THE DOHA DEVELOPMENT AGENDA AND BRAZIL: A CLOSER LOOK INTO THE DISTRIBUTIONAL IMPACTS INSIDE AGRICULTURE

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Abstract
In this paper we extend previous results about how trade integration can affect poverty and income distribution in Brazil. To assess the impacts of a Doha Development Agenda (DDA) scenario on poverty and income distribution in Brazil, a

computable general equilibrium model (CGE) of Brazil was used, linked to a micro-simulation (MS) model. This method was proposed by Ferreira Filho and Horridge, and guarantees consistency between both models. The model comprises 112,055 Brazilian households and 263,938 adults, distinguishing 42 activities, 52 commodities, and 27 regions. The Doha round is simulated with the aid of a modified version of the GTAP model, and its impacts upon poverty and income distribution in Brazil analyzed. Results suggest that even a large shock like the one simulated would not greatly reduce poverty in Brazil, although the poorest households benefit most. The analysis was extended to look more carefully inside agriculture, splitting the households according to their working status (temporary workers, permanent workers, self-employed and employers), as well as according to their land ownership status (land less workers and farmers holding 5 land size farms).
Model results show an increase of 253,066 new jobs in the agricultural activities. Most of it (197,187) would be new jobs creation, or workers coming to agriculture from unemployment, and the other part (55,882 workers) would be a net attraction of jobs from contracting industries. The job creation benefits the poor disproportionately: 57% of the new agricultural workers belong to the first three lowest income classes (78% if only count the previously unemployed are considered). As a result of this job increase, total income increases by 3.3% in agriculture as a whole, and almost half of this increase (1.42%) is due to workers coming from unemployment and getting new jobs in agriculture.
The simulated DDA scenario, which was found to be poverty-reducing in previous work by the authors, is shown to also reduce poverty inside Brazilian agriculture. Despite the regional differences, all the players in agriculture seem to gain from the policy change. There are complex region/product/technology interactions to be taken into account, and no simple pattern emerges from the analysis.
Model results, then, contradict the notion that only landlords would gain from trade liberalization in the DDA agenda, an idea that became somewhat popular recently. The strong agricultural employment effect and the distribution of land ownership must be taken into account for this discussion.

Introduction

Brazil has one of the worst patterns of income distribution in the world. The persistence of this problem has interested researchers worldwide, and has stimulated a lively debate in Brazil. Central to this discussion is the role played by past trade liberalization, and the possible effects of future changes -- such as the Doha round. Global economic integration has complex effects: it is not obvious whether Brazil's

poor will benefit. For example, although Brazil's poorest regions and workers depend on agriculture, some have argued that increased agricultural exports will benefit mainly landowners rather than poorer people.

This paper addresses the potential impacts of a Doha agreement on income distribution and poverty in Brazil, and seeks to extend previous results. It focuses on impacts within agriculture, and on effects linked to ownership of land and other production factors.

Background and motivation

The share of agriculture-based products in Brazilian exports began to rise again by 1994, after a steady decline since the seventies. Likewise, the rate of growth of agricultural GDP has been rising, mainly from the late nineties, at higher rates than total GDP. For the Brazilian economy the agricultural sector is still important. With strong forwards and backwards linkages with other sectors in the economy, agricultural GDP was about 10.3% of total GDP in 2003, and accounted for about 19% of total population (in 2002).

Studying the effects of Doha Development Agenda (DDA) scenarios on income distribution and poverty in Brazil, Ferreira-Filho and Horridge concluded that trade liberalization would benefit the poor: around a quarter of a million persons would leave poverty due to the DDA scenario simulated. Their analysis, however, did not differentiate between the impacts on different farm sizes or on different types of workers in Brazilian agriculture. These impacts can be of considerable interest, due to regional specialization and different technological patterns across regions. This paper addresses these questions more thoroughly.

Poverty in Brazil: an overview

Although Brazil is a large country with many poor people, it is not among the world's poorest. Drawing on the 1999 Report on Human Development, Barros, Henriques and Mendonça show that around 64 percent of countries have smaller per capita income than Brazil, as do 77 percent of world population. They also show that, while in Brazil 30 percent of the total population is poor, on average only 10 percent are poor in other countries with similar per capita income.

Focusing on income insufficiency, the same authors show that in 1999 about 14 percent of the Brazilian population lived in households with income below the line of extreme poverty (indigence line, about 22 million people), and 34 percent of the population lived in households with income below the poverty line (about 53 million people). Green, Dickerson and Arbache arrived to the same general results, concluding that the egalitarian consequences of trade liberalization were not important in Brazil for the period under analysis.

Brazilian poverty also has an important regional dimension. According to calculations by Rocha in a study for the 1981/95 period the richer South-East region of the country, while counting for 44 percent of total population in 1995 had only 33 percent of the poor. For the poorer regions, on the contrary, the share of population is lower than the share of poor: 4.6 percent (9.3 percent of poor) for the North region, and 29.4 percent (44.3 percent of poor) for the North-East region, the poorest region in the country. Table 1 shows more information about poverty and income inequality in Brazil in 2001.

Calculations by Ferreira-Filho and Horridge show that agriculture is an important employment sector for the poorest in Brazil. Using a ten wage class classification and data from the Brazilian Household Survey for 2001 they showed that the lowest wage

class accounts for 40% of the total agriculture labor bill, and agriculture accounts for about 41% of wages of the less skilled (lower-waged) workers.

Table 2 shows the importance of each broad income source for workers in agriculture, classified by occupation: permanent workers, temporary workers, self employed producers, and employers[1]. For comparison, the first column reports income sources for non-agricultural workers. As Table 2 shows, wages are the main income source for every category. The reported values for employers, however, should be regarded as including the returns from land and capital stocks. The same applies to self-employed workers.

Transfers are an important income source both for self-employed workers and employers. These are mainly retirement pensions, which account for 23% of total income of self employed workers in 2001. The income profile for both permanent and temporary workers in agriculture closely follows that of non-agricultural workers: wages are 92% to 95% of total income.

Table 3 shows the composition of income inside agriculture, according to the occupational status, by region. In the southeast region the states of São Paulo, Bahia and Minas Gerais concentrate the bulk of the temporary and permanent employed workers in Brazil. São Paulo and Minas Gerais have also high shares of employers in national total. Rio Grande do Sul and Paraná (states in southern Brazil), on the other hand, account for high shares of self employed workers in agriculture. Santa Catarina, another southern state, is also important for the self-employed specially if one takes into account the state's small size.

The center-west states (Mato Grosso do Sul, Mato Grosso and Goias) are also interesting cases. Mato Grosso is the most important soybean producing state in

Brazil, followed closely by Rio Grande do Sul. Mato Grosso, however, shows small shares of all worker types, including employers. This follows from its particular land ownership structure, dominated by large and more capital intensive farms. Note that while Rio Grande do Sul state accounts for 17% of the self-employed in Brazilian agriculture, Mato Grosso accounts for just 3%, but the employers' shares are about the same for both states (6% for RS and 7% for MT).

Potential impacts of DDA scenario: the methodology

To assess the impacts of a DDA scenario on poverty and income distribution in Brazil, a computable general equilibrium model (CGE) of Brazil was used, linked to a micro-simulation (MS) model. This method was proposed by Ferreira Filho and Horridge, and guarantees consistency between both models[2].

The CGE model used here is a static inter-regional model of Brazil based on the well-known ORANI-G model of Australia (Horridge) and was calibrated with Brazilian 1996 data. The model's structure is quite standard: consumption is modeled through the Linear Expenditure System over composite commodities (domestic and imported); exporters of each commodity face constant-elasticity[3] foreign demand schedules; production for exports or domestic markets are regulated by CET[4] functions for each firm, production is a nested LEONTIEF/CES structure for primary factors and composite inputs, labor is a CES function of 10 different types of labor. This non-linear model is solved with the GEMPACK software, and distinguishes between 42 sectors and 52 commodities[5]; 10 labor occupational categories.

All quantity variables in the model are disaggregated according to 27 regions within Brazil, using an elaboration of the top-down regional modeling method described in Dixon *et al.* This methodology recognizes local multiplier effects: many

service goods are little traded between regions, so that local service output must follow local demand for services.

On the income generation side of the model, workers are divided into 10 different categories (occupations), according to their wages. These wage classes are then assigned to each regional industry in the model. Together with the revenues from other endowments (capital and land rents) these wages will be used to generate household incomes. The CGE model covers 270 different expenditure patterns, composed of 10 different income classes in 27 regions. In this way, all the expenditure side detail of our micro-simulation dataset is incorporated within the main CGE model.

The main sources of information for the household micro-simulation model were the Pesquisa Nacional por Amostragem de Domicílios –PNAD (National Household Survey – IBGE, 2001), and the Pesquisa de Orçamentos Familiares- POF (Household Expenditure Survey, IBGE, 1996). The model database contains 263,938 adults, grouped into 112,055 households, with records about wage by industry and region, and personal characteristics such as the ownership of land, type of work, years of schooling, sex, age, position in the family, and other socio-economic characteristics.

Model closure

Model closure was chosen to mimic the GTAP model that generated the foreign price scenario. On the supply side, total national employment is fixed by occupation, with labor moving freely across sectors. The model allows substitution between occupations, driven by relative wages. Similarly, capital is fixed nationally but is mobile between sectors and regions. Land stocks (used just in Agriculture) are fixed.

On the demand side a fixed trade balance enforces the national budget balance, which is accommodated by changes in real consumption, with investment and government spending fixed. The Consumer Price Index (CPI) is the model's numeraire.

Finally, tax revenue losses due to tariff cuts are replaced: real aggregate revenue from all indirect taxes is kept fixed, via a uniform endogenous change in the power of indirect taxes on sales to households. This mechanism is equivalent to a lump sum tax, of value proportional to each household's spending

The DDA scenario

The simulated DDA scenario comprises cuts in agricultural tariffs according to a non-linear (two tier) formula with maximum cuts of 75%, cuts in domestic support for OECD agriculture, elimination of export subsidies, and 50 percent proportional cuts in non-agricultural tariffs. In the case of special and differential treatments developing countries were given a 2/3 reduction of the developed countries, while no reduction was imposed for the least developed.

Simulation results

As a result of the shocks, agriculture and agriculture-related industries (the food industry in general) expand. Model results show a general fall in activity in the Brazilian manufacturing sectors after trade liberalization, since these are the protected sectors in Brazil in the base year. This suggests that regions specializing in manufacturing would fare worse. Indeed, employment falls in São Paulo and Rio de Janeiro in the southeast (the most populous and industrialized states) which host the bulk of Brazil's manufacturing, and falls also in Amazonas, where there is a free exporting zone. Reduced mining activity cuts jobs in Amapá.

The trade liberalization simulation redistributes economic activity toward poorer regions, because manufacturing sectors (concentrated in the richer regions) shrink, and agriculture (concentrated in relatively poorer regions) grows, with a net effect of 235,886 persons leaving poverty in Brazil.

Extending the results to look inside agriculture, model results show an increase of 253,066 new jobs in the agricultural activities. Most of it (197,187) would be new jobs creation, or workers coming to agriculture from unemployment, and the other part (55,882 workers) would be a net attraction of jobs from contracting industries. The job creation benefits the poor disproportionately: 57% of the new agricultural workers belong to the first three lowest income classes (78% if only count the previously unemployed are considered). As a result of this job increase, total income increases by 3.3% in agriculture as a whole, and almost half of this increase (1.42%) is due to workers coming from unemployment and getting new jobs in agriculture[6].

Income variation (percent) by type of agricultural worker (occupational status) and income class of the household to which the worker belongs can be seen in Table 4. New jobs in agriculture help the poor (top left Table 4), while rising land rents benefit agricultural employers (last column), who are mostly landowners[7]. Richer employers benefit proportionately more (bottom right) since more of their income arises from rents. The aggregated result is an increase in income for every agricultural worker type, and a decrease in income for non-agricultural workers.

Since the PNAD includes data for land holdings (hectares owned) the following question can be addressed: do owners of large (area) farms benefit more than small farm owners? Table 4 shows that owners of larger farms do indeed benefit

more: the larger farmers group in the richest household would get an 8.2% income increase. But other farmers also gain, regardless of their land holding. Even the poorest landless group enjoy a 6.17% income increase (Table 9).

However, area of land owned is not closely correlated with income class. It is apparent from Table 4 that there are employers (mostly landowners) in every household income class. Indeed, the PNAD shows that 13.3% of farmers owning less than 25 ha fall in the lower 5 income groups while 55.2% of these farmers belong to the two highest income groups -- even though 25 ha is a small farm area by Brazilian standards. Behind this lies a regional distinction: poorer farmers with big farms are concentrated in the north of Brazil, and richer farmers with small farms in the south and southeast.

More regional information can be seen in tables 5 and 6. Table 5 shows the share of total farmer income, by region and occupation status. As it can be seen, the share of employers in each region's total agricultural income is higher in the industrialized states of the southeast (Minas Gerais, Espirito Santo, Sao Paulo, Rio de Janeiro), and in the "new" agricultural frontiers in the center-west (Mato Grosso do Sul, Mato Grosso, and Goias). Some states in the north (Acre and Para) are also important[8], as well as some estates in the northeast (Rio Grande do Norte and Tocantins). Self employment is most important in northern and northeastern Brazil, and in the south (Rio Grande do Sul and Santa Catarina). The share of temporary workers tends to be smaller in the states with relatively more modern agriculture in the southeast (except Minas Gerais), center-west and south, reflecting technology choices. And, interesting enough, the share of permanent workers tends to be higher where the share of employers is also higher[9].

Regional differences in farm size concentration can be seen in Table 6. As it can be seen, states where the farm income is dominated by large farms are mainly the center-west states, where important part of the modern grain and livestock production is concentrated, and some other states in the north (Acre) and northeast (Rio Grande do Norte and Paraiba). On the other hand, in the state of Santa Catarina (south), for example, all reported farmer income come from farmers with land area up to 100 ha, and 75% up to 50%[10].

Tables 7 and 8 shows simulation results for regions. Table 7 shows the average income variation by occupation status. As it can be seen, results can differ considerably across states. Employer's average income increase less in some of the poorest Brazilian states, like Piaui, Ceara and Rio Grande do Norte. On the other hand, the region of extensive grain and livestock production (CW) shows high values for employers income variation. Temporary workers benefit more in those poorer states abovementioned than in the other states, and the same happens to the self-employed workers.

No clear pattern seems to emerge from the results in Table 8. Large income increases can be observed in different farm sizes and regions. Again, this is another indication that just the farm size is not a safe classification for welfare analysis. Regions, and inside them the product composition (not showed here) may be determinant for the results of policy shocks regardless the size of the exploitation.

The simulated DDA scenario, then, generates an income rise to landowners, and a fall in income to non-agricultural workers. However, many previously unemployed get new jobs in agriculture. Considering that initially poverty is concentrated in agricultural households and among the unemployed, the jobs/income

shift helps raise income of the poorest households (POF[1] and POF[2]) and reduces poverty overall.

And, finally, the gains according to household income class and farm size can also be seen in Table 9. As it can be seen, the simulated DDA scenario would entail a 6.17% income increase for agricultural (land less) workers in the lowest income class (POF[1]), a gain almost as high as those observed for large farmers (above 250 ha). The gains would increase with farm size: the larger farmers group in the richest household would get an 8.2% income increase. But results from Table 4 and Table 6 show that they wouldn't be the only ones to gain. In aggregated terms the income of all occupations inside agriculture would increase, and farmers would gain regardless their land area[11].

Conclusions

The simulated DDA scenario, which was found to be poverty-reducing in previous work by the authors, is shown to also reduce poverty inside Brazilian agriculture. Despite the regional differences, all the players in agriculture seem to gain from the policy change. There are complex region/product/technology interactions to be taken into account, and no simple pattern emerges from the analysis.

Model results, then, contradict the notion that only landlords would gain from trade liberalization in the DDA agenda, an idea that became somewhat popular recently. The strong agricultural employment effect and the distribution of land ownership must be taken into account for this discussion.

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Table 1. Poverty and income inequality in Brazil, 2001.

Income group	PrPop	PrInc	AveHouInc Index	UnempRate	Share below poverty line	AveWage Index	PrChild
POF[1]	10.7	0.9	0.1	32.6	0.96	0.2	46.2
POF[2]	8.0	1.8	0.4	17.3	0.77	0.3	37.2
POF[3]	16.0	5.2	0.6	10.4	0.54	0.4	35.1

POF[4]	7.3	3.1	0.8	8.8	0.28	0.4	32.5
POF[5]	11.0	5.8	1.0	7.5	0.11	0.5	28.7
POF[6]	7.9	5.1	1.2	7.4	0.03	0.6	26.4
POF[7]	12.9	11.1	1.7	6.8	0.01	0.8	24.5
POF[8]	7.5	8.7	2.3	6.1	0.01	0.9	21.5
POF[9]	7.7	12.7	3.1	5.9	0.00	1.4	20.5
POF[10]	10.9	45.7	7.9	4.2	0.00	3.2	17.7
Total	100.0	100.0	1.0	9.5	0.31	1.0	29.5

PrPop = % in total population; PrInc = % in country total income; AveHouInc Index = average household income index; UnempRate = unemployment rate; PrWhite = % of white population in total; AveWage Index = average normalized wage index; PrChild = share of population under 15 by income class.
Source: PNAD, 2001.

Table 2. Income composition (shares) of working adults by income source. Brazil, 2001.

		Farmers and farm workers			
Income source	**Non-farm workers**	**Permanent workers**	**Temporary workers**	**Self employed workers**	**Employer**
Wage	0.92	0.95	0.94	0.73	0.83
Nonwage	0.02	0.02	0.02	0.04	0.06
Transfers	0.06	0.03	0.05	0.23	0.11
Total	1	1	1	1	1

Source: PNAD, 2001. For non-workers, transfers are 89% of income.

Table 3. Share of wage income by region, according to the type of worker. Brazil, 2001.

		Working in agriculture				Population Share
Region	**NonAgr**	**Permanent**	**Temporary**	**SelfEmploy**	**Employer**	
North (N)	0.04	0.03	0.06	0.04	0.04	0.06
Northeast(NE)	0.14	0.21	0.34	0.33	0.18	0.29
Southeast (SE)	0.57	0.43	0.41	0.21	0.39	0.44
South	0.17	0.15	0.09	0.36	0.18	0.15
Center-west	0.08	0.18	0.10	0.07	0.22	0.07
Total	1.00	1.00	1.00	1.00	1.00	1.00

Table 4. Income variation (%) by income class and type of agricultural household.

Income class	NonAgr	Permanent	Temporary	SelfEmploy	Employer
POF[1]	8.52	1.22	1.37	1.68	5.79
POF[2]	1.27	0.61	0.80	1.13	7.23
POF[3]	0.64	0.23	0.74	0.91	6.57
POF[4]	0.23	0.06	0.63	0.68	6.11
POF[5]	0.13	0.04	0.52	0.55	5.88
POF[6]	-0.07	-0.07	0.26	0.36	7.11
POF[7]	-0.15	-0.14	0.27	0.20	7.39
POF[8]	-0.29	-0.17	0.12	0.10	7.36
POF[9]	-0.31	-0.01	0.00	-0.02	8.37
POF[10]	-0.38	0.49	0.28	0.12	8.25
Aggregate	-0.15	0.15	0.64	0.45	8.05

Row and column headings refer to adult status in the presimulation database (based on PNAD). The NonAgr column includes unemployed as well those working outside agriculture: the large increases for NonAgr POF[1] and [2] reflect income boosts for those newly employed in agriculture.

Table 5. Income variation (%) by farm size and income class.

		Farm size (ha)				
Income class	**NoLand**	**upto25**	**upto50**	**upto100**	**upto250**	**above250**
POF[1]	6.17	4.64				
POF[2]	1.21	4.82				
POF[3]	0.65	4.42				
POF[4]	0.28	3.95	4.72	7.02		
POF[5]	0.17	3.64	5.28	4.91	5.29	9.62
POF[6]	-0.03	4.75	3.60	6.58	7.63	6.06
POF[7]	-0.13	4.30	5.99	6.93	5.88	7.06
POF[8]	-0.27	4.90	8.53	5.07	6.56	8.58
POF[9]	-0.30	4.57	6.02	8.31	9.14	8.71
POF[10]	-0.37	3.45	6.88	6.91	7.39	8.20

NoLand: All adults without land. Source: Model results. Blank cells reflect a PNAD sample size too small to report.

[1] An employer is not necessarily a land owner, although this would be generally the case. The land rentals market is not well developed in Brazil. The situation for the self-employed, however, is less clear.

[2] A detailed methodological discussion regarding this method can be seen in Ferreira-Filho and Horridge.

[3] For the simulations reported here, export demand elasticities were set to values derived from the GTAP model, so as to increase consistency between results for the world and Brazil models.

[4] The domestic/exportable CET was set to infinity for the simulations reported below, to fit in with the assumptions of the GTAP model.

[5] One of the activities (Agriculture) produces 11 commodities.

[6] A point should be notice here. In the core AGE model labor is in fixed supply at national level. In the micro-simulation model, however, there is no migration across regions. This difference is accommodated by the fact that there is high unemployment in every region and occupation in the database. The shocks to the micro-simulation model coming from the main core AGE model are consistent with the nationally fixed labor supply, by occupation.

[7] Note that the simulation links employer income to land rents; the wage income of other workers is modeled normally. There is a strong correlation between crop prices and land prices, since Brazilian agriculture receives no production subsidies. With fixed land endowment, the earnings of the employers (land owners) increase more than the wage of the workers, who just receive the value of their marginal product as wages. Whether the income of self-employed should be linked also to land rents, is open to discussion. Many of these workers are not land owners, but land renters. In this case, the owner would get the land rent, not the self employed, who would tend to get just the cost opportunity of labor.

[8] The results agriculture for the northern region should be regarded with less confidence, since sometimes the sample is small. Besides that the field conditions for the survey are often poor, and may affect the results.

[9] Ferreira Filho also noted that the production of dynamic products in the dynamic agriculture regions in Brazil demand less unskilled workers the than the respective production in more traditional regions.

[10] Santa Catarina (southern Brazil) is one of the smallest Brazilian states, whose population is mainly composed of former German and Italian settlers.

[11] Ferreira Filho and Horridge also found a substantial fall in the consumption bundle price of the poorest household in the economy. This price fall reduces as the household income rises, and actually increases for the richest. This means that the real increase for the poorest is higher than what could be guessed just from the income increase if it is deflated by the relevant price index.