

How changes in households consumption and income affects the Brazilian economy: an input-output approach for 2003 and 2009

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Abstract

We aim to analyze the impacts of the Brazilian households consumption and income structure on the sectorial output of the economy. To achieve this, the information of the World Input-Output Database (WIOD), for years 2003 and 2009, were calibrated for 35 productive sectors. The household consumption and income structure were endogenized on the model and decomposed into eight intervals. The information on consumption and household income were obtained through the *Pesquisa de Orçamento Familiar* (POF) and *Pesquisa por Amostra de Domicílio* (PNAD), respectively. The extraction method is used in this study, however, rather than the extraction of a sector, were extracted the consumption and income stratum. Thus, it is possible to quantify how much sectorial and total output of the economy changes due to loss of a hypothetical household group. In this regard, the results allow us to evaluate, in particular, two points: (1) how changes in consumption and income structure, between 2003 and 2009, impact the sectorial output of the economy; and (2) how the hypothetical subtraction of a layer of consumption and income affect the production structure in Brazil. This approach may provide a basis for formulation of policies toward increasing domestic production.

1. Introduction

Brazil is a country historically characterized by high levels of income inequality. Since 2003, with the expansion of cash transfer programs such as Bolsa Família, the benefits to lower-income segments of the population are now perceived in a more evident way, which greatly reduced the income inequality in the country.

In this respect, studies such as Barros (2010), Hoffmann (2009) and Mendonça and Oliveira (2001) perceive a clear improvement in income inequality indicators after the year 2000. While in 2001, the Gini index in Brazil was 0.593, in 2007 this index drops to 0.552. Despite this reduction, inequality in the country remains at high levels. Ferreira

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et al. (2006) point to three key factors for the decrease in inequality in the 2000s. The first factor would be associated to decline in the returns to education, that is, there was a reduction in income inequality between different educational groups. The second reason given by the authors concerns the convergence of household income in urban and rural sectors. Finally, the third factor would be a direct effect of the expansion of government cash transfer programs. Regarding the behavior of income, as pointed out by Neri and Souza (2012), between 2001 and 2011, the lower income groups had higher per capita income growth, and up to the sixth decile, growth was greater than 50%.

It is important to highlight that, these transformations, especially given the income growth of poorest households, were presented in a differently way across income groups. These changes in consumption structures and household income may generate different impacts on the national sectorial output.

Guilhoto et al. (1996), in an analysis of production structures, consumption and income distribution in Brazil in 1975 and 1980, note that the dynamic pole of the economy is concentrated in the consumers with incomes from 5 to 20 minimum wages. Still according to the authors, separate sector strategies have different results in terms of level of production, imports, wages and income distribution.

A research conducted by Almeida and Guilhoto (2006), in turn, investigates the contribution of the different sectors of the Brazilian economy to economic growth and its impact on income distribution. Based on data from the System of National Accounts, the Consumer Expenditure Survey and the National Household Sample Survey, the authors build an input-output table to Brazil for 2002. They simulate exogenous shocks on the demand of each sector in order to determine which one has the highest contribution to economic growth and reducing the Gini index. The results of the study indicate that the sectors that contribute most to economic growth are, in general, distinct from those sectors that reduce income inequality.

Considering giving a contribution on the issue of income distribution in the country, which is still persistent and has affected the consumption pattern of households, the question is: regarding the most recent period, there were significant changes in household consumption, and particularly in the income distributive profile that affected the output of the economy? Brazilian industry production structure are more sensitive to the "loss" of consumption or income?

In the Brazilian literature, there are several studies about the income gap of Brazilian households, who observed only the income indicators. In this sense, this study

presents an improvement by considering an input-output model, using the method of hypothetical extraction, which allows us to investigate the relationship between changes in the pattern of consumption/income of Brazilian households and the output of the economy. This analysis provides a better understanding of the behavior of the income distribution of the Brazilian households and each one of the productive sectors. Thus, the aim of this study is to evaluate the impact of household income on the sectorial output of the economy. Therefore, we intend:

- i) Identify the effects of an hypothetical extraction of income and consumption of different households groups on the total output;
- ii) Check the main changes in the behavior of the dependence of industry production for different family groups, between the years 2003 and 2009.

For methodological procedure, we used the data from the World Input-Output Database (WIOD) calibrated for 35 productive sectors. The information on household consumption were obtained through *Pesquisa de Orçamento Familiar* (POF), and the data were divided into eight intervals⁴. For income, we used eight income levels based on the data of *Pesquisa Nacional por Amostra Domiciliar* (PNAD), for the years 2003 and 2009⁵.

The paper of this *is organized* as follows: section 2 presents the methodology, where we discuss the databases is the extraction method; Comments on the results are shown in section 3; and section 4 presents the conclusions.

2. Methodology

This section initially presents a description of the compatibility of data, based on the World Input-Output Database (WIOD); the *Pesquisa de Orçamento Familiar* (POF); and the *Pesquisa Nacional por Amostra Domiciliar* (PNAD)⁶. In a second moment, we present the analysis method used, which is the Hypothetical Extraction Method.

⁴ The POF (Consumer Expenditure Survey) aims to portray the profile of the living conditions of the population measuring the consumption structures, the expenditures and the household's income

⁵ The PNAD (National Household Sample Survey) aims to portray the basic information for the socioeconomic development of the country, in particular, indicators on the general characteristics of the population (e.g. gender, education, occupation, income, etc.)

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2.1 Compatibility of Input-Output Matrix

We use Perobelli *et al* (2014) procedure to build our input-output matrix. They calibrate the World Input-Output Database (WIOD) for 35 productive sectors, where the household consumption are decomposed into eight intervals based on the POF, and incomes are decomposed into eight groups using the PNAD. The analysis period covers the years 2003 and 2009.

The compatibility between the information of the 35 economic sectors of input-output matrix and POF data was made as follows: first was held the transformation of 10.360 POF products into an aggregate vector of goods and services with 35 rows that composes the household consumption of input-output matrix. Then, was created an input-output matrix that distributed the consumption of the 35 different products into eight families of classes. These intervals were calculated based on percentiles of the GDP per capita (see Table 1).

Table 1. Opening of Consumption Intervals – GDP Per Capita (R\$)

Estratos de consumo		2003		2009	
Household 1	Below	96.00		186.70	
Household 2	Between	96.00	158.87	186.70	297.00
Household 3	Between	158.87	227.66	297.00	422.43
Household 4	Between	227.66	310.41	422.43	570.02
Household 5	Between	310.41	432.50	570.02	767.91
Household 6	Between	432.50	641.23	767.91	1.095.55
Household 7	Between	641.23	1.156.46	1.095.55	1.833.58
Household 8	Above	1.156.46		1.833.58	

Source: Perobelli et al (2014)

2.3 Extraction Method⁷

The method consists on the hypothetical extraction of a sector in the input-output structure. The objective, according Miller and Blair (2009), is to quantify how much the total output of an economy with n sectors is affected if a particular industry is removed from the economy. However, instead of extracting a sector, in this study we will extract the consumption and household income.

This analysis allows us to evaluate how the hypothetical extraction of a stratum of consumption or household income affects the total and sectoral output in the rest of the

⁷ This section is based on Miller and Blair (2009).

economy, that is, according to this approach, we can analyze the importance of family classes for domestic production.

The method allows three different ways of extraction: i) the total extraction of the sector, i.e. the columns and rows; ii) extracting the purchase structure (consumer), i.e., backward linkages, given by the extraction of the columns; and iii) extracting the sales structure (Income), that is, forward linkages, given by the extraction of the lines. In this study, the extraction of purchases and sales structure is used, namely, the effects of backward and forward linkages.

Consider an endogenous households input-output model with n productive sectors and m households in which the matrices had size $(n + m) * (n + m)$. In this context, the model is given by:

$$X = A^*x + f^* \quad (1)$$

Where: X is an output vector with $(n + m)$ elements;

A^* is a $(n + m) * (n + m)$ coefficients matrix of inputs;

f^* is the vector of final demand with $(n + m)$ elements.

In the full model, the solution is:

$$X = (I - A^*)^{-1}f^* \quad (2)$$

where $(I - A^*)^{-1}$ is the Leontief inverse.

The hypothetical extraction of the j -th column of the matrix produces a new matrix A^* represented by $\bar{A}_{(cm)}^*$, corresponding to coefficients of the inputs given the hypothetical extraction of the m -th column of the matrix A . The subscript m represents the extraction of household m from the input-output table. The solution given the extraction is:

$$\bar{X}_{(cm)}^* = [I - \bar{A}_{(cm)}^*]^{-1}f^* \quad (3)$$

The effect of extraction of the m -th family consumption structure to the total production is given through comparison between equations (2) and (3) as follows:

$$i'x^* - i'\bar{x}_{(cm)}^* \quad (4)$$

where $i'x^*$ is the total economy production and $i'\bar{x}_{(cm)}^*$ is the result of production given the extraction of a household stratum. This result allows us to calculate an estimate of the percentage of decline in economic activity.

$$\bar{T}_m = 100[(i'x^* - i'\bar{x}_{(cm)}^*)/i'x^*] \quad (5)$$

This same analysis can be done on a disaggregated basis to the productive sectors so that, if x_m is omitted, $(i'x^* - x_m) - i'\bar{x}_{(cm)}^*$ becomes the measure of the importance of m 's household consumption to sectors of the economy.

The forward linkages are characterized by the eliminating of sales structure. In this study, this means the elimination of the income structure (wages) in matrix B. As Miller and Blair (2009), we use A to denote the backward measure and B for the forward measure.

The matrix B is the ratio of sales of intermediate consumption and the total sales of sector i . Therefore, based on our previous discussion, the production *before* extraction is given by $X' = v'(I - B)^{-1}$ and $\bar{X}'_{rm} = v'(I - \bar{B}_{rm})^{-1}$ corresponds to the result of production *after* the extraction, where v is the vector of primary inputs (value added).

Consequently, the aggregate measure of j 's sector forward linkage is defined by $x'i - [\bar{x}'_{(rm)}]i$ and each element of $x' - \bar{x}'_{(rm)}$ is an indicator of dependence of the m household relative to I sector. The calculation of the percentage of decline in economic activity, given the elimination of household income structure, can be done similarly by adapting the results from the equation (5).

3. Discussion of Results

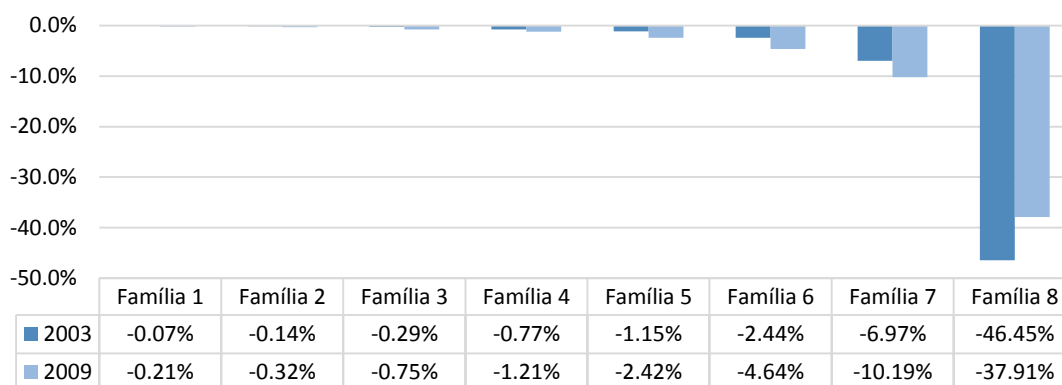
The behavior of the Brazilian productive structure, given the hypothetical extraction of an specific class of income, is analyzed according to two points of view: First, we observe what is the effect of this extraction on the total output of the economy; second, we observe the impact that the absence of each family group has on the sectorial output. In both cases, we tried to highlight the differences between the extraction of the consumption structure and the extraction of household income structure. In other words, we seek to answer the following question: Brazilian industry production structure is more sensitive to "loss" of income (wages) or consumption?

This approach may provide a basis for formulation of policies toward increasing domestic production. When the productive structure is more sensitive to changes in income, the promotion of policies in this area is more efficient, since the response of production given incentives that modify the income occurs more intensely. Thus,

governmental actions that operate directly on the income, as employment incentive programs and cash transfer programs, should be prioritized. A different situation occurs when the production structure is more sensitive to changes in consumption. In this case, state action can be given through policies that stimulate consumption, such as reducing taxes and the increase credit.

Figure 1 shows the impact of hypothetical extraction of the income structure for all eight family classes on total production of the economy in 2003 and 2009. The only family extract that, when removed from the analysis, causes a reduction in the impact of production between the years 2003 and 2009, is the last family class, i.e., the one with highest per capita incomes. This means that there was a reduction in the dependence of domestic production on the income of the last family class.

Figure 1. Impact of income structure on total production, according to the family stratum (2003 and 2009)

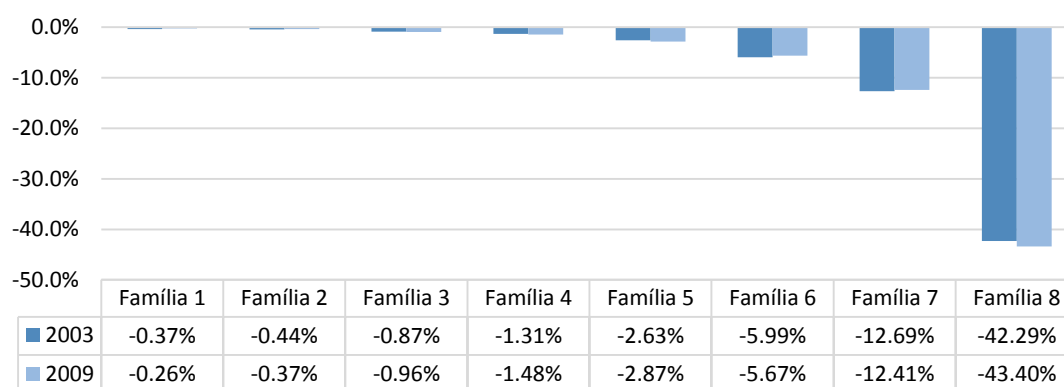


Nevertheless, it is important to note that, despite the increase in proportion of the impact on income structure, to the first seven households extracts, on total production (and the reduction of importance of the richest households), the difference between these two groups still remained quite high. To check the importance of the last household group for the production, in 2009, the simultaneous extraction of the structure of income of the first seven households stratum results in a decrease of 17.63% in the total production, while the reduction in output due to the exclusion only of household 8 is 37.91%. In addition to demonstrating the importance of this stratum to the economy, this example confirms a fact that is fairly treated in the literature: the heterogeneity of income in Brazil.

The impact of hypothetical extraction of the consumption structure for all eight family classes on total production of the economy, in 2003 and 2009, can be seen in Figure 2. The most striking difference, if we compare the analysis of income and

consumption structures (Figures 1 and 2) lies in the eighth household: while there is an increase, between the years analyzed, in the impact on production due to the extraction of consumption structure, there is a reduction of impact from the perspective of income. The reduction in the impact of the eighth household income structure on total production may be explained by the improvement in income distribution and the reduction of inequality and poverty occurred between the years of analysis. However, this change may not have been able to modify the marginal propensity to consume of these individuals, since there was an increase in the importance of the consumption structure of the highest income class on production.

Figure 2. Impact of consumption structure on total production, according to the family stratum (2003 and 2009)

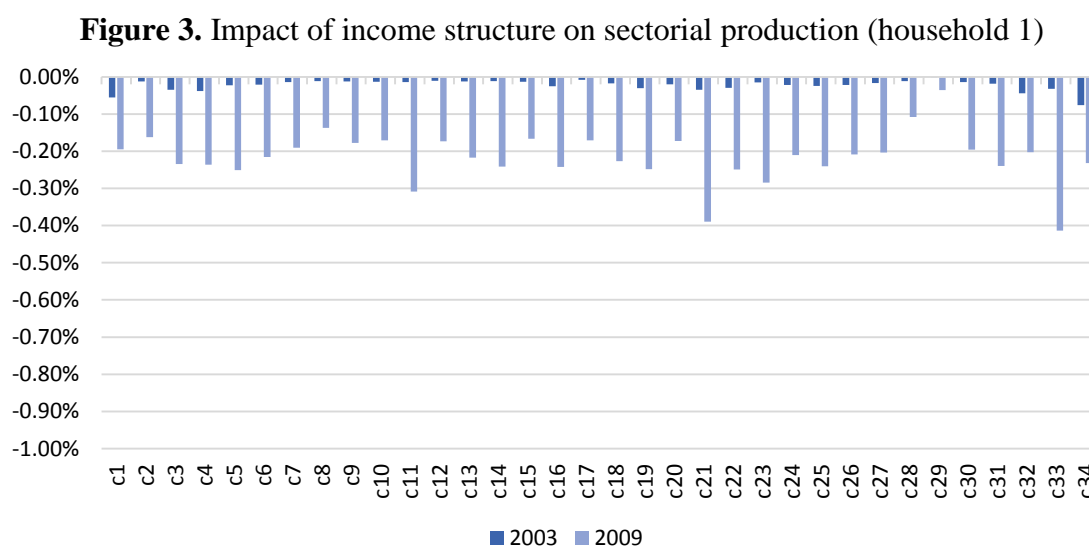


The results observed in Figures 1 and 2 show that the sectorial production structure is very dependent on the household group with per capita income above R\$ 1.156.46 (Household 8). Thus, *ceteris paribus*, policies that have a negative effect on income / consumption of this group can be harmful for production. In this sense, a central question is how to fight the problem of income distribution inequality in Brazil without reducing the production sector.

The following figures show the impact of consumption and income structures of household extracts on sectorial output, given the hypothetical extraction of these groups⁸. From the perspective of income (Figure 3), there was significant increase in dependence of all sectors on the class that represents the poorest families (household 1). Despite this, dependence on sectors of the economy to the first household group remains quite low.

⁸ We decided to include in results only the graphics of households extracts 1, 4 and 8. The graphics of households 2, 3, 5, 6 and 7 are in Appendix.

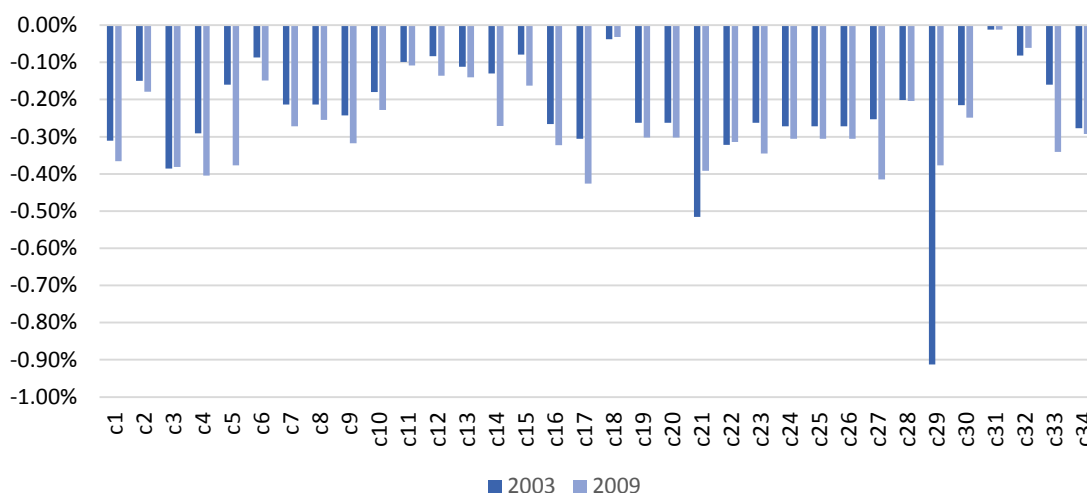
The most affected sector, in 2009, was Health and Social Care sector (c33), with a reduction of only 0.23%.



The study of the consumption structure impact of the poorest household on the sectorial output is seen in Figure 4. There are, in general, an increase in the importance of this household group in the productive structure. The most prominent exception is in Real Estate Activities sector (c29), which suffered the greatest reduction in dependence (-0.91 in 2003 to -0.38 in 2009). While the Leather & Shoes sector (c5) was the one that showed the greatest increase in dependence, from -0.16 in 2003 to -0.38 in 2009.

Another point that can be noted is that the increased importance of the poorest group on sectorial output, between the years 2003 and 2009, were significantly lower under the perspective of consumption structure (Figure 4), compared to the extraction of the income structure (Figure 3). This fact may indicate that the multiplier effect of income was higher in the period, compared to the multiplier effect of consumption. It is worth noting that in both analyzes, considered the first four household extracts, the impact of lower income classes in the sectors is minimal, not reaching 3%.

Figure 4. Impact of consumption structure on sectorial production (household 1)



For the fourth family extract, assessing the income structure, the productive sector that suffered the greatest impact in 2009 was the Wood and Products of Wood and Cork (c6). Already, the sector Other Community Services, Social and Personal Services (c34) showed the greatest reduction in the impact on production, when we withdraw de household 4.

Figure 5. Impact of income structure on sectorial production (household 4)

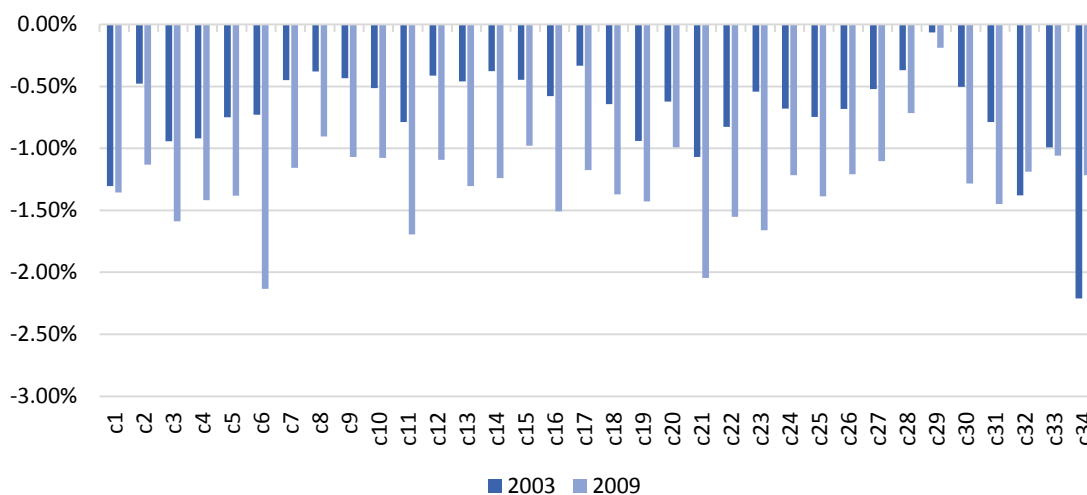
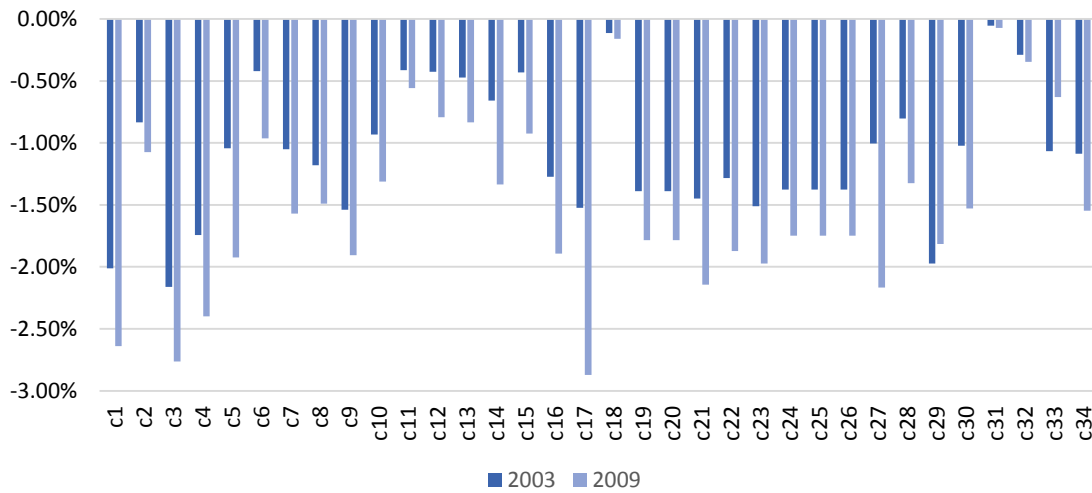


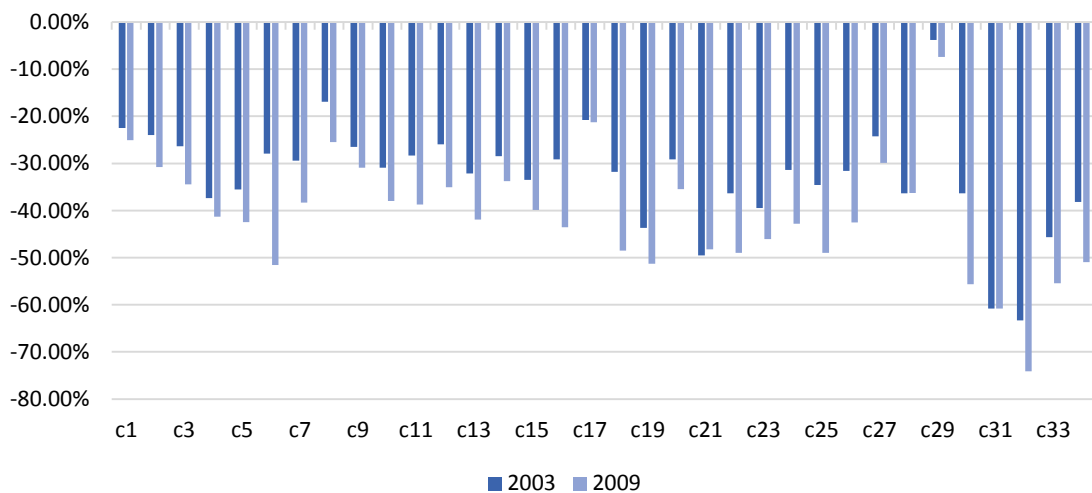
Figure 6 shows the impact of the consumption structure on sectorial output, when we removed the fourth household group. Again, the income structure was more sensitive to the temporal analysis, with higher variations between the years 2003 and 2009. The highlight is the increased dependence occurred in the electricity sector, Gas and Water Supply. The negative impact of extraction of household 4 on this sector almost doubled, from 1.52% to 2.87%. What is somewhat expected since the increase in income has a positive relationship with the increase of electricity, gas and water consumption.

Figure 6. Impact of consumption structure on sectorial production (household 4)



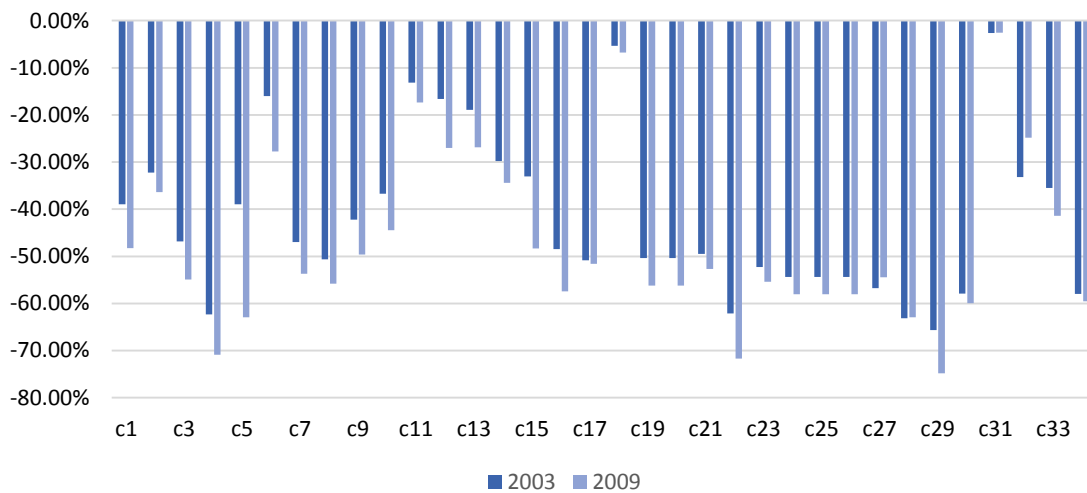
In the higher family extracts, sectorial changes are less intense, for both income and consumption perspectives. An important fact occurs when we look at the Real Estate Activities (c29) and Public Administration, Defense and Social Security (c31). In the first sector, it is evident that greater sensitivity to loss of consumption (Figure 8,) compared to loss of income (Figure 7), for both years. In the Public Administration, Defense and Social Security sector, the effect is reversed: while in 2009, the impact on this sector from the perspective of income is over 60%, from the perspective of consumption, the loss is only 2.54%. This difference is due to the nature of the sectors. The Real Estate Activities are fundamentally dependent on the households consumption structure, especially those with higher per capita income. Already the Public Administration, Defense and Social Security sector are not influenced by the consumption structure, being intensely affected by the income structure.

Figure 6. Impact of income structure on sectorial production (household 8)



The most affected sectors, from the perspective of consumption, when the household 8 is extracted from the input-output matrix are, beyond the real estate activities (c29), the Textile and Textile Products (c4) and Hotels and Restaurants sectors (c22). In other words, these sectors are more dependent on the consumption structure of higher-income families.

Figure 7. Impact of consumption structure on sectorial production (household 8)



4. Conclusion

The aim of this study was to analyze the impact of the Brazilian households consumption and income structure on the sectorial output of the economy. To achieve this, the information of the World Input-Output Database (WIOD), for years 2003 and 2009, were calibrated for 35 productive sectors. The household consumption and income structure were endogenized on the model and decomposed into eight intervals. The extraction method was used in this study. Through the method, it was possible to quantify how much sectorial and total output of the economy changes due to loss of a hypothetical household group.

The main results indicate that when we analyze the income structure, there was a reduction of domestic production dependence over the richest household group. That is, the extract containing the households with the highest per capita income lost importance for production, during the study period. However, despite the reduction of inequality, the sectorial production structure were very dependent on the group of the wealthiest household. Thus, policies that focus negatively on income/consumption of this group, can

be harmful for production. Therefore, a central question is how to fight the problem of income inequality in Brazil, without reducing the sectorial production.

5. References

ALMEIDA, L. de O.; GUILHOTO, J.. Crescimento Econômico e Distribuição de Renda: Uma Análise a partir das Estruturas Econômicas do Brasil Contemporâneo. XXXIV **Encontro Nacional de Economia** - ANPEC, Salvador, 2006.

BARROS, R.P; CARVALHO, M.; FRANCO, S.; MENDONÇA, R. Determinantes da queda na desigualdade de renda no Brasil. Rio de Janeiro; IPEA, 2010. (Texto para discussão, n.1460).

FERREIRA, F. H.G.; LEITE, P.; LITCHFIELD, J. A.; ULYSSEA, G. Ascensão e queda da desigualdade de renda no Brasil. **Econômica**, Rio de Janeiro, v.8, n.1, p.147-149, junho 2006.

GUILHOTO, J.; CONCEIÇÃO, P. H. Z. da; CROCOMO, F. C.. Estruturas de produção, consumo, e distribuição de renda na economia brasileira: 1975 e 1980 comparados. *Economia & Empresa*, v. 3, n. 3, 1996.

HOFFMANN, R. Desigualdade da distribuição da renda no Brasil: a contribuição de aposentadorias e pensões e de outras parcelas do rendimento domiciliar per capita. **Economia e Sociedade**. Campinas, v.18, n1(35), p. 213-231, 2009.

MENDONÇA, E.L.; OLIVEIRA, J.S. **Pobreza e desigualdade**: representando pressupostos, 2001. Available in: <www.ibase.br/paginas/jane.pdf>. Access: 03 fev. 2010.

NERI, M. C. ; SOUZA, P. H. C. F. . Comunicado 155: A Década Inclusiva (2001-2011): Desigualdade, Pobreza e Políticas de Renda. Rio de Janeiro: IPEA, 2012 (Comunicado 155).

MILLER, R.E.; BLAIR, P.D. Input-output analysis: foundations and extensions. Cambridge University Press, 2009.

PEROBELLI, F. S.; VALE, V. DE A. Emissions structure: a systemic analysis to Brazilian economy 2003 and 2009. In: 54th - ERSO Congress - Regional Development and Globalisation: best practices, 2014, Sao Petersburgo.

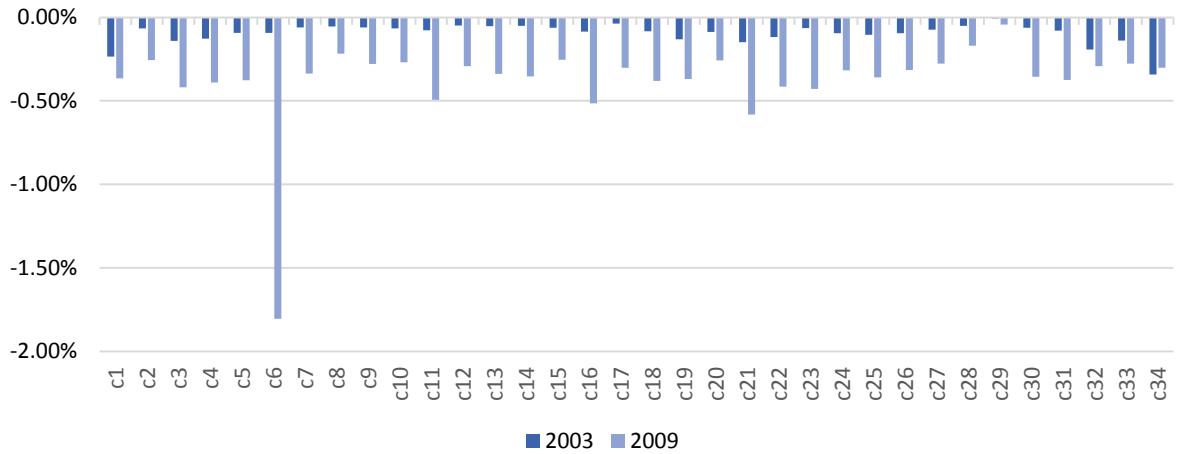
PNAD. Pesquisa Nacional por Amostra Domiciliar. Microdados – Pesquisa básica. Brasil, Rio de Janeiro: IBGE, 2003 a 2009.

POF. Pesquisa de Orçamento Familiar. Microdados – Pesquisa Básica. Brasil, Rio de Janeiro: IBGE, 2003 e 2009.

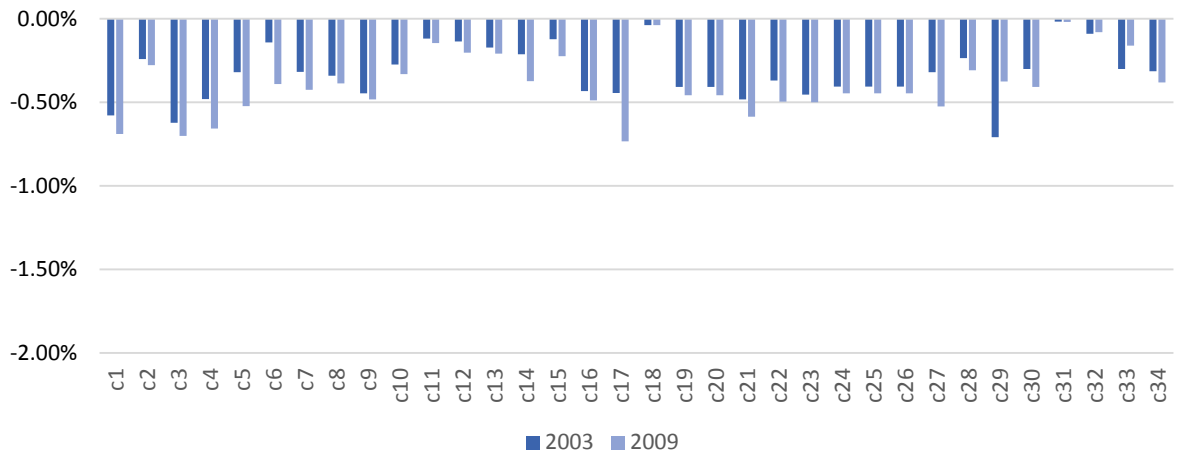
WIOD. World Input-Output Database. 2003 e 2009. Available in: http://www.wiod.org/new_site/home.htm. Access: 20 ago. 2014.

Appendix

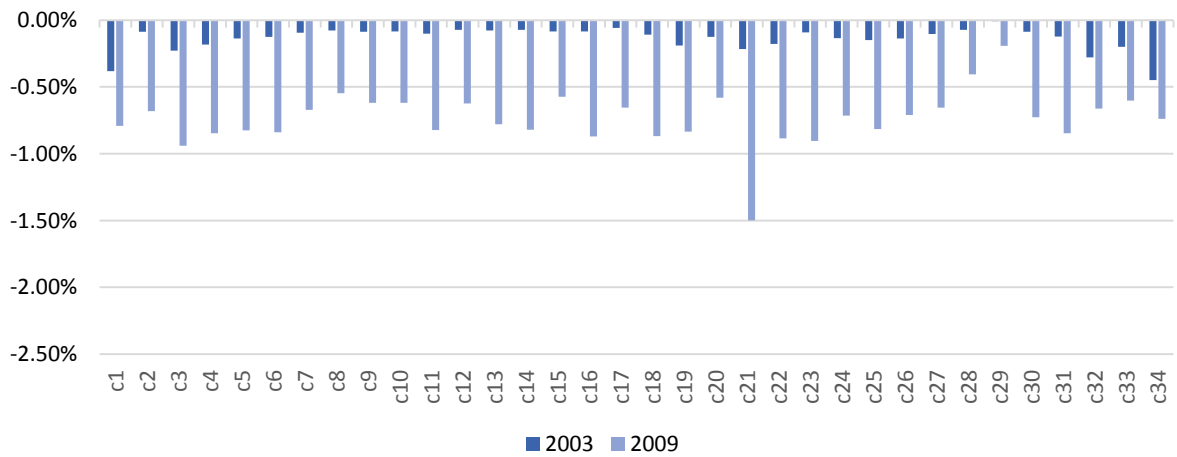
Impact of income structure on sectorial production (household 2)



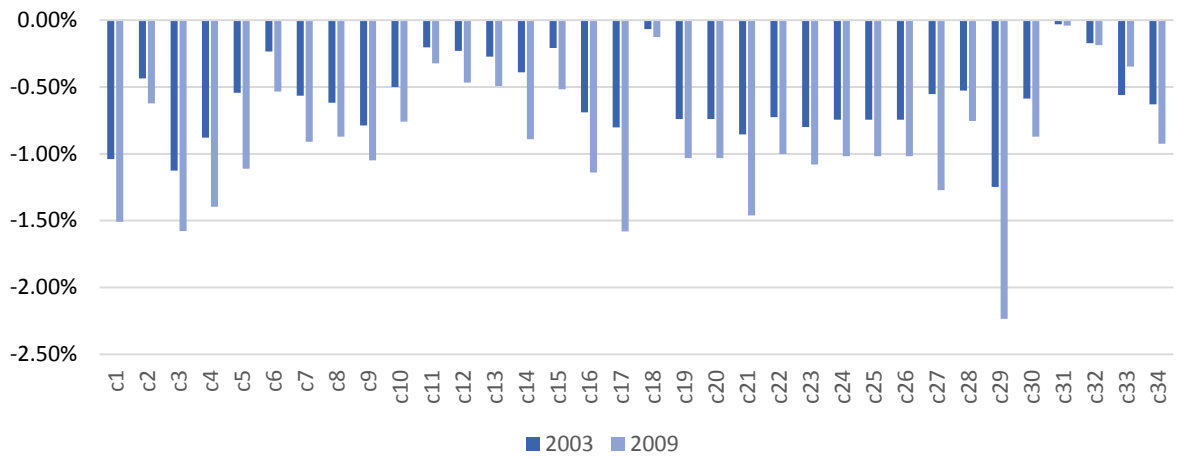
Impact of consumption structure on sectorial production (household 2)



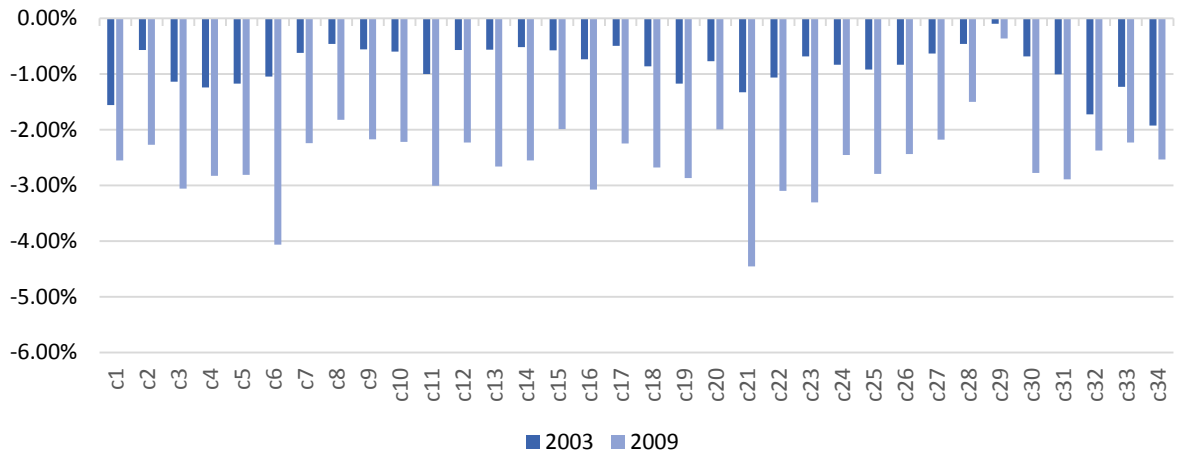
Impact of income structure on sectorial production (household 3)



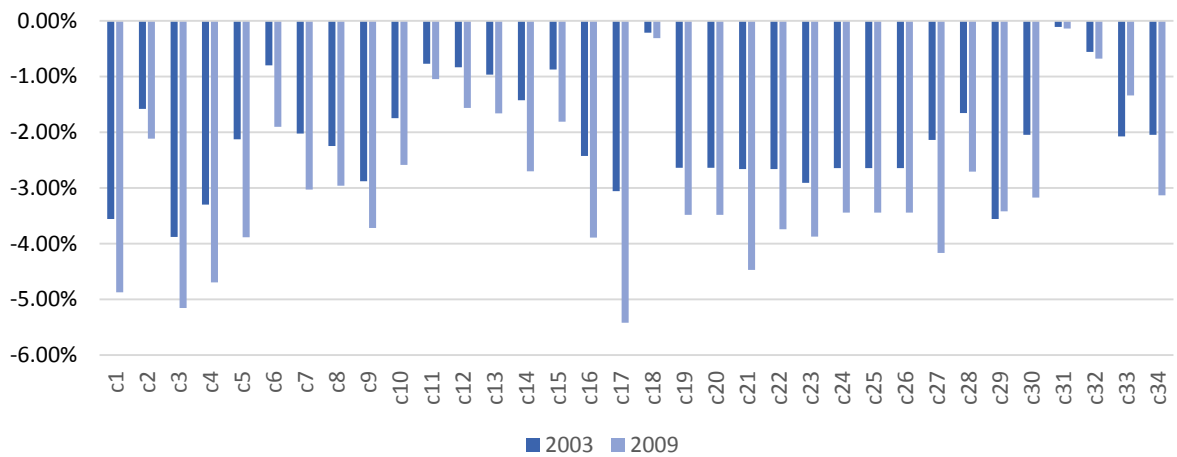
Impact of consumption structure on sectorial production (household 3)



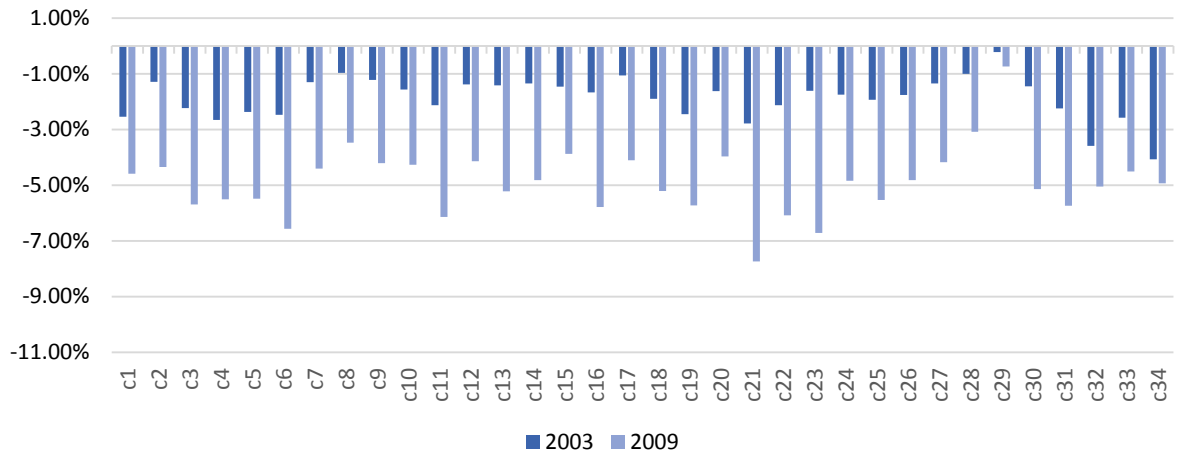
Impact of income structure on sectorial production (household 5)



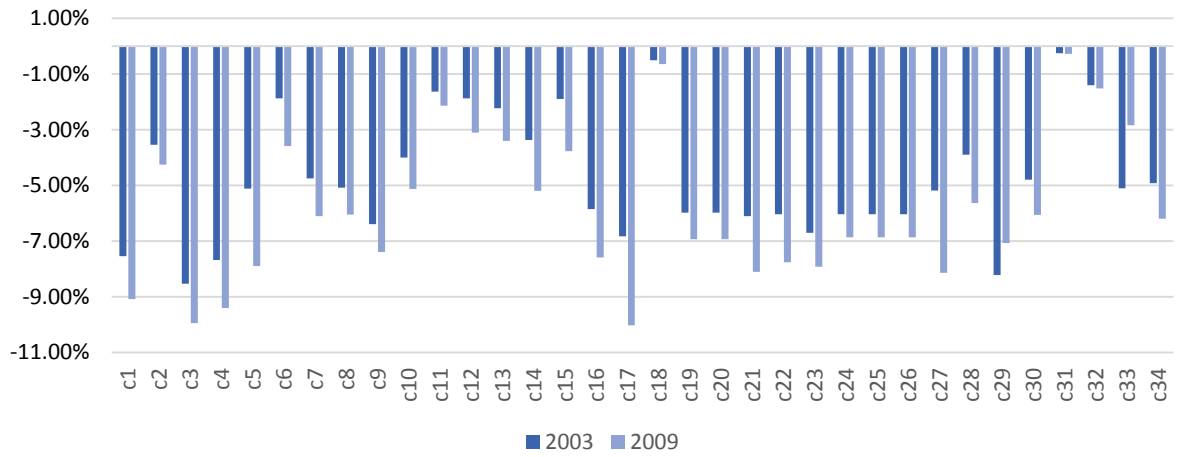
Impact of consumption structure on sectorial production (household 5)



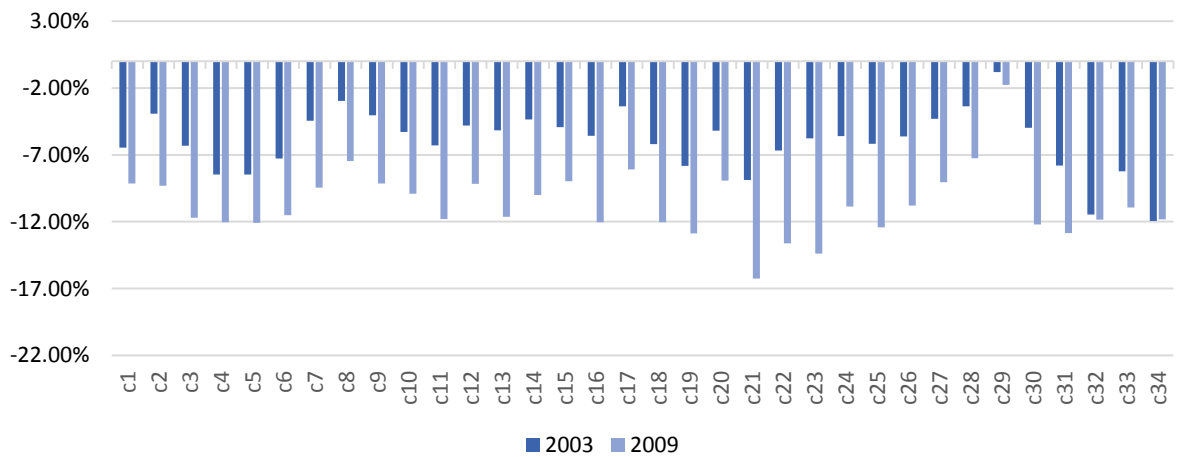
Impact of income structure on sectorial production (household 6)



Impact of consumption structure on sectorial production (household 6)



Impact of income structure on sectorial production (household 7)



Impact of consumption structure on sectorial production (household 7)

