Assessing the impacts of agricultural policy and structural reforms on income distribution and poverty in Brazil

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1. Introduction

Producers and households in developing countries are affected by the prices of products involved in international transactions. The impacts of agricultural policy and structural reforms leading to changes in international prices of goods and services are expected to be differentiated across households and producers, depending on how they are involved in the circular flow of goods and services within the country of residence. As such, it might be expected that these reforms will affect income distribution and poverty levels within those countries.

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Considering the supply side, units producing commodities facing price increases in the international markets will benefit, since their product will become more valuable; those using imported inputs whose prices increased as a result of the structural reforms will lose. As for households, those working in sectors with increased international prices could experience income gains, and those working in other sectors could rest unaffected in terms of income. However, since some prices would rise, households not working for gaining sectors could suffer a decrease in real income. A general price increase could also result, thus affecting all sorts of households.

Therefore, structural reforms that can change international prices are expected to produce important changes in income distribution in all countries involved in international trade. Since the impacts will vary according to the role played by different agents in the production and distribution of national income, it is important to produce a detailed analysis of such impacts.

The objective of this study is to produce an estimate of the impacts of agricultural policy and structural reforms on income distribution and poverty in Brazil, considering not only the first round (direct) effects but also their spillovers (indirect effects) across the circular flow of income. The introduction of the second and higher round effects is important, for the initial effects could either be mitigated or empowered by the indirect effects.

The knowledge of such compounded effects is important in the design of alternative policies for cushioning the measured adverse impacts of reforms on poor people. It is possible that an increase in the price of a very important export product of a country does not necessarily benefit all households equally. As a matter of fact, some may be badly hurt,

if the prices of products with high participation in their consumption basket increased as a result of the second and higher order effects in the national economy, and if they do not work in sectors benefited by the initial price increase.

The relationship between income and consumption in the economic system is such that: a) consumption level depends on the structure of income distribution; b) consumption structure is different across income groups; and c) consumption structure determines employment, income level, and income distribution in the economy. These links can be studied through a Social Accounting Matrix model. We plan to construct such a model for Brazil, as will be presented later on in this report, and use it to estimate the impacts of changes in international prices of agricultural products on income distribution and poverty in Brazil.

2. Methodology and data sources

2.1. The SAM framework

When constructing a SAM, besides the need to fulfill its theoretical requirements, one must pay attention to the use that the SAM its going to be put to, i.e., the goals of the study should direct its final structure. With the above in mind, the SAM for the Brazilian model must make a distinction between the agricultural and nonagricultural activities and agents in the economy, and take into consideration the relations that occur between them. At the same time, the SAM should also take into consideration the relation with agricultural and nonagricultural activities and agents with the rest of the world economy.

The structure of SAM is described below, and is portrayed in Figure 1. Figures 2.A through 2.D detail its parts. In these figures, the first two columns show, among other elements, the inputs from agricultural and nonagricultural goods and agents that are need to produce the agricultural and nonagricultural goods available in the economy (rows 1 and 2). Rows 3 and 4 show the destination of the agricultural and nonagricultural goods that are produced in the economy (columns 3 and 4).

Rows 5 to 9 show how the income generated by the domestic activities is allocated among the factors of production, and columns 5 to 9 show how this income is allocated to the institutions in the economy. Rows 10 to 14 show the different sources of income of the institutions in the economy, while the corresponding columns 10 to 14 show how this income is spent.

Columns 15 and 16 show the composition of the total value imports in the economy, while rows 15 and 16 show the destiny of these imports. The composition of total value of exports is displayed in columns 17 and 18, which are allocated to the rest of the world, in rows 17 and 18. Rows 19 to 22 show the source of the taxes received by the government. While columns 19 to 22 show that these value are allocated directly to the government row (row 14). The transactions with the rest of the world are displayed into row 23 and column 23. While the accumulation that occurs in the economy is displayed into row 24 and column 24, closing in this way the values for the SAM.

SAM Structure for the Brazilian Model			Domestic Activities		Domestic Products		Factors					Households		Enterprises		Gov	Imports		Exports		Ind Taxes on Products		Other Taxes		ROW	Acc.	Totals
							Capital		Labor		Land																
			Ag	Nag	Ag	Nag	Ag	Nag	Ag	Nag	Ag	Ag	Nag	Ag	Nag		Ag	Nag	Ag	Nag	Ag	Nag	Ag	Nag			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Domestic Activities	Ag	1			$S_{1,2}$	$S_{1,3}$																					S_1
	Nag	2			$S_{2,2}$	$S_{2,3}$																					S_2
Domestic Products	Ag	3	$S_{3,1}$	$S_{3,2}$								$S_{3,10}$	$S_{3,11}$			$S_{3,14}$			$S_{3,17}$							$S_{3,24}$	S_3
	Nag	4	$S_{4,1}$	$S_{4,2}$								$S_{4,10}$	$S_{4,11}$			$S_{4,14}$				$S_{4,18}$						$S_{4,24}$	S_4
Factors: Capital	Ag	5	$S_{5,1}$	$S_{5,2}$																							S_5
	Nag	6	$S_{6,1}$	$S_{6,2}$																							S_6
Factors: Labor	Ag	7	$S_{7,1}$	$S_{7,2}$																							S_7
	Nag	8	$S_{8,1}$	$S_{8,2}$																							S_8
Factors: Land	Ag	9	$S_{9,1}$																								S_9
Institutions: HH	Ag	10							$S_{10,7}$	$S_{10,8}$				$S_{10,12}$	$S_{10,13}$	$S_{10,14}$									$S_{10,23}$		S_{10}
	Nag	11							$S_{11,7}$	$S_{11,8}$				$S_{11,12}$	$S_{11,13}$	$S_{11,14}$									$S_{11,23}$		S_{11}
Institutions: Firms	Ag	12					$S_{12,5}$	$S_{12,6}$			$S_{12,9}$					$S_{12,14}$									$S_{12,23}$		S_{12}
	Nag	13					$S_{13,5}$	$S_{13,6}$			$S_{13,9}$					$S_{13,14}$									$S_{13,23}$		S_{13}
Institutions: Government		14																			$S_{14,20}$	$S_{14,20}$	$S_{14,21}$	$S_{14,22}$	$S_{14,23}$		S_{14}
Imports	Ag	15	$S_{15,1}$	$S_{15,2}$								$S_{15,10}$	$S_{15,11}$													$S_{15,24}$	S_{15}
	Nag	16	$S_{16,1}$	$S_{16,2}$								$S_{16,10}$	$S_{16,11}$													$S_{16,24}$	S_{16}
Exports	Ag	17																							$S_{17,23}$		S_{17}
	Nag	18																							$S_{18,23}$		S_{18}
Ind Taxes on Products	Ag	19	$S_{19,1}$	$S_{19,2}$								$S_{19,10}$	$S_{19,11}$				$S_{19,15}$		$S_{19,17}$							$S_{19,24}$	S_{19}
	Nag	20	$S_{20,1}$	$S_{20,2}$								$S_{20,10}$	$S_{20,11}$					$S_{20,16}$		$S_{20,18}$						$S_{20,24}$	S_{20}
Other Taxes	Ag	21	$S_{21,1}$									$S_{21,10}$		$S_{21,12}$													S_{21}
	Nag	22		$S_{22,2}$									$S_{22,11}$		$S_{22,13}$												S_{22}
Rest of the World		23															$S_{23,15}$	$S_{23,16}$									S_{23}
Accumulation		24										$S_{24,10}$	$S_{24,10}$	$S_{24,10}$	$S_{24,23}$	$S_{24,23}$									$S_{24,23}$		S_{24}
Totals		25	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}	S_{16}	S_{17}	S_{18}	S_{19}	S_{20}	S_{21}	S_{22}	S_{23}	S_{24}	

Figure 1: Schematic View of the Brazilian SAM

Figure 2A – Structure of Brazilian SAM – Part 1 of 4

SAM Structure for the Brazilian Model - 1999			Domestic Activities		Domestic Products	
			Agriculture	Nonagriculture	Agriculture	Nonagriculture
			1	2	3	4
Domestic Activities	Agriculture	1			Domestic sales agric goods	Domestic sales nonagric goods
	Nonagriculture	2			Domestic sales agric goods	Domestic sales nonagric goods
Domestic Products	Agriculture	3	Int. demand for agric. goods	Int. demand for agric. goods		
	Nonagriculture	4	Int. demand for nonagric. goods	Int. demand for nonagric. goods		
Factors – Capital	Agriculture	5	Capital Income from agriculture	Capital Income from nonagric.		
	Nonagriculture	6	Capital Income from agriculture	Capital Income from nonagric.		
Factors – Labor	Agriculture	7	Labor Income from agriculture	Labor Income from nonagric.		
	Nonagriculture	8	Labor Income from agriculture	Labor Income from nonagric.		
Factors – Land	Agriculture	9	Land Income from agriculture			
Institutions – Households	Agriculture	10				
	Nonagriculture	11				
Institutions – Enterprises	Agriculture	12				
	Nonagriculture	13				
Government		14				
Imports	Agriculture	15	Imports of agric goods for production	Imports of agric goods for production		
	Nonagriculture	16	Imports of nonagric goods for procduction	Imports of nonagric goods for procduction		
Exports	Agriculture	17				
	Nonagriculture	18				
Indirect Taxes on Products	Agriculture	19	Indirect taxes on agriculture inputs	Indirect taxes on agriculture inputs		
	Nonagriculture	20	Indirect taxes on nonagriculture inputs	Indirect taxes on nonagriculture inputs		

Figure 2B – Structure of the Brazilian SAM – Part 2 of 4

SAM Structure for the Brazilian Model - 1999			Factors				
			Capital		Labor		Land
			Agriculture	Nonagriculture	Agriculture	Nonagriculture	Agriculture
			5	6	7	8	9
Domestic Activities	Agriculture	1					
	Nonagriculture	2					
Domestic Products	Agriculture	3					
	Nonagriculture	4					
Factors – Capital	Agriculture	5					
	Nonagriculture	6					
Factors – Labor	Agriculture	7					
	Nonagriculture	8					
Factors – Land	Agriculture	9					
Institutions – Households	Agriculture	10			Allocation of Labor Income From Ag to Ag	Allocation of Labor Income From Nag to Ag	
	Nonagriculture	11			Allocation of Labor Income From Ag to Nag	Allocation of Labor Income From Nag to Nag	
Institutions – Enterprises	Agriculture	12	Allocation of Capital Income From Ag to Ag	Allocation of Capital Income From Nag to Ag			Allocation of Land Income From Ag to Ag
	Nonagriculture	13	Allocation of Capital Income From Ag to Nag	Allocation of Capital Income From Nag to Nag			Allocation of Land Income From Ag to Nag
Government		14					
Imports	Agriculture	15					
	Nonagriculture	16					
Exports	Agriculture	17					
	Nonagriculture	18					
Indirect Taxes on Products	Agriculture	19					
	Nonagriculture	20					

Figure 2C – Structure of the Brazilian SAM – Part 3 of 4

SAM Structure for the Brazilian Model - 1999			Households		Enterprises		Government	Imports		Exp
			Agriculture	Nonagriculture	Agriculture	Nonagriculture		Agriculture	Nonagriculture	Agriculture
			10	11	12	13	14	15	16	17
Domestic Activities	Agriculture	1								
	Nonagriculture	2								
Domestic Products	Agriculture	3	Agric HH cons of domestic agric goods	Nonagric HH cons of domestic agric goods			Government cons of domestic agric goods			Net exports of agricultural goods
	Nonagriculture	4	Agric HH cons of domestic nonagric goods	Nonagric HH cons of domestic nonagric goods			Government cons of domestic nonagric goods			
Factors – Capital	Agriculture	5								
	Nonagriculture	6								
Factors – Labor	Agriculture	7								
	Nonagriculture	8								
Factors – Land	Agriculture	9								
Institutions – Households	Agriculture	10			Profits from agric to agriculture household	Profits from nonagric to agric household	Transfers to agriculture households			
	Nonagriculture	11			Profits from agric to nonagriculture household	Profits from nonagric to nonagric HH	Transfers to nonagriculture households			
Institutions – Enterprises	Agriculture	12					Transfers to agriculture enterprises			
	Nonagriculture	13					Transfers to nonagriculture enterprises			
Institutions – Government		14								
Imports	Agriculture	15	Agric HH cons of imported agric goods	Nonagric HH cons of imported agric goods						
	Nonagriculture	16	Agric HH cons of imported nonagric goods	Nonagric HH cons of imported nonagric goods						
Exports	Agriculture	17								
	Nonagriculture	18								
Indirect Taxes on Products	Agriculture	19	Indirect taxes on agric HH cons of agric goods	Indirect taxes on nonagric HH cons of agric goods				Tariffs on imp agricultural goods		Indirect & Export taxes on agricultural goods
	Nonagriculture	20	Indirect taxes on agric HH cons of nonagric goods	Indirect taxes on nonagric HH cons of nonagric goods					Tariffs on imp nonagricultural goods	

Figure 2D – Structure of the Brazilian SAM – Part 4 of 4

SAM Structure for the Brazilian Model - 1999			Indirect Taxes on Products		Other Taxes		Rest of the World	Accumulation	Totals
			Agriculture	Nonagriculture	Agriculture	Nonagriculture			
			19	20	21	22	23	24	25
Domestic Activities	Agriculture	1							Total Sales of Agricultural Activities
	Nonagriculture	2							Total Sales of Nonagricultural Activities
Domestic Products	Agriculture	3						Investment expenditure on dom agric goods	Total Sales of Agricultural Goods
	Nonagriculture	4						Invest expenditure on dom nonagric goods	Total Sales of Nonagricultural Goods
Factors – Capital	Agriculture	5							Total Capital Income in Agriculture
	Nonagriculture	6							Total Capital Income in Nonagriculture
Factors – Labor	Agriculture	7							Total Labor Income in Agriculture
	Nonagriculture	8							Total Labor Income in Nonagriculture
Factors – Land	Agriculture	9							Total Land Income in Agriculture
Institutions – Households	Agriculture	10					Net Current Transfers to HH (Agric)		Total Agriculture HH Income
	Nonagriculture	11					Net Current Transfers to HH (Nonagric)		Total Nonagriculture HH Income
Institutions – Enterprises	Agriculture	12					Net Current Transfers to Enterprises (Agric)		Total Agriculture Enterprises Income
	Nonagriculture	13					Net Current Transfers to Enterp (Nonagric)		Total Nonag Enterprises Income
Institutions – Government		14	Allocation of agric indirect taxes to government	Allocation of nonagric ind taxes to government	Allocation of agric other taxes to government	Allocation of nonagric other taxes to gov	Net Current Transfers to Government		Government Income
Imports	Agriculture	15						Investment expenditure on imp agric goods	Total Imports of Agriculture Goods
	Nonagriculture	16						Invest expenditure on imp nonagric goods	Total Imports of Nonagriculture Goods
Exports	Agriculture	17					Total exports of agricultural goods		Total Exports of Agriculture Goods
	Nonagriculture	18					Total exports of nonagricultural goods		Total Exports of Nonagriculture Goods
Indirect Taxes on Products	Agriculture	19						Indirect taxes on agric capital goods	Total Indirect Taxes on Agriculture
	Nonagriculture	20						Indirect taxes on nonagric capital goods	Total Indirect Taxes on Nonagriculture

2.2. Sectoral disaggregation

Previous applications of this model for the Brazilian economy can be found in Fonseca and Guilhoto (1987), and Guilhoto, Conceição, and Crocomo (1996). The input-output matrices released by the Brazilian Statistical Institute (IBGE) only take into consideration the Agriculture as a whole and 7 food processing industries, of a total of 42 sectors. The most recent data released from IBGE refers to the year of 1996; this matrix was up-dated to the year 1999, following the methodology developed by Guilhoto et al (2002), based on Brazilian national accounts. Given data constraints, the maximum possible disaggregation is disposed in table 1 below. Agriculture was broken down into 17 sectors, and food-processing industries were disaggregated into 12 sectors, including alcohol, that is treated separately from the chemical sector. The other sectors are the same as in the official national input-output matrix.

Table 2 presents the importance of 33 sectors representing agribusiness activities in Brazil. The first column indicates the importance of each sector in total national production; the second presents the shares within the 33-sector group. It can be seen that this group of sectors accounts for only 15.3% of total national production, in spite of the fact that Brazil is a major world producer of several products. This reflects the fact that Brazil presents a large and diversified economy. The next two columns indicate the destination of production to domestic household consumption and to exports. These two destinations are important in terms of internal income distribution and in terms of competitiveness of the country. Export-oriented sectors, such as coffee, sugar, and soybean, compete in the international market and are prone to be the first affected by different

conditions in the world food market. On the other hand, sectors oriented towards the local market, such as rice, beans, manioc, beef, dairy, etc., will lead important internal distributional impacts in case of changes in world prices.

3. Household and farmer typology

The definition of farm types is based on two different data sets: the Agricultural Census of 1996/97 and the Pesquisa Padrão de Vida (PPV) of 1996, both from IBGE. The first source is more comprehensive and allows for more information across states, farm sizes, technology, etc. The second source provides more information on household characteristics, consumption structures, etc.

Starting with the census, our definition of household types is be based on the study by the Ministry of Agrarian Reform/Incra and FAO. In that study, Brazilian farms were split into family and non-family, based on size, use of hired labor, etc. Family farms were split into 4 groups, based on value added; non-family farms were split into 3 groups, based on technology and size. Based on the objectives of this study, and on our analysis of characteristics of family and non-family farms, we have decided to work with four groups of family farms, and to deal with non-family farms as a sole group.

Since we will use information from two different sources, it is important to analyze the matching of those two in terms of general characteristics of farmers. Therefore, we have allocated PPV farmers into the five groups defined above. Results are displayed in Table 3.

Comparing the proportions of area, number of farms and number of people working in the different farm types, it can be seen that the distributions in the two data sets are quite

similar. In other words, PPV consists of a good sample for the census results. This conclusion is even stronger if we consider that some variables have different definitions in the two data sets. For example, the census study considers total farm size, while PPV considers only cultivated area. This explains why the sizes in the latter are smaller for all farm types. The same holds for income variables: census deals with value added while PPV considers income. Given these different definitions, proportions of income by farmer type across data sets are not as similar as for the other variables. For comparison purposes only, we have excluded from PPV household heads with non-farm incomes (heads living in the rural area but working in urban activities) and have imposed a limit to property size, arriving at the income per farm figures of table 3.

The second part of table 3 presents some indicators of input use. Since our definition of "other" types of energy is more restrictive than the census classification, we came up with higher proportions of manual use of energy and smaller proportions of animal and "other". However, comparing the distribution of proportions according to household types, it can be seen that in general the same pattern holds for both classifications. The last three columns present the value and distribution of expenditures by household type in PPV, indicating a clear differentiation between family and non-family farms.

As a result of these comparisons, we are quite confident that we can use PPV information to supplement census data whenever necessary in the study. This will be particularly important when we consider the consumption structure of household types. Urban households were split into four groups, based on income level. A group comprising only agricultural employees is also included.

Table 4 presents the sources of monetary income for the ten groups of households defined above. It can be seen that wages account for 23% of monetary income for family farmers 1, and around 31% for family farmers 2 and 3. For the fourth type of family farmers, it goes up to 56%. For agricultural employees it is even higher, 70%. Income from self-employment is low for family farmers in general, being higher for family farmers 3. As expected, it is highest for business farmers (type 5). For urban households, the importance of wage income does not vary much, being 40% for the poorest, and around 47%-48% for the other three groups.

4. Distributional aspects

It was pointed out before that different sectors present different linkages within the production system, be it through technical relationships with other sectors, or through income generation and distribution, and, hence, through consumption, as a feed-back mechanism. Therefore, it is important to take into consideration how wages and value added are distributed to different groups of income. Figures 1 and 2, showing the distribution of wages and value added to income deciles, present an example of how sectors are heterogeneous in this respect. Figure 1 indicates that, from all wage income received by the lowest income group, farm sectors are responsible for 20%, increasing to 24% in the next decile, and decreasing there on. For rich people, wages coming from farm producing sectors are less important. A similar situation is present for value added distribution, as presented in Figure 2.

The lines in the figures represent manufacturing sectors producing food products. It is clear that the participation of different income groups in this case is quite different from the case analyzed before. Very poor people receive a smaller portion of income from these sectors; this share increases up to the sixth decile, both for wages and value added. This contrast in the two types of sectors producing food products illustrates the need to consider how different sectors can influence income distribution.

Figures 3 and 4 present a different sort of sector grouping, one that is particularly interesting for the study we are developing. It contrasts sectors producing food the consumption of the local population, and soybean production, an export-oriented sector. As it is evident, foods directed to the consumption of the local population are more important in the income generation of poor people, both in terms of wages and value added. Soybean production is more important for employees and producers in the middle-income range. Therefore, a price shock in this sector tends to affect this group of households more intensively than poor households, at least in the first round of effects.

5. Consumption structures

So far we have presented the importance of different agribusiness sectors in total production and their role in the generation of income for different groups of people. Since income is distributed differently across sectors, households associated to each sector are expected to have a different consumption structure. This is especially true when considering the differences in consumption between urban and rural families. Therefore, an

important step towards constructing a SAM is the consideration of how families spend their income.

The data sources for this part of the study are the 1987 and 1995/96 Household Expenditure Surveys developed by IBGE. For urban households, we use the household surveys of 1987 and 1995/96 (POF); we consider 4 groups of households, defined according to income levels. For rural households, we use the 1996 PPV. The five categories of farms presented before will be considered. Thus, we have consumption structures for 10 types of consumers, 6 rural (5 farmers, 1 employees), and 4 urban.

Figure 5 and 6 illustrate the importance of taking into account how people spend differently their income. Figure 5 portrays a comparison of household consumption between agricultural food and manufactured food. It is clear that poorer households spend a higher proportion of their income on the first, although in both cases the importance declines as income grows. For rich households, the importance is almost the same.

Figure 6 presents a more interesting comparison, considering the objectives of this study. It puts together food most frequent in the local diet, and food that, besides being consumed internally, is also exported. In this case, it turns out that for low-income groups, the difference is not as important as in the previous case, although poorer households spend a large proportion of their income with local-diet food. Up to the sixth decile, the change in consumption by income group is quite similar. Starting in the seventh decile, the proportion of income devoted to exportable food products is higher. This is an interesting case, in which a possible change in international price of a tradable product can affect high-income groups more heavily than low-income groups.

Figures 7 and 8 present additional aspects of expenditure heterogeneity across household groups. Figure 7 indicates how different households spend their monetary income on food, as well as how self-consumption varies across families. As expected, rural households present more self-consumption than urban households, and the proportion decreases from family farms 1 through 4. Figure 8 displays expenditure on housing and education. Again, as expected, urban households spend a larger share of their income with housing. In general, both housing and education expenditure shares rise from low-income households to high-income ones.

7. Product supply estimations

For the analysis of the impacts of agricultural policy and structural reforms on income distribution and poverty, it is important to understand how different agents react to distinct sorts of shocks. Particularly, it is necessary to consider the behavior of farmers in terms of income and price chances. For that, it is necessary to estimate supply functions for different products.

For that, we will construct a separable model, in each production and consumption decisions are made sequentially. Following Saudolet and Janvry (1995), the reduced form of the model is

$q_i = q_i(p_i, p_x, w, z^q)$ → Supply function for good i

$x = x(p_i, p_x, w, z^q)$ → Demand function for factor x

$l = l(p_i, p_x, w, z^q)$ → Demand function for labor

$\pi^* = \pi^*(p_i, p_x, w, z^q)$ → Maximum profit

Where q_i is the quantity of product i; x is the quantity of factor x and l is the quantity of labor; p stands for price of goods and inputs; w indicates wages; z indicates farm size, capital, etc.

We will use a translog profit function, since it is a flexible model, with variable elasticities. In order to grant enough variability in factor use and prices, we will combine cross-section of states with time series data. We will have yearly prices and quantities for each product and factor of production for the period 1990-2002, for each Brazilian state. The number of states will vary from product to product. We might be able to go back in time with the time series beyond 1990, but this is not clear at this moment. As for product quantities, data is available for area planted, physical quantity and value of production. As for inputs, data is available for prices and quantities of land, wages, fertilizers, chemicals, seeds, fuel and services. As for z^q, we will use the physical productivity in each state as a proxy for all other factors that influence supply.

Due to data constraints and econometric problems, we will have to estimate elasticities for groups of products and apply these for the products within each group. This problem only appear for products with low participation in total production; products with significant shares will have their own elasticities calculated.

Given the data restrictions, the calculated elasticities will be product-specific, regardless of the type of producer. Thus, a small producer will present the same supply elasticities as a large producer.

8. Product demand estimation

As in the case of producer's reactions to income and price incentives, it is necessary to introduce how different households will react to changes in prices and income. For that, demand functions will be estimated for different products.

We will use the QUAID model presented by Blundell, Pashardes and Weber (1993), in which the demand structure is calculated under the assumption of time-related preferences. We will add a spatial perspective, since families from different Brazilian states will be simultaneously compared. For this part of the project we will work with 39 food products and 15 non-food items. It will be assumed that consumers decide first, exogenously, on the amount of income to be allocated between this group of 54 items and the remaining items on their consumption basket. In a second stage, they make decisions for items within the 54- item group.

Let **q** represent the basket of 54 items for which we will calculate elasticities and **z** the basket of remaining items in the consumer consumption structure. The preferences of household *h* are such that in period *t*, in city *l*, each family decides on how much to consume from **q**, conditional to the products in **z**. Let q^h_{il} be the quantity of good *i* consumed by household *h* in city *l*, and m^h_l be the expenditure of family *h* with basket **q** in city *l*. Expenditure with good *i*, for a given $\mathbf{z}_l^h$, is given by:

$$p_{il}q_{il}^h = f_i(\mathbf{p}_l, m_l^h; \mathbf{z}_l^h) \qquad (1)$$

with f_i describing preferences in each city, and $\mathbf{p}_l$ being the vector of prices in the city. Under the weak separability of preferences hypothesis, and given m^h_l, it is possible to

establish the value of each f_i without knowing the prices and expenditures with the other products in the other cities.

Family preferences are described without taking into consideration distinct characteristics across regions. Assuming families are utility maximizers, and using an indirect utility function (Marshallian), it can be established that the participation of good *i* in the income of household *h* in city *l* is given by:

$$s_{il}^{h} = \alpha_0 + \sum_{l} \gamma_{ji} \ln p_{jl} + \beta_{il}^{h} \ln x_{l}^{h} + \lambda_{il}^{h} (\ln x_{l}^{h})^2 \qquad (2)$$

In which x^h_l is the income of family *h* in city *l*.[1]

The model will consider *k* income classes (*k*=1, 2,...,10). Expenditure of income class *k,* with basket **q** in city *l* are M_{kl} ($\sum_h m^h_{kl}$). The participation of family *h* in total expenditure in city *l* is given by $\mu^h_{kl}=(m^h_{kl}/M_{kl})$. By multiplying s^h_{il} and μ^h_{kl}, one gets the participation of good *i* in income class *k* in city *l*, s_{ikl}. Thus, the aggregate equivalent for equation (2) is:

$$s_{ikl} = \alpha_0 + \sum_j \gamma_{ji} \ln p_{jl} + \beta_{il} \sum_h \mu_{kl}^h \ln x_l^h + \lambda_{il} \sum_h \mu_{kl}^h (\ln x_l^h)^2 \qquad (3)$$

Equation (3) can be estimated as:

$$s_{ikl} = \alpha_0 + \sum_j \gamma_{ji} \ln p_{jl} + \beta_{il} \pi_{0kl} \ln X_{kl} + \lambda_{il} \pi_{1kl} (\ln X_{kl})^2 \qquad (4)$$

in which $\ln X_{kl}$ is the average of the log of family per capita income for each income class. To verify the consistency of the parameters after the aggregation process, we have that

$$\pi_{0kl} = \sum_h \mu_{kl}^h \ln x_l^h / \ln X_{kl} \quad (5a)$$

$$\pi_{1kl} = \sum_h \mu_{kl}^h (\ln x_l^h)^2 / (\ln X_{kl})^2 \quad (5b)$$

If the aggregation factors (5a) and (5b) are approximately constant across cities, π_{jl} approaches the unity, and the parameters of equation (4) can be estimated consistently.

Based on equations (4), (5[a]) and (5b), we will estimate models (6) and (7)

$$s_{ikl} = \alpha_0 + \sum_j \gamma_{ji} \ln p_{jl} + \beta_{il} \ln Y_{kl} + \lambda_{il} (\ln Y_{kl})^2 + e_{ikl} \quad (6)$$

$$s_{ikl} = \sum_j \gamma_{ji} \ln p_{jl} + \beta_{il}^* (\ln Y_{kl} * RM) + \lambda_{il}^* [(\ln Y_{kl})^2 * RM] + e_{ikl} \quad (7)$$

In model (6) the coefficients for income and income squared allow for the estimation of income elasticities. In model (7), we add metropolitan region dummies and the coefficients for the interaction terms provide for the estimation of income elasticities for different metropolitan regions

If expenditure is not a good proxy for consumption, influencing both the dependent variable and income, endogeneity would be present in the model, causing the estimators to be biased. For food products, this problem could be disregarded, since consumption decisions are frequent and repeated. For products with more sparse consumption decisions, such as clothing, electronic equipment, etc., this might be a problem. In each year, only a fraction of consumers in a city would have bought a TV set, for example. That is, we would have consumption heterogeneity across consumers. To avoid this situation, we will work with data aggregated by income and metropolitan regions. Thus, we will have 10 representative consumers in each metropolitan region, in each year.

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[1] As derived in Blundell, Pashardes and Weber (1993).

We will use a panel model with fixed effects for calculating the elasticities. The household expenditure surveys (POF) of 1987 and 1996 will be the basis for this exercise. We will have two observations for consumption, prices and income for each of the 10 representative consumers for the 11 metropolitan regions in Brazil.

9. Household models

A key part of the project is the relationship between the reception of income by households of different sectors and types, and their consumption patterns. Therefore, there is a need to develop household models that will indicate how different types of agricultural households react in the labor market – therefore explaining how they react in terms of incentives/disincentives coming from the labor market -, and how they react in the product markets – that is, how they define their output and expenditure patterns considering product price signals. Given the emphasis on the agricultural sector, urban households will be modeled only at the consumption side. The basic data for these estimations will be micro data of the surveys PPV and PNAD (Pesquisa Nacional por Amostra de Domicílios).

10. Final remarks

The knowledge of the possible impacts of commercial liberalization on income distribution and poverty is very important for policy design within developing countries. Given the estimated impacts on different groups of producers, different sorts of policies could be designed. The sort of model estimated in this research is highly suitable for simulations on different policy options. Taylor and Adelman (2003) provide examples of how such models can be used for that matter. In the case of Mexico, they simulate the effects of compensating mechanisms for the effects of subsidy termination for some specific agricultural products (price changes due to diminished subsidies; income transfers to compensate for diminished subsidies, and income transfers without diminished subsidies). Sadoulet and Janvry (1995) provide a varied range of policy applications for such models.

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Table 1 – Product/Sector List

1 Coffee farming	33 Refined petroleum
2 Sugar cane farming	34 Fertilizers industries
3 Rice farming	35 Other Chemical industries (petroleum)
4 Wheat farming	36 Agricultural defensives industries
5 Cotton farming	37 Pharmaceutical and medicine industries
6 Soybeans farming	38 Plastic industries
7 Corn farming	39 Textile industries
8 Beans farming	40 Clothing industries
9 Cassava farming	41 Footwear industries
10 Orange farming	42 Coffee industries
11 Other Fruits & Vegetables farming	43 Rice industries
12 Other crops farming	44 Wheat flour industries
13 Poultry and egg production	45 Other vegetables processing
14 Cattle ranching and farming	46 Poultry industries
15 Milk farming	47 Beef industries
16 Hog and pig farming	48 Other meat industries
17 Other animals production	49 Dairy products industries
18 Forest Exploitation	50 Sugar industries
19 Silviculture	51 Vegetable oil mills
20 Fishing, Hunting and Trapping	52 Animal food manufacturing
21 Metal Mining	53 Other food industries
22 Petroleum and gas mining	54 Beverage industries
23 Non-metallic mineral industries	55 Miscellaneous manufacturing
24 Metallurgy	56 Electricity, gas and water supply
25 Tractors industries	57 Construction
26 Machinery industries	58 Wholesale and retail trade
27 Electric and Electronic equipment industries	59 Transport services
28 Automobiles & Other Vehicles industries	60 Communications
29 Wood and furniture industries	61 Private services
30 Pulp and paper industries	62 Public administration
31 Alcohol industries	63 Private households with employed persons
32 Other Chemicals (non-petroleum)	

Table 2 - Importance and Destination of Production by Agribusiness sectors, 1999

Products	% of National Production		Destination of Production *	
	All Sectors	Agriculture	Household consumption	Exports to other countries
Coffee farming	0.4%	2.6%	0%	0%
Coffee products	0.7%	4.7%	28%	32%
	1.1%	**7.4%**		
Sugar cane farming	0.3%	2.0%	0%	0%
Sugar products	0.5%	3.1%	23%	35%
	0.8%	**5.1%**		
Rice farming	0.2%	1.5%	0%	0%
Rice products	0.2%	1.1%	85%	1%
	0.4%	**2.6%**		
Wheat farming	0.0%	0.2%	0%	0%
Wheat flour products	0.2%	1.6%	10%	0%
	0.3%	**1.8%**		
Cotton farming	0.1%	0.4%	0%	0%
Soybeans farming	0.5%	3.0%	0%	31%
Vegetable oil mills	1.0%	6.7%	29%	21%
	1.5%	**10.1%**		
Corn farming	0.3%	2.0%	2%	0%
Beans farming	0.1%	0.7%	13%	0%
Cassava farming	0.1%	0.9%	8%	0%
Orange farming	0.1%	0.6%	15%	3%
Other Fruits & Vegetables farming	0.3%	1.7%	28%	6%
Other crops farming	1.3%	8.6%	36%	1%
Other vegetables processing	1.2%	8.0%	70%	17%
	3.4%	**22.4%**		
Poultry and egg production	0.3%	2.3%	16%	0%
Poultry products	0.5%	3.3%	77%	15%
	0.8%	**5.6%**		
Cattle ranching and farming	0.8%	4.9%	0%	0%
Beef products	0.6%	4.0%	70%	9%
	1.4%	**8.9%**		
Milk farming	0.4%	2.4%	24%	0%
Dairy products	0.7%	4.3%	76%	0%
	1.0%	**6.7%**		
Hog and pig farming	0.2%	1.4%	0%	0%
Other animals production	1.2%	8.1%	65%	1%
Other meat products	0.6%	3.9%	71%	6%
Animal food manufacturing	0.5%	3.0%	22%	9%
Other food products	0.9%	6.1%	85%	6%
Beverage products	0.7%	4.7%	56%	2%
	4.2%	**27.3%**		
Forest Exploitation	0.1%	0.8%	1%	3%
Silviculture	0.1%	0.7%	3%	3%
Fishing, Hunting and Trapping	0.1%	0.7%	93%	0%
	0.3%	**2.2%**		
All Agribusiness	**15.3%**	**100.0%**		

*** Sum may exceed 100%, due to inventory variations**

Table 3 - Comparing Census and PPV data

Farm types		Property Size		Income/Value Added		Proportions					
						Area		Numer of Farms		Number of People	
		Farm Size	Cultivated Area	VA/ Farm	Income*/ Farm	Farm Size	Cultivated Area				
		Census	PPV	Census	PPV	Census	PPV	Census	PPV	Census	PPV
	A	16.50	4.54	8.17	131.58	10.90	11.30	40.80	38.40		39.70
Family	B	22.10	3.97	110.83	313.82	4.20	4.30	17.50	16.80		17.30
	C	34.00	9.36	290.92	555.78	11.70	11.80	21.10	22.20		20.60
	D	59.40	13.80	1.332.17	1.753.79	7.30	9.80	8.70	10.50		8.70
						34.10	**37.20**	**88.10**	**87.90**	**76.90**	**86.30**
	E		14.60		1.056.70	8.80	7.90		8.50		9.90
Non-family	F		249.14		2.227.34	57.10	54.90		3.70		3.80
		432.90		**1.590.42**		**65.90**	**62.80**	**11.80**	**12.20**	**23.10**	**13.70**

* Excludes houhesold heads with non-farm job and limits the size of the cultivated area

Farm types		Use of Energy (% of farms using)						Expenditure in PPV		
		Manual **		Animal		Other		Total		Inputs
		Census	PPV	Census	PPV	Census	PPV	R$	%	R$
	A	59.10	76.17	18.90	9.99	22.00	13.84	124.38	6.30	72.78
Family	B	52.30	72.52	25.50	8.73	22.20	18.75	159.16	3.50	91.86
	C	39.50	66.18	28.10	14.54	32.40	19.28	334.95	12.10	268.03
	D	26.70	54.63	21.20	6.93	52.10	38.45	273.92	3.50	183.35
		44.40	**67.38**	**23.43**	**10.05**	**32.18**	**22.58**	**250.09**	**25.40**	**183.66**
	E		45.33		20.69		33.98	3406.45	39.70	1.831.92
Non-family	F		21.78		39.06		39.16	7795.39	35.00	4.249.96
		9.8	**33.56**	**21.90**	**29.88**	**68.3**	**36.57**	**5.462.85**	**74.70**	**2.964.87**

** Definition of Manual in PPV is more restrictive, leading to a larger number of farms in this situation

Table 4 - Sources of monetary income

	Wages	Self Employment	Other labor	Rent	Sum
Family Ag 1	23.9%	10.7%	17%	20%	100%
Family Ag 2	30.9%	13.4%	23%	12%	100%
Family Ag 3	31.5%	18.7%	14%	13%	100%
Family Ag 4	55.7%	7.3%	8%	9%	100%
Business Ag	25.2%	38.3%	9%	10%	100%
Ag Employees	70.1%	2.1%	5%	16%	100%
Urban 1	40.5%	17.8%	12%	22%	100%
Urban 2	47.2%	18.6%	9%	20%	100%
Urban 3	48.8%	18.5%	10%	19%	100%
Urban 4	46.3%	22.3%	12%	13%	100%

Figure 3 - Distribution of wages

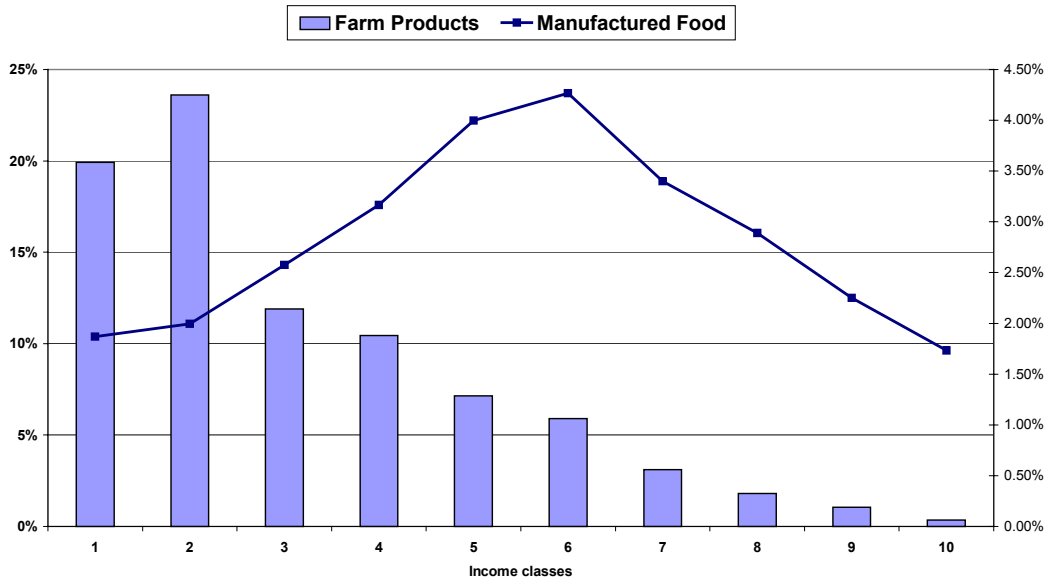


Figure 4 - Distribution of value added

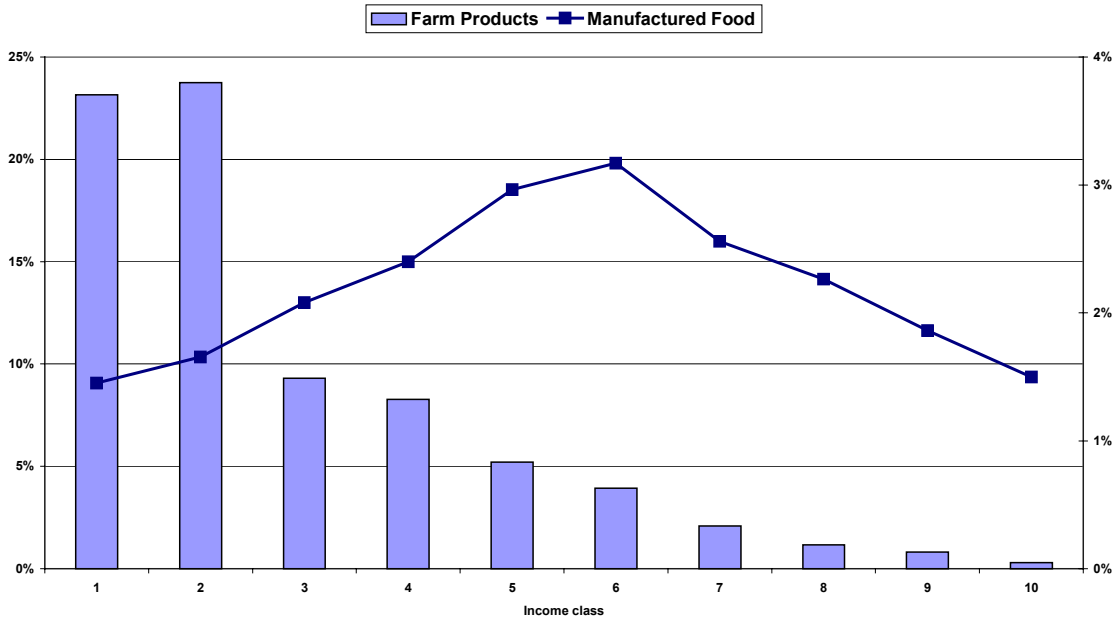


Figure 5 - Distribution of wages - Local Consumption x Exports

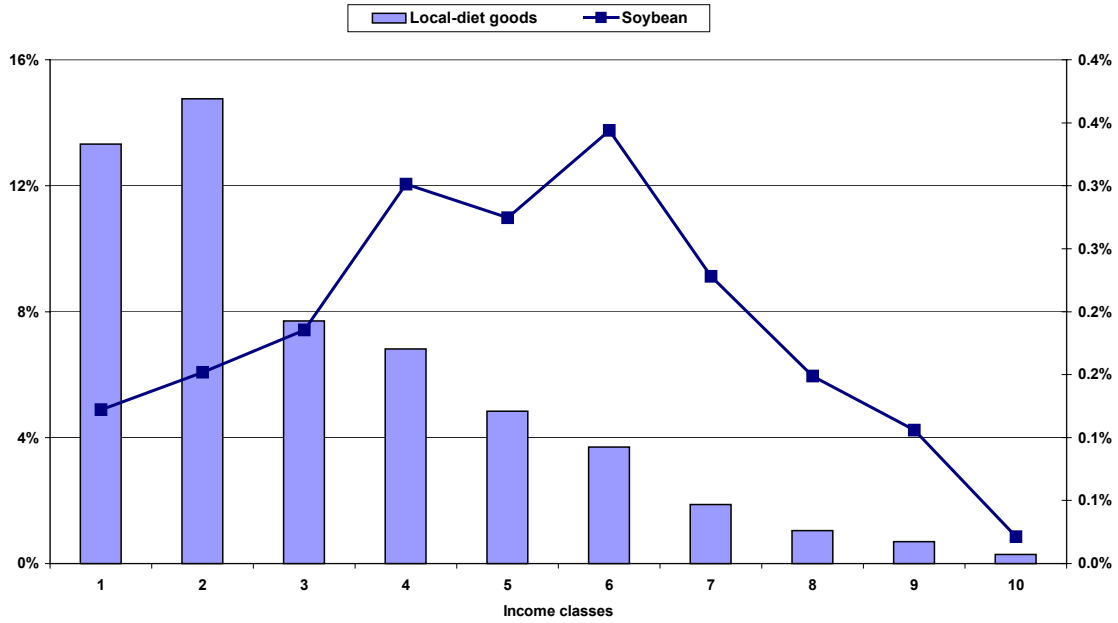


Figure 6 - Distribution of value added - local consumption x exports

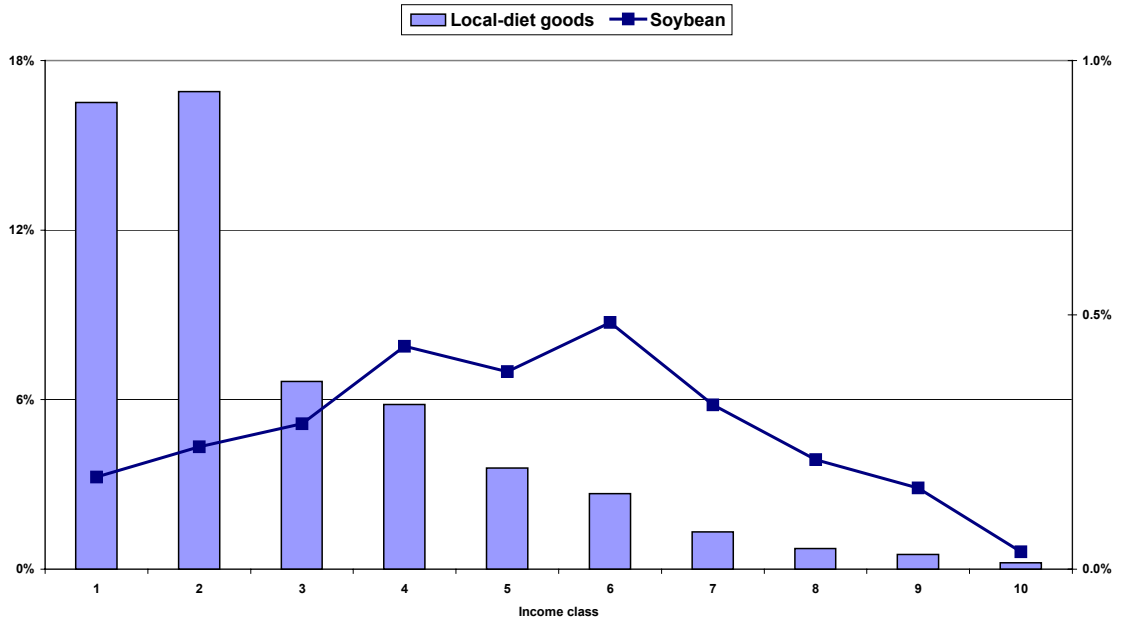


Figure 7 - Consumption by income group

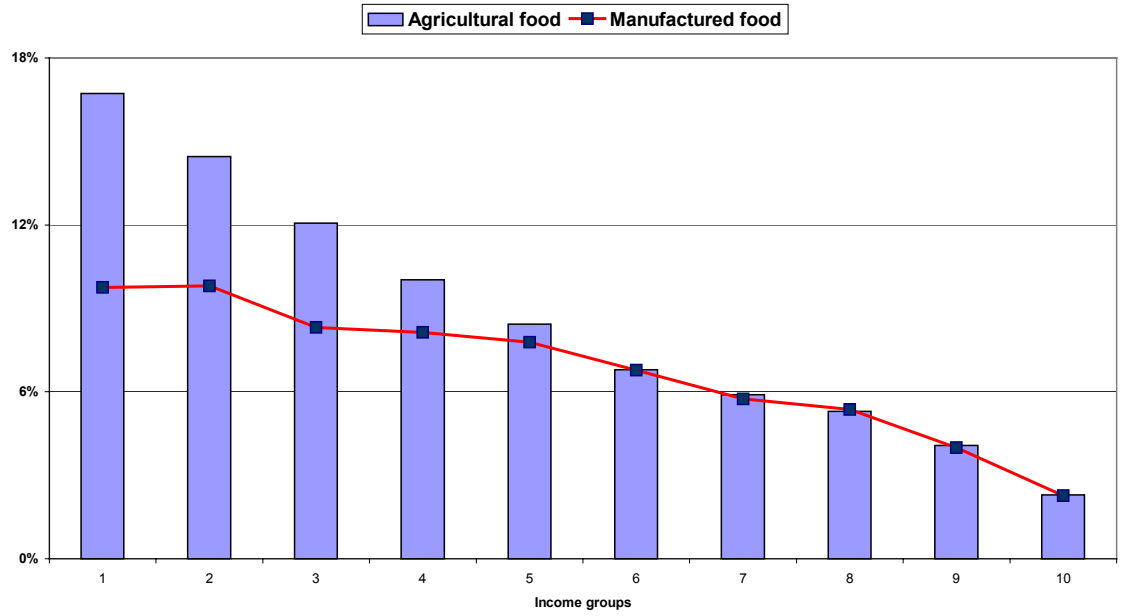


Figure 8 - Consumption by different groups

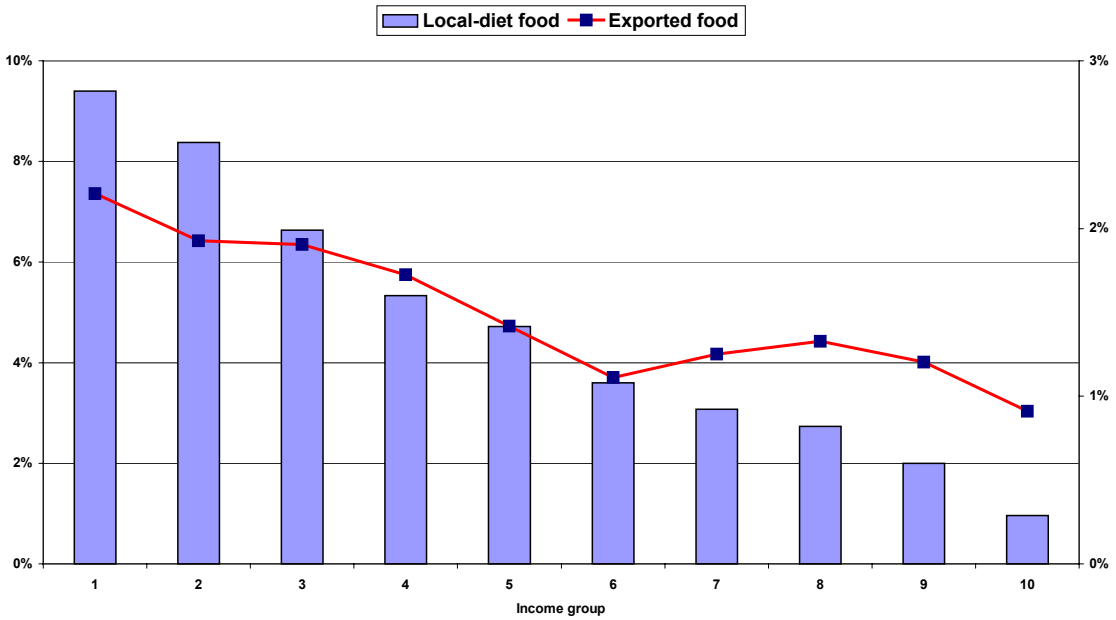


Figure 9 - Expenditure on Food, by family type

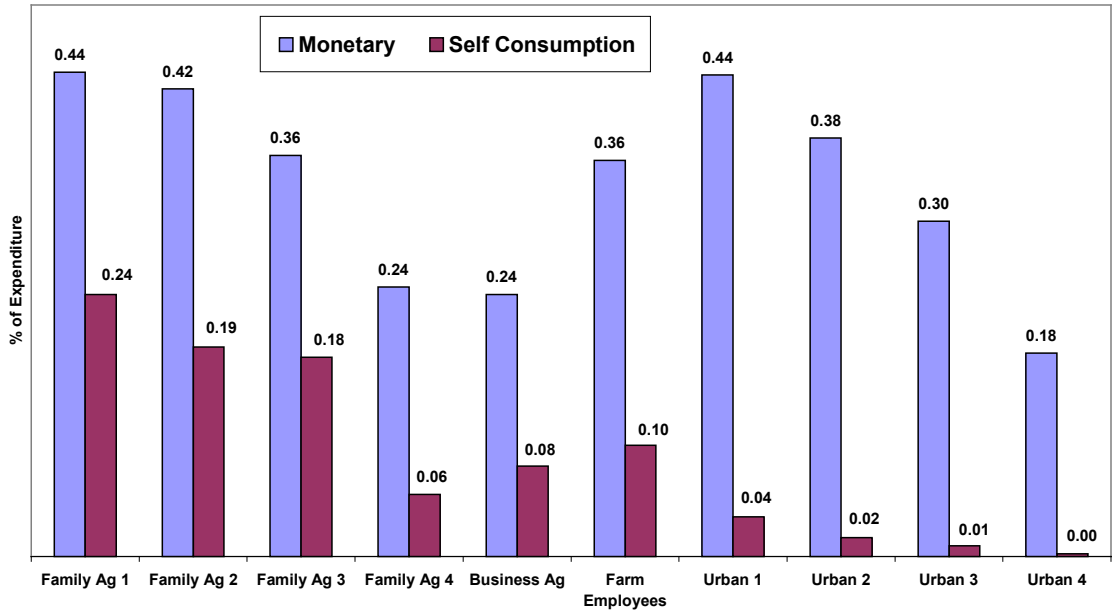
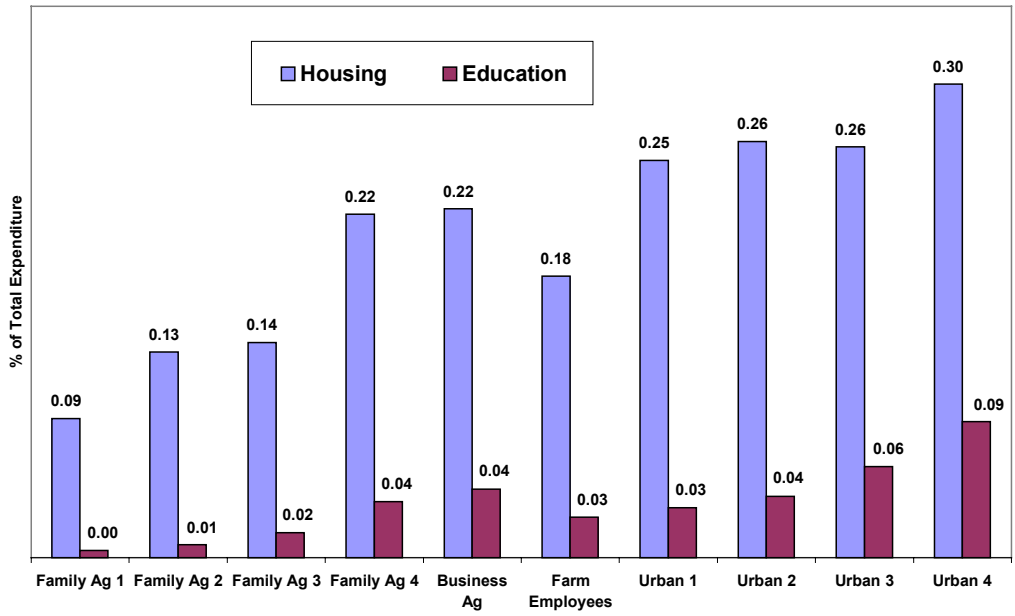


Figure 10 - Expenditure on Housing and Education

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