefficient generates the multiplier (MV_i). The MV_i indicates the generated amount (directly and indirectly) of employment, taxes or any other variable for each unit directly created. For example, the output multiplier indicates the output created amount, directly and indirectly, for each monetary unit invested. The multiplier for the *i-th* sector is given by:

$$MV_i = \frac{GV_i}{v_i} \quad (6)$$

The *j-th* sector production multiplier (MP_j) indicates the amount produced for each monetary unit spent on final consumption and it is defined as:

$$MP_j = \sum_{i=1}^{I} b_{ij} \quad (7)$$

When one only considering the demand for intermediate inputs, the multipliers is called type I multipliers. When the household demand is endogenous to the system, taking into account the induced effect, these multipliers receive the name of type II multipliers.

Although multipliers and generators make possible to point out some differences between the regions, the aforementioned mechanism does not explain the regional effects. Thus, is possible to decompose the regional effects of multipliers and generators. This approach allows to point out how much of total effect is spreading within the own region and the how much spillover to the rest of Brazil.

Take the Leontief partitioned inverse matrix (B) partitioned (as in Equation 1). The regional production multipliers are calculated as:

$$M_j^r = \sum_{i=1}^{I} b_{ij}^{rr} + \sum_{i=1}^{I} b_{ij}^{sr} \quad (8)$$

$$M_j^s = \sum_{i=1}^{I} b_{ij}^{ss} + \sum_{i=1}^{I} b_{ij}^{sr} \quad (9)$$

The multiplier can be divided into parts between regions and inter-regional . For example, consider the region r, the spatial decomposition of the effects is given by:

$$\frac{M_j^r}{M_j^r} = \frac{\sum_{i=1}^{I} b_{ij}^{rr}}{M_j^r} + \frac{\sum_{i=1}^{I} b_{ij}^{sr}}{M_j^r} \rightarrow 1 = m_j^{rr} + m_j^{sr} \quad (10)$$

The Hirschman-Rasmussen indices (HRI) calculate the backward and forward linkage in the economy system. Sectors that have the linkages greater than or equal to one are considered key sectors. According Guilhoto and Sesso Filho (2005), backward linkage (U_j) is calculate as fallowing:

$$U_j = \frac{\frac{B_{*j}}{n}}{B^*} \quad (11)$$

Where, B^* is the mean of each element in B matrix; B_{*j} is the sum in the column j in B matrix and n is the sector number.

For the forward linkage calculation, mathematically:

$$U_i = \frac{\frac{G_{i*}}{n}}{B^*} \quad (12)$$

Where, G_{i*} is row sum of Gosh matrix (G) – G is estimated as: $F = \frac{Z_{ij}}{X_i}$.

V. Results

a. Evaluation of generators and linkages

In this section, we show the impacts on the aggregated macroeconomics due to positive shocks on each addressed low-income housing type. The results can be read as responses to US$ 1 million shocks.

Considering the Type I[28], it is estimated that an investment shock in the amount specified above, it generates an increase of US$ 3,283 mi in the Brazilian economy - as shown in Table 3. This effect can be dismembered as direct, indirect and induced multiplier. The first effect arises from the impact generated by the initial shock of US$ 1 mi. The indirect effect corresponds to purchases made in other sectors due to increased house production, i.e., US$ 659,000 are generated in the production of other sectors due to the induced demand. On induced effect multiplier, the economy increases in the order of US$ 1,624 million due to the wage increasing induced.

The estimated total effect on GDP is US$ 1,946 million due to the arising from the expansion of production and household income. Again, the multiplier effects can also be split as described above: US$ 622,000 directly, while US$ 349,000 and R$ 976,000 are the indirect and induced effects.

The impact on state tax revenue (ICMS) is US$ 112,000 and US$ 217,000 on federal tax revenue (IPI). The direct effect is null for ICMS and IPI, it is so common because there is no incidence of taxes on the initial activity of investment. However, the indirect effect generates an increase of US$

[28] The same analysis can be done to the all other typologies.

33.8 million in ICMS revenues and US$ 66.5 billion in IPI revenue. Taking into account the expenditures made from the income-induced by the initial investment shock, the collection of these two taxes rises 7.8% and 15.03%, respectively.

Table 3: Multipliers by housing typologies

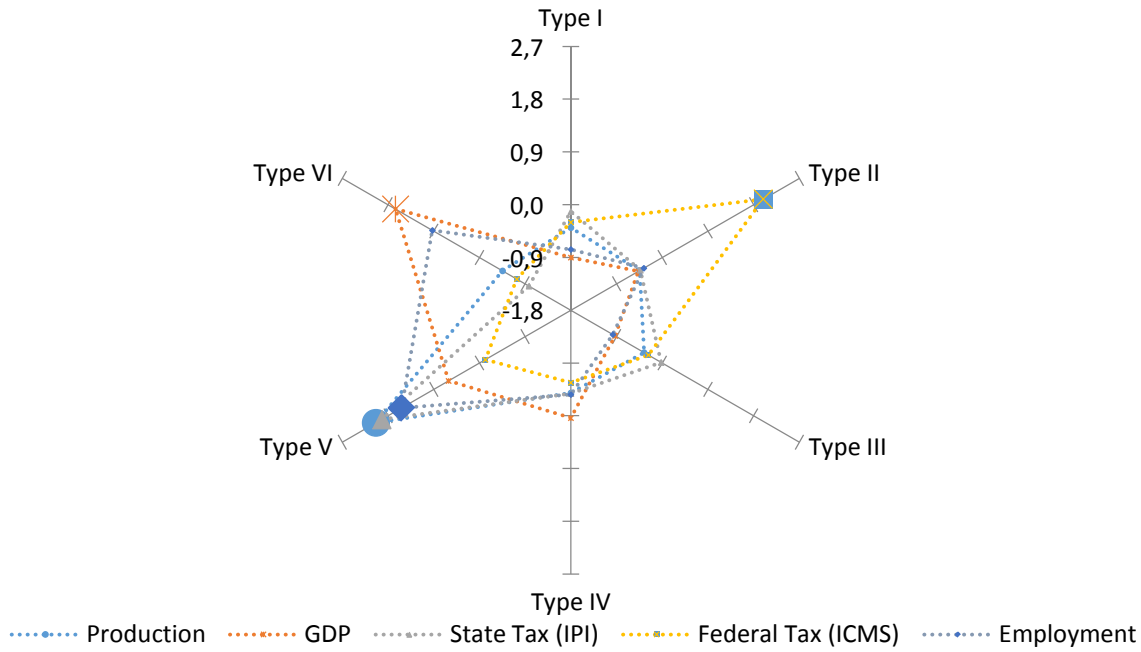
Typology		Impact			
		Direct	Indirect	Induced	Total
Type I	Production	1	0,6590	1,6241	3,2831
	GDP	0,6216	0,3489	0,9755	1,9461
	ICMS	0,0000	0,0338	0,0786	0,1124
	IPI	0,0000	0,0665	0,1503	0,2168
	Employment	222,708	84,599	311,845	619,152
Type II	Production	1	0,6376	1,6334	3,2710
	GDP	0,6317	0,3380	0,9811	1,9508
	ICMS	0,000	0,0331	0,0791	0,1122
	IPI	0,000	0,0961	0,1348	0,2309
	Employment	229,887	81,588	313,193	624,668
Type III	Production	1	0,6709	1,6192	3,2901
	GDP	0,6180	0,3551	0,9726	1,9457
	ICMS	0,0000	0,0341	0,0784	0,1125
	IPI	0,0000	0,0671	0,1498	0,2170
	Employment	218,447	86,699	311,102	616,248
Type IV	Production	1	0,6494	1,6336	3,2830
	GDP	0,6310	0,3442	0,9812	1,9564
	ICMS	0,0000	0,0332	0,0791	0,1122
	IPI	0,0000	0,0640	0,1511	0,2151
	Employment	225,851	85,309	313,500	624,659
Type V	Production	1	1,1629	1,6629	3,8258
	GDP	0,6191	0,3677	0,9760	1,9628
	ICMS	0,0000	0,0350	0,0787	0,1137
	IPI	0,0000	0,0676	0,1503	0,2179
	Employment	236,840	101,064	312,959	650,863
Type VI	Production	1	0,6038	1,6651	3,2689
	GDP	0,6521	0,3221	1,0001	1,9743
	ICMS	0,0000	0,0313	0,0806	0,1119
	IPI	0,0000	0,0600	0,1541	0,2141
	Employment	241,890	81,250	319,355	642,494

Fonte: resultados obtidos a partir da matriz de insumo produto.

On employment generation, 222.78 new jobs are created and it is directly related with housing construction. The indirect effects on the other sectors have an impact on jobs creation, we estimate 84.5 new jobs. On the induced effect is around 311 new jobs. The total impact on labor supply is around 619 new jobs.

For a relative evaluation on housing typologies, Graph 1 shows the multiplier effects on production, GDP, state tax (ICMS), federal tax (IPI) and jobs. To fit the data scale, we normalize all results. Therefore, is possible to compere one typology to the other. As usual, the radar graph point out to the most representative typology for each macroeconomics variable.

Graph 1: Total Generator by Typologies



Source: Results from Input-Output Model

The Type V has the greatest impact on the productive system, the estimating for each US$ 1 million invested generates US$ 3,825 million in the economy production. The GDP responds in greater amounts to investment in Type VI. This result follows from the scale return absence, e.g., house construction has a higher cost of production because demand more inputs. This fact also explains the why complex typologies have lower GDP multiplier.

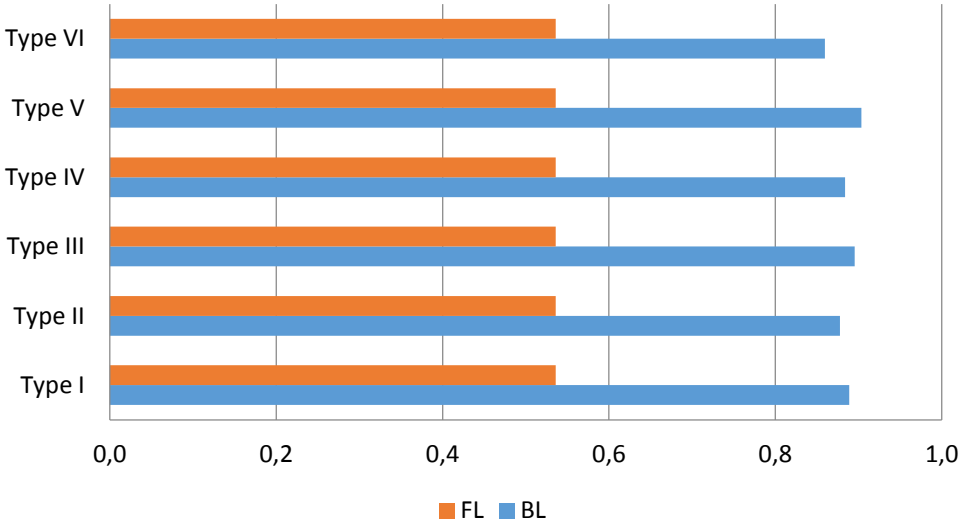
The Type V has the biggest state tax generator. For federal tax, the Type II is the biggest one among all typologies. Importantly, the vertical types (buildings) have greater effect *vis-à-vis* horizontal types (houses). A possible answer to this characteristics comes from the fact that most industrial goods are used in vertical typologies (elevators, for example). Compered between state tax and federal tax, ICMS has greater multipliers than IPI.

Regarding job creation, Type V has biggest multiplier among all typologies. Type V relative advantage in terms of job creation can be justified by allocative structure of production factors, that is, vertical typologies construction need to be built floor by floor – then, the large labor force hiring is not optimal relative horizontal houses hiring. Meanwhile, in a context of horizontal housing is

possible to admit more workers without diminishing returns to scale due to the possibility to construct many houses at the same time.

Is relevant to underline the backward linkage (BL) and forward linkage (FL) to each housing typologies. The biggest BL and lower FL are related to Type V and Type VI, respectively – as shown in Graph 2.

Graph 2: Linkage by typology



Source: Results from Input-Output Model

On FL, all housing typologies have small indicator. Bon (1992), Pietroforte and Bon (1999) points out this characteristic is common in real estate sector due to houses supply is directed to final demand. Among all 56 sectors analyzed in Brazilian economics system, typologies FL raking is always in the last position.

The BL indicator is a measure of inter-sector dependence. None of BL index is greater than one, i.e., all housing construction typologies have low integration (below average) with regarding all other sectors. However, taking into account Sao Paulo economy, Type I has backward linkage greater than iron ore sector (46), public health sector (49), public administration (50) and commerce (53)[29].

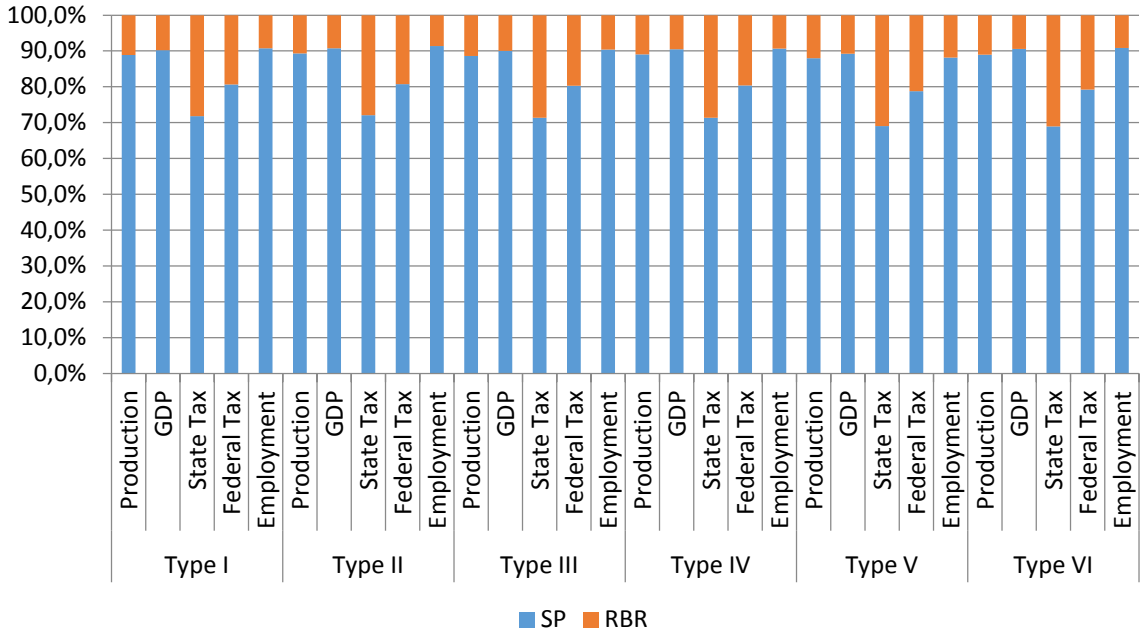
b. Spatial assess from multipliers

The assessment that follows is able to point out investments focalization. As the focus of this work is the economy of the state of Sao Paulo, we evaluate the effects generated due to a positive monetary shock from the state economy. In other words, it is possible to shed light on investment

[29] Number between brackets corresponds to rank position regarding BL index.

extent when it is made by Sao Paulo state and how state investment promotes its own economics growth and/or the rest of the Brazilian economic growth, either by the public sector (public direct investment or tax exemption) or by the private sector.

Graph 3: Regional Multiplier by Typologies



Source: Results from Input-Output Model

From Graph 3 is possible to identify the portion of the generators that is retained in the state economy and the spillover to the rest of Brazil. The absolute values for both regions are obtained by multiplying regional participation (SPR: Sao Paulo region and RB: Rest of Brazil) by the absolute values shown in Table 1.

The output multiplier has the maximum spillover of 25.4 % (Type V) and the minimum spillover is 24.6 % (Type II). By removing the induced effect, the same typologies have maximum and minimum spillover – 12% and 10.6%, respectively.

To GDP multiplier (direct + indirect), Type V has the greater spillover (10.7%) and the smallest spillover to the rest of Brazil is due to Type II (9.2%). When considering the total multiplier, the same housing typologies have the upper limit (24.3%) and lower limit (23.3%), respectively.

The taxes multiplier has the greater values among all estimated multipliers. The estate tax spillover ranges between 31-27% (direct + induced) and 37-36 % (total multiplier). For the first one interval, Type VI represents the upper limit and Type II represents the lower limit. For the second one range, the highest spillover out of the estate economic system stems from the Type V and the lowest spillover is derived from Type II.

Regarding direct and indirect effects on federal taxes, the estimated spillovers are 21% (Type V) and 19% (Type II). By adding the induced effect, the spillover raises to 32% (Type V) and 31% (Type II), respectively.

The greatest jobs creation outside of the state come from the Type V (11.8%). Type II (8.6%) represents the smallest employment multiplier. The total effect becomes the interval more reduced, but the level is greater than before. That is, 32%-31% is the upper and lower spillover bound and it is correspondent to the same housing typologies.

Under all the multipliers estimated, Type V generates lower retention in the state economy. However, when we analyze state tax spillover (ICMS) Type Vi has the greater spillover index. Typology that has the highest retention in terms of output, GDP, tax revenues and employment is Type II. In this case, one can say this kind of housing construction has comparative advantage to retain resources in the state of São Paulo.

VI. Final Remarks

Housing issue can be analyzed under several prisms, passing for macroeconomic issues (inflationary pressure, public policy, etc.), finance issues (reserve assets, real estate funds, etc.) and microeconomic issues (cost shifting, price determination, public policy evaluation, etc.).

Taking into account the housing deficit in Sao Paulo state and most vulnerable income class, is possible to emphasize the residential supply need to lower-income household group. The funds allocated to investments in low-income housing can be justified by its systemic effects on the state economy and on the rest of Brazil. In this work, we underline housing policies (MCMV and CDHU) managed by the federal government and by state government.

At federal level, the MCMV I program covers the investments made between 2009 and 2011. During this period, the federal government allocated US$ 1.43 billion[30] to low-income families[31] (Brasil, 2015) for housing construction. As for investments promoted by the state government (only resource from state source), the spending targeted at low-income housing were US$ 1.17 billion[32] between 2010 and 2011 (Brasil, 2012).

Since the spending database do not specify the housing typologies, we consider for impact exercising the typologies with comparative advantage, i.e., those housing typologies with the greatest estimated total multiplier.

[30] R$ 1.811/USD was the average annual exchange rate used for this period.
[31] When considering the values targeted to groups II and III (incomes between 3 and10 minimum wage), the total amount were US$ 4.02 billion (group II) and US$ 2.61 billion (group III).
[32] R$ 1.718/USD was the average annual Exchange rate used for this period.

First, we taking into account the federal tax multiplier (Type II). The MCMV I investment shock (actual amount invested) contributed to the federal's revenue in around US$ 319 million, with US$ 220 mi generated within the state of São Paulo and US$ 100 million in the rest of the Brazil. However, when the state tax is considered (Type V), US$ 168 million is incorporated into the economic system.

An assessment restricted to revenue and cost and considering the IPI (federal tax) and ICMS (state tax), the results suggest federal government should prioritize the construction of Type II because it has greater effect on its own revenue. However, when we focus on programs developed by CDHU, state government should prioritize Type V due to its power for expanding the state revenue.

Still focusing on investments in the first phase of the MCMV program, we estimated that output, employment and GDP multipliers expand their aggregates in US$ 5.52 billion, 1.7 mi jobs and US$ 2.93 billion (for these exercises we take into account the typologies with comparative advantages in Graph I). Under a spatial assessment, the output spillovers to the rest of Brazil are estimated in US$ 1.43 billion, jobs spillover was 566,041 and US$ 662.6 million spillover in terms of GDP from the shock of MCMV I program applied in the state of São Paulo. The residual parts (total values minus spillover values) provide São Paulo participation on the total generation due to MCMV invested in the state.

Considering the total estimated amount for the state tax revenue, US$ 203.9 million arises from the effect of demand for inputs from other sectors and US$ 186.1 million result from the expansion of family income. Decomposing the federal tax multiplier, US$ 49.5 million derive from the indirect effect and US$ 118.3 million is due to induced effect. On the output multiplier, US$ 1.46 billion and US$ 1.71 billion are the direct and indirect effects, respectively. When we endogenize families in the productive system, US$ 2.44 billion is generated due to wage induction. On the level of employment, we estimated the program had expanded jobs creation in 618,800 (direct effect), the indirect and induced effects are 264,000 and 817,400, respectively. On GDP, the greatest effect is derived from the induced effect (R$ 335.6 mi). The direct and indirect estimated effects were US$ 218.8 million and US$ 108 mi, respectively.

As for state investments, CDHU received R$ 1.17 billion in 2010-2011 period to invest in social housing. For assessing the impact on macroeconomic aggregates, we consider typologies with relative advantages, as aforementioned. It is estimated that the investments made by CDHU presented contribution to federal revenue in the order of US$ 271 mi (SP: US$ 187.4 million and RBR: US$ 80.3 mi – it is the spillover amount). As for the expansion of state revenue (ICMS), we estimated increasing in order of R$ 230 mi. Since 1% of the ICMS tax is intended to finance the

production of low-income housing, it is estimated that the fund was increased in order of US$ 838,100.00 in this biennium.

Spillover issue is so relevant for the state of São Paulo when residential buildings are managed by CDHU, since the construction financing is derived from the state fund in the greater part. Given the ICMS tax revenue generated due to CDHU investments, US$ 50 mi is generated outside the state, i.e. 37.4% of the generated amount spillover into the rest of the country.

For the other multipliers, we estimated the CDHU investments had generated US$ 4.58 billion of output, 1,317 mi new jobs and US$ 2.77 billion in terms of GDP. In spatial term, US$ 1.14 mi, 403.107 new jobs and 547 million were generated outside São Paulo state.

Thus, within the proposed objectives, this paper was able to objectively point out the ability of the economy responses to the different building typologies. Further, it measures the Sao Paulo state spillovers and retained percentage on the state economy.

Besides the main goal, this paper contributes in many ways to the literature. First, an assessment that addresses the effect of general equilibrium, considering the effects of housing policies in a relevant state of Brazilian economic system, is of paramount importance. The object of analysis (housing) also becomes important due to its high share in the consumer budget. In addition, the work helps to provide an assessment that considers not only the heterogeneity of the macro sector as is recurrent in the literature, but it brings to analysis the question about different typologies in the context of public policies and its impact on within São Paulo economic system and on the rest of Brazil.

Therefore, the results and contributions of this research put a new dimension of discussion regarding the assessment of the housing market of social interest. In this context, an agenda to consider the heterogeneity and shed light on the different sub components of the construction macro sector is extremely important for a developing country and it lacks physical infrastructure. Is expected that the results raise researcher questions up and lead them to spend efforts in this direction.

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