THE WORLD INCREASE IN ETHANOL DEMAND AND POVERTY IN BRAZIL

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Motivation

- Brazil has traditionally been one of the largest ethanol producers in the world.
- End of PROALCOOl program subsidies in the 80's and increase of sugar prices in the 90's reduced markedly ethanol production in Brazil.
- Beginning of the 2000's: increase in oil prices and introduction of the flex fuel engines increased production again.

EPE (2008)

- In 2008 the ethanol was already economically viable as a fuel in 17 out of 26 Brazilian states.
- 87% of sales of new cars were with flex fuel engines.
- Estimate: in 2017 73% of total demand of liquid fuels in Brazil will be met by ethanol.

External demand

- The projection in external demand increase is also very large.
- Exports:
  - 4.2 billions liters in 2008
  - 8.3 billion liters in 2017.
- There is also a projected increase in ethanol demand for chemical industries use.

Distributive aspects of the problem

- The expansion of the sugar cane production complex will not be uniform across the territory.
- There are important regional differences in the technology of production, specially in the sugar cane primary production case.
- The distributional impacts of this expansion have not been analyzed so far.
- OBJECTIVE: analyze the distributive impacts of ethanol expansion in Brazil, focusing the differential impacts across the territory.

Methodology

- A general equilibrium model of Brazil calibrated with 2005 data.
- The model is linked to a micro-simulation model of Brazil for distributional analysis.

The CGE model

- Static, inter-regional, bottom-up.
- 35 sectors.
- 35 products (11 agricultural products)
- 10 types of workers (wage classes)
- 27 regions inside Brazil
- 10 household types (income classes)
- Linearized, solved with GEMPACK

The micro-simulation model

- PNAD (Household Survey) 2005 – wages by sectors and regions, personal and households characteristics.
- POF (Expenditure survey) 2003 – household expenses, 270 different patterns.
- After preparation:
  - 126,007 households
  - 293,048 adults
  - 35 sectors, 35 products
  - 27 regions

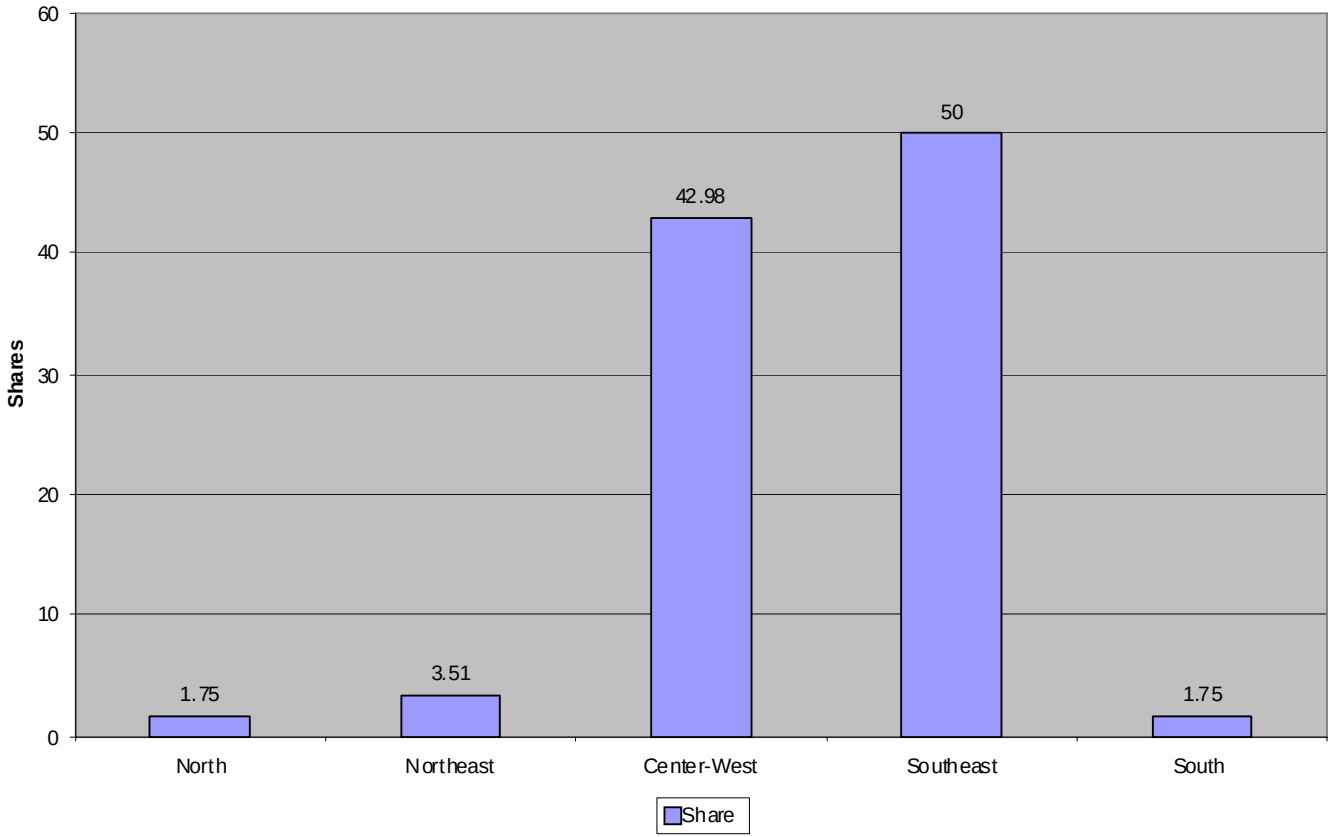
The scenario to be simulated: EPE and UNICA

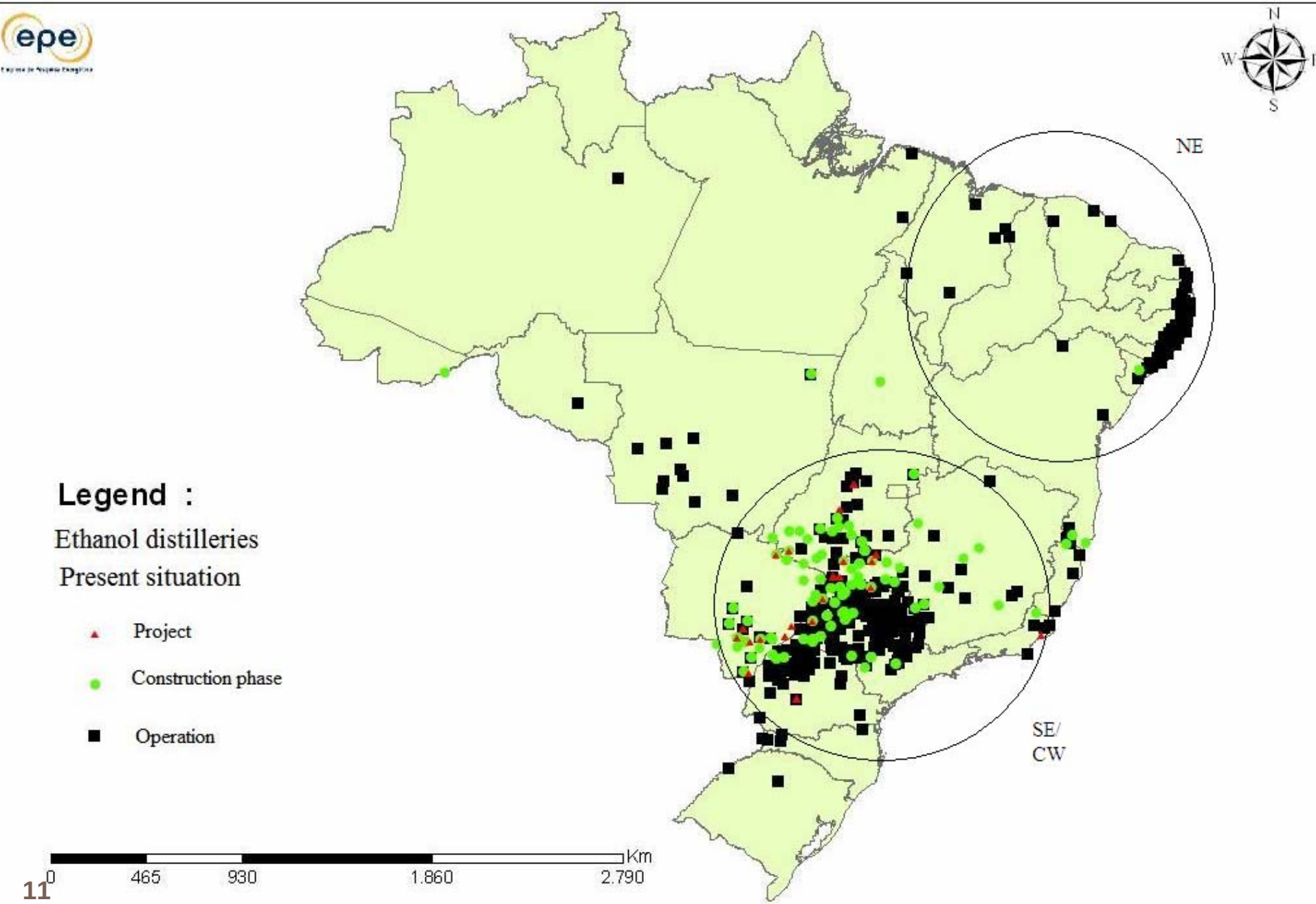
Ethanol demand projections for Brazil. Billions of liters.

Ethanol use projections	2006/2007	2015/2016	% variation
Domestic fuel use	13.55	32.65	141.0
Chemical industry use	0.65	1.95	200.0
Exports	3.7	12.3	232.4
Total	17.9	46.9	162.0

The projected expansion will not be uniform in the territory: 132 new mills

Regional distribution of new sugar cane mills in Brazil. 2010




N
W
E
S
NE
SE/
CW
Legend :
Ethanol distilleries
Present situation
Project
Construction phase
Operation
Km
0
465
930
1.860
2.790

Simulation

- Increase in ethanol demand:
  - Household fuel use
  - Intermediate consumption
  - Exports.
- Intermediate step: adjustment of the 2005 database

Closure: long run

- Fixed national employment
- Endogenous household consumption, government consumption linked to household.
- Capital stock endogenous for most sectors. For ethanol:
  - Endogenous in the expansion states: Minas Gerais, Sao Paulo, Mato Grosso do Sul, Mato Grosso and Goias.
  - Fixed in the other states.
- Land stocks fixed by state.
- Reduction in ethanol transport costs in the center-west states.
- Ethanol use increase accommodated by:
  - A fall in gasohol use by households and
  - A fall in Basic Petrochemical Products use in intermediate consumption.

Shocks

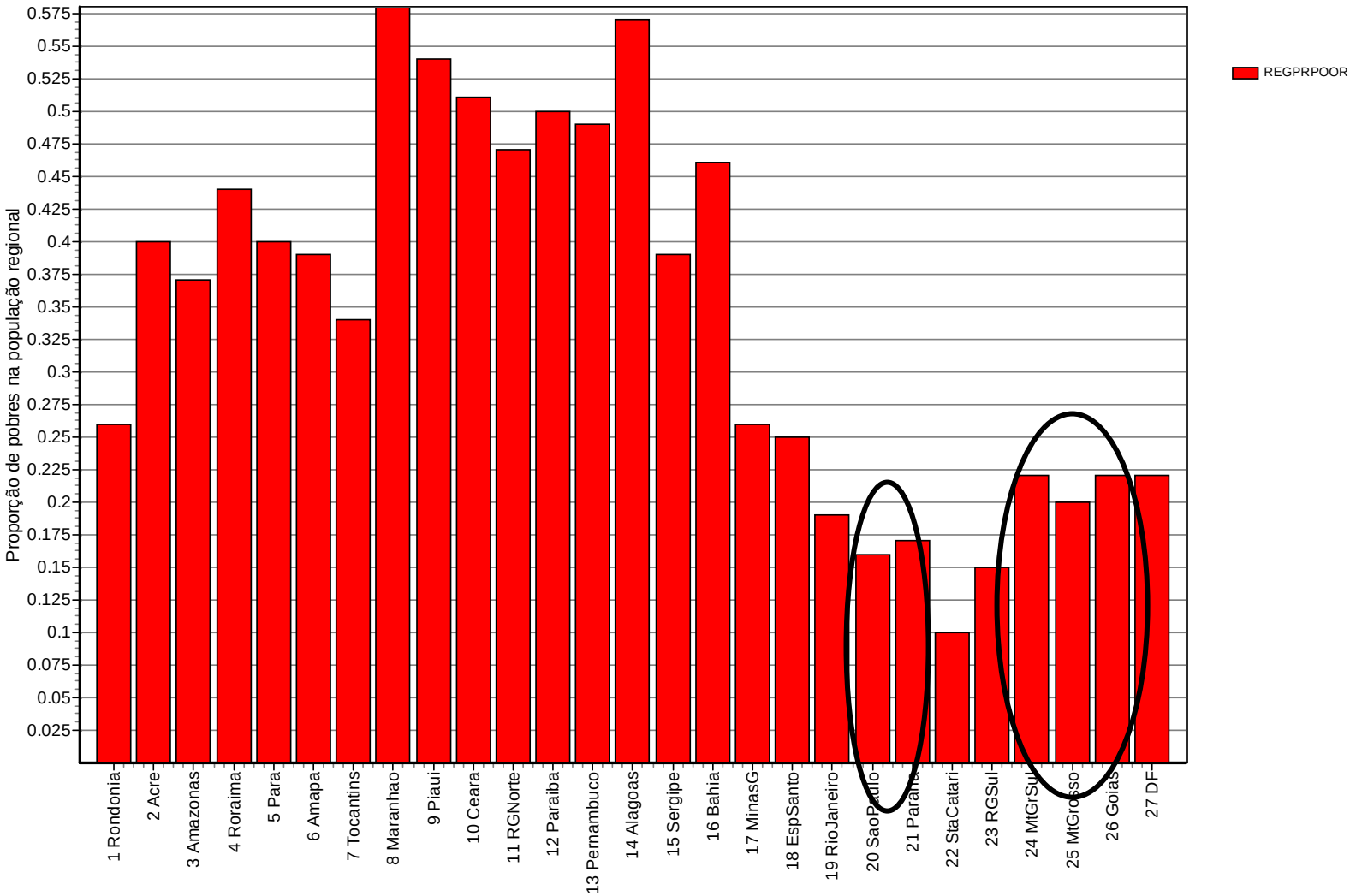
. Ethanol demand shocks to the model.

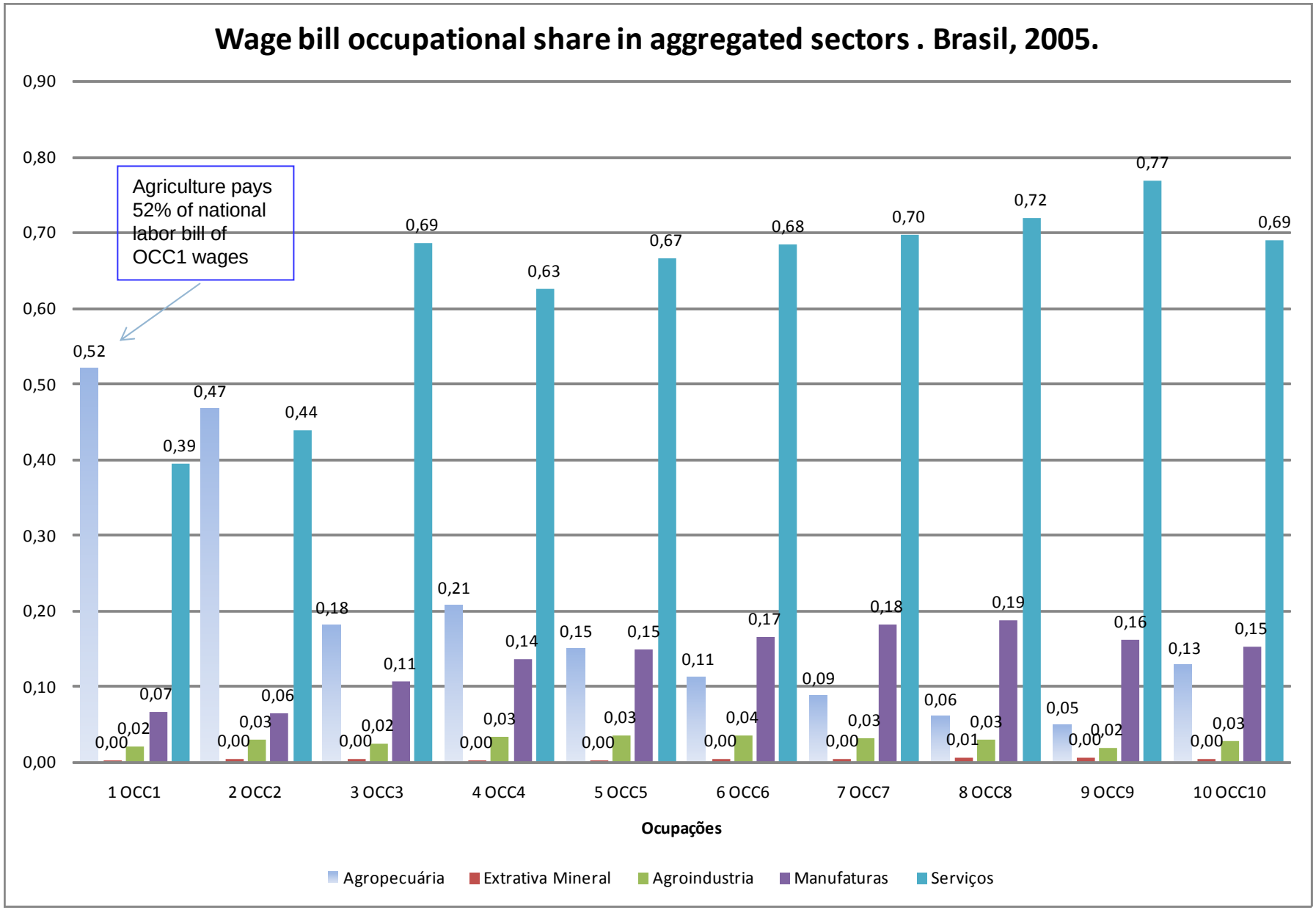
Shocks	% variation
Domestic household demand for fuel use	135.0
Chemical industry use	25.0
Exports	232.4

Poverty and income distribution in Brazil in 2005: 15,7 millions of poor households

Household income group	Share of population	Share of income	Share below poverty line (FGT0)	Contribution to the % of poor (FGT0)	Average poverty gap (FGT1)	Contribution to total poverty gap FGT1
1 POF[1] (poorest)	14.1	2.3	0.85	0.14	0.50	0.08
2 POF[2]	14.0	4.2	0.62	0.09	0.18	0.02
3 POF[3]	21.0	10.1	0.20	0.04	0.03	0.01
4 POF[4]	7.7	4.7	0.05	0.00	0.01	0.00
5 POF[5]	10.9	8.4	0.01	0.00	0.00	0.00
6 POF[6]	7.2	7.0	0.00	0.00	0.00	0.00
7 POF[7]	9.9	12.6	0.00	0.00	0.00	0.00
8 POF[8]	5.3	9.2	0	0	0	0
9 POF[9]	4.8	11.8	0	0	0	0
10 POF[10]	5.2	29.7	0	0	0	0
BRASIL	100.00	100.00	0.28	Sum = 0.28	0.12	Sum = 0.12
GINI	0.55					

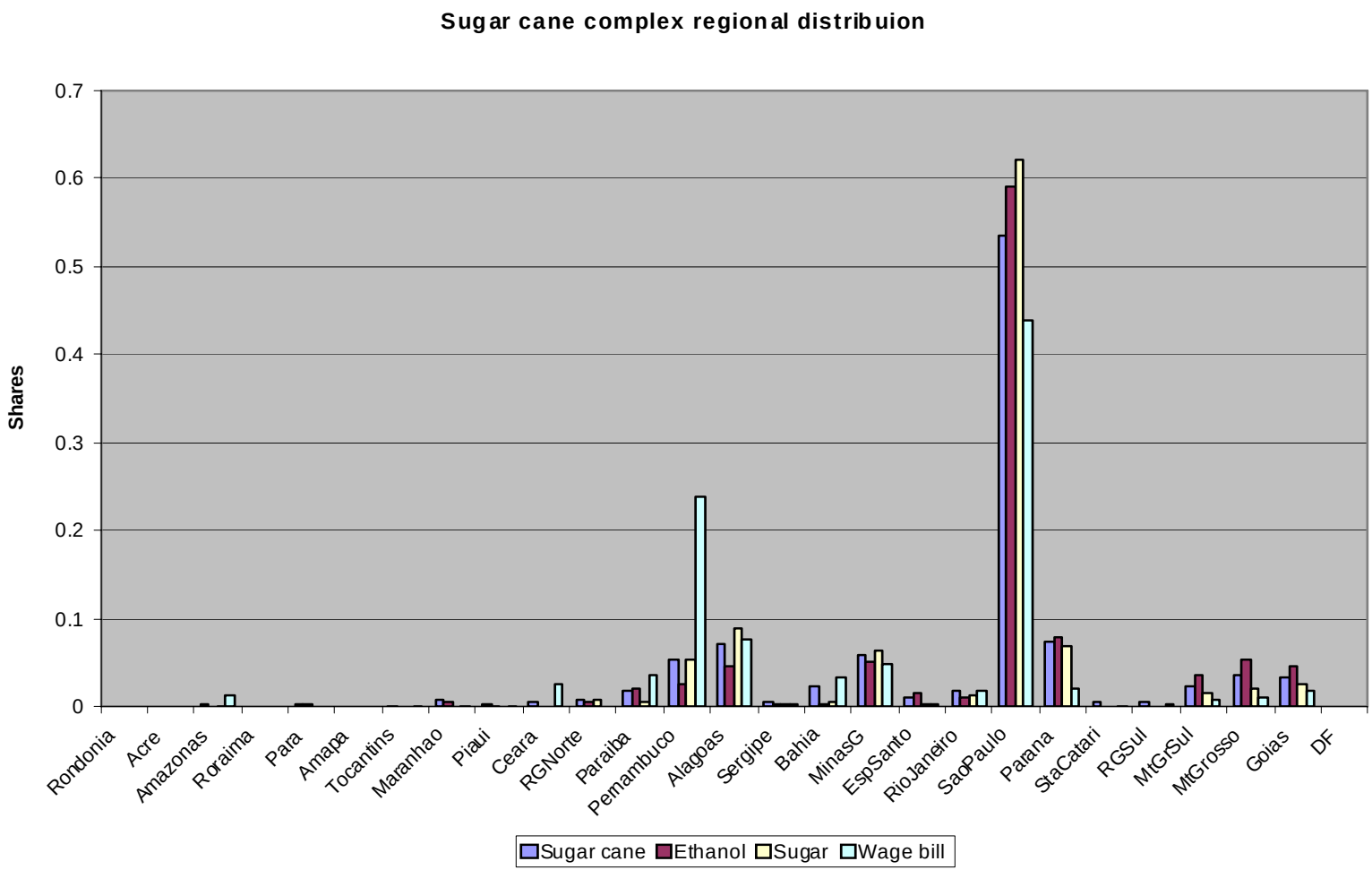
Proportion of poor persons, by region.



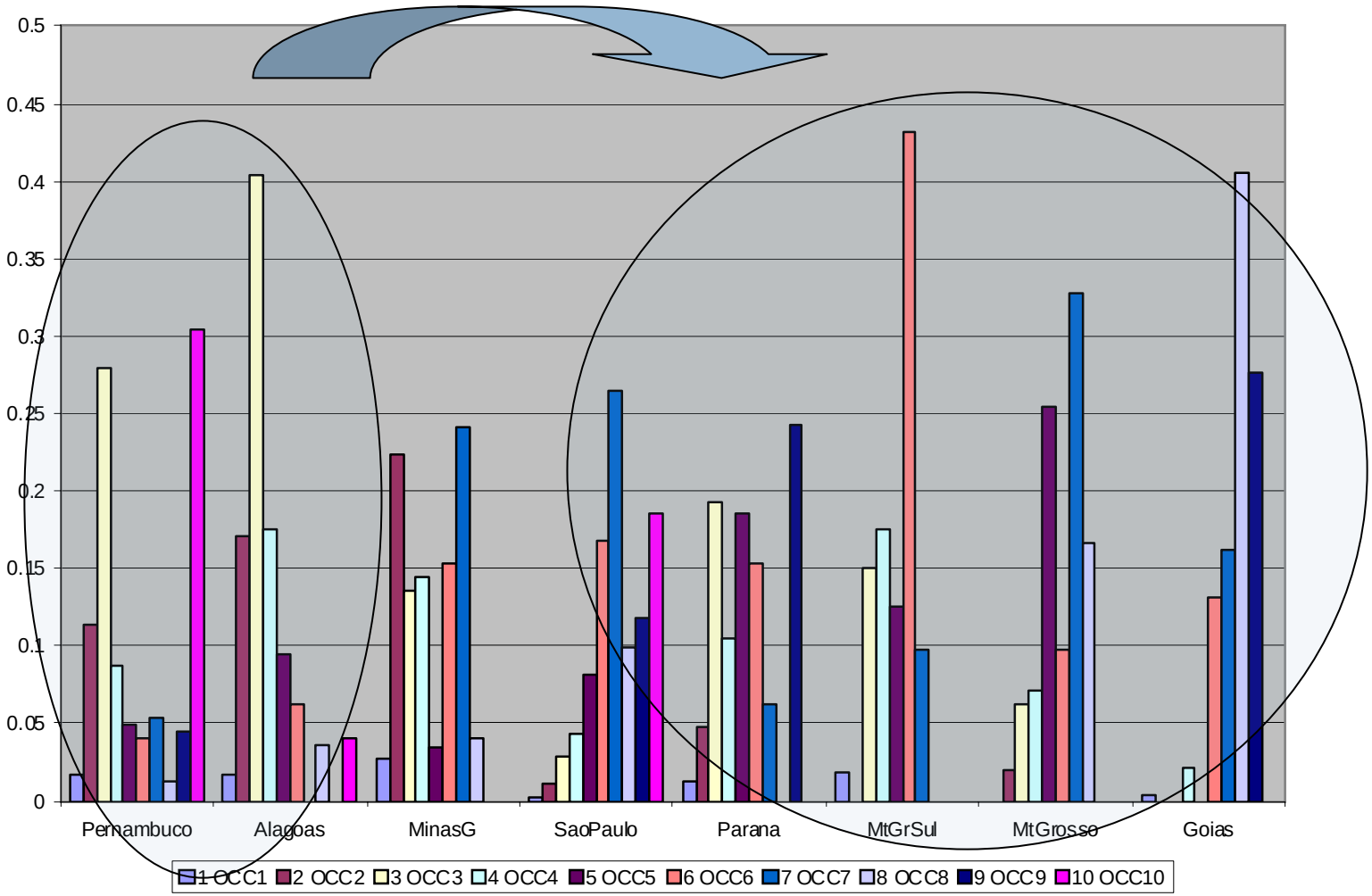

Wage bill occupational share in aggregated sectors . Brasil, 2005.
Agriculture pays 52% of national labor bill of OCC1 wages
0,90
0,80
0,70
0,60
0,50
0,40
0,30
0,20
0,10
0,00
0,52
0,00
0,02
0,07
0,39
0,47
0,00
0,03
0,06
0,44
0,18
0,00
0,02
0,11
0,69
0,21
0,00
0,03
0,14
0,63
0,15
0,00
0,03
0,15
0,67
0,11
0,00
0,04
0,17
0,68
0,09
0,00
0,03
0,18
0,70
0,06
0,01
0,03
0,19
0,72
0,05
0,00
0,02
0,16
0,77
0,13
0,00
0,03
0,15
0,69
1 OCC1
2 OCC2
3 OCC3
4 OCC4
5 OCC5
6 OCC6
7 OCC7
8 OCC8
9 OCC9
10 OCC10
Ocupações
Agropecuária
Extrativa Mineral
Agroindustria
Manufaturas
Serviços

Household income composition, by wage class

Regional distribution of the sugar cane production complex in Brazil



Workers by wage class in sugar cane production in Brazil. 2005



Selected macro results. Sugar cane+ethanol+sugar = 1.6% of total value of production in Brazil.

Variáveis Macro	% variation
Real Household Consumption	0.15
Real Investment	0.21
Real Government Expenditure	0.17
Real Exports	-0.48
Real Imports	-0.77
Real GDP	0.13
Aggregate Employment	-0.00
Average real wage	0.25
Aggregated Capital Stock	0.45
GDP Price Index	0.08
Consumer Price Index (CPI)	0
Exports Price Index	-0.07
Imports Price Index	-0.87
Nominal GDP	0.22
Land price	2.61

Sectoral results:

Commodity	Production	Exports	Employment
Rice	-0.53	0	-0.56
Corn	-0.56	-2.75	-0.53
Wheat and Cereals	-2.20	-1.94	-2.23
Sugar Cane	39.07	0	38.13
Soybeans	-2.36	-4.94	-2.43
Cassava	-0.60	-3.14	-0.59
Tobacco	0.17	-2.15	0.15
Cotton	-0.83	-8.08	-1.03
Oranges	-0.47	-6.05	-0.19
Coffee	-2.53	-3.80	-2.52
Forestry	-0.79	-3.87	-0.78
Live Animals	-0.33	-4.72	-0.37
Raw Milk	-0.31	0	-0.38
Other Agriculture	-0.45	-4.18	-0.40
Mining	-2.88	0.72	-4.54
Meats	-0.99	-3.81	-1.32
Edible Oils	-0.10	-3.71	-0.52
Dairy	0.12	-4.37	-0.23
Processed Rice	-0.19	-2.80	-0.49
Sugar	-0.38	-6.06	-1.13
Processed Coffee	-0.69	-6.85	-1.04
Other Food	-0.30	-3.85	-0.64
Textiles and Apparel	-0.97	-6.17	-1.13
Paper and Graphic	-0.35	-2.84	-0.58
Gasoline	-5.50	-0.76	-5.61
Gasohol	-16.73	0	-16.71
Ethanol	103.50	232.40	112.67
Combustible Oils	-0.03	-1.18	-0.13
Petrochemicals	-7.90	-1.80	-8.01
Other Manufacturing	-0.62	-3.97	-0.84
Automobiles, Buses, Trucks	-2.43	-7.80	-2.56
Metal Products	-1.44	-3.43	-1.82
Trade	-0.90	-3.40	-1.03
Transport	-0.54	-2.82	-0.70
Services	-0.06	-3.09	-0.17

Regional results

State (Region)*	Real GDP	Aggregate employment	Aggregate Capital Stock	Ethanol production	Sugar production
Rondonia (N)	-0.13	-0.24	-0.13	21.43	1.68
Acre (N)	-0.25	-0.35	-0.26	21.52	1.01
Amazonas (N)	-0.61	-0.56	-0.71	20.44	1.31
Roraima (N)	-0.64	-0.61	-0.65	19.80	2.06
Pará (N)	-0.91	-0.72	-1.08	24.09	2.43
Amapá (N)	-0.58	-0.56	-0.62	26.36	2.04
Tocantins (N)	-0.10	-0.25	0.12	23.74	1.55
Maranhao (NE)	-0.72	-0.53	-0.96	34.95	2.22
Piauí (NE)	-0.42	-0.37	-0.49	33.45	2.00
Ceará (NE)	-0.66	-0.56	-0.75	37.17	2.72
RGNorte (NE)	-0.73	-0.47	-1.12	44.00	0.85
Paraíba (NE)	1.15	1.08	1.19	36.63	1.30
Pernambuco(NE)	0.28	0.26	0.31	50.72	-2.22
Alagoas (NE)	2.81	2.91	2.67	37.96	-6.32
Sergipe (NE)	-0.90	-0.59	-1.37	43.30	2.72
Bahia (NE)	-0.51	-0.55	-1.04	40.33	2.62
MinasG (SE)	0.04	-0.09	0.21	104.88	1.90
EspSanto (SE)	-0.90	-0.65	-1.16	31.06	1.44
RioJaneiro (SE)	-0.98	-0.75	-1.44	24.83	1.92
SaoPaulo (SE)	0.76	0.43	1.49	113.10	-0.29
Paraná (S)	-0.24	-0.28	0.05	83.82	0.69
StaCatari (S)	-0.42	-0.39	-0.40	17.77	1.65
RGSul (S)	-0.62	-0.49	-0.74	21.01	1.93
MtGrSul (CW)	2.56	1.25	5.03	135.66	1.41
MtGrosso (CW)	2.43	0.99	5.56	154.78	4.96
Goiás (CW)	1.61	0.77	2.94	129.48	2.40
DF (CW)	0.13	0.05	0.19	29.52	1.06

Results: labor demand % variation.

	Macro regiões					
Worker type	N	NE	São Paulo	RSE	S	CW
OCC1	-0.28	0.14	-0.30	0.07	-0.17	-0.15
OCC2	-0.37	0.37	-0.16	-0.08	-0.22	0.00
OCC3	-0.57	0.53	-0.07	-0.40	-0.37	0.27
OCC4	-0.55	0.15	0.41	-0.41	-0.35	1.09
OCC5	-0.76	0.20	0.35	-0.37	-0.58	1.69
OCC6	-0.62	-0.32	0.50	-0.28	-0.35	0.80
OCC7	-0.87	-0.60	0.63	-0.68	-0.69	1.66
OCC8	-0.76	-0.50	0.54	-0.70	-0.53	1.84
OCC9	-0.57	-0.35	0.45	-0.32	-0.35	0.22
OCC10	-0.35	-0.32	0.41	-0.48	-0.32	0.39

Commodity	Production
Rice	-0.53
Corn	-0.56
Wheat and Cereals	-2.20
Sugar Cane	39.07
Soybeans	-2.36
Cassava	-0.60
Tobacco	0.17
Cotton	-0.83
Oranges	-0.47
Coffee	-2.53
Forestry	-0.79
Live Animals	-0.33
Raw Milk	-0.31

- Sugar cane planted area in Brazil in 2006: 6.18 millions ha.
- 10% of total land in agriculture (not livestock) in Brazil.
- Sugar cane area would have to be increased by 2.2 millions ha.
- Livestock: 172 millions ha.
- Food x energy dilemma? Small fall in food production.

There is also room for productivity increases (Sao Paulo).

Area of efficiency classes of sugarcane crop production, during two growing seasons, in the State of Sao Paulo, Brazil.

Crop Efficiency	Growing season		Growing season	
	1995/1996		2002/203	
	Km2	%	Km2	%
0-10%	59,285	24	55,855	22
11-30%	40,634	16	33,985	14
31-50%	42,648	17	35,185	14
50-70%	89,275	36	85,269	34
>70%	16,965	7	38,513	15

Source: Marin et alii, 2008.

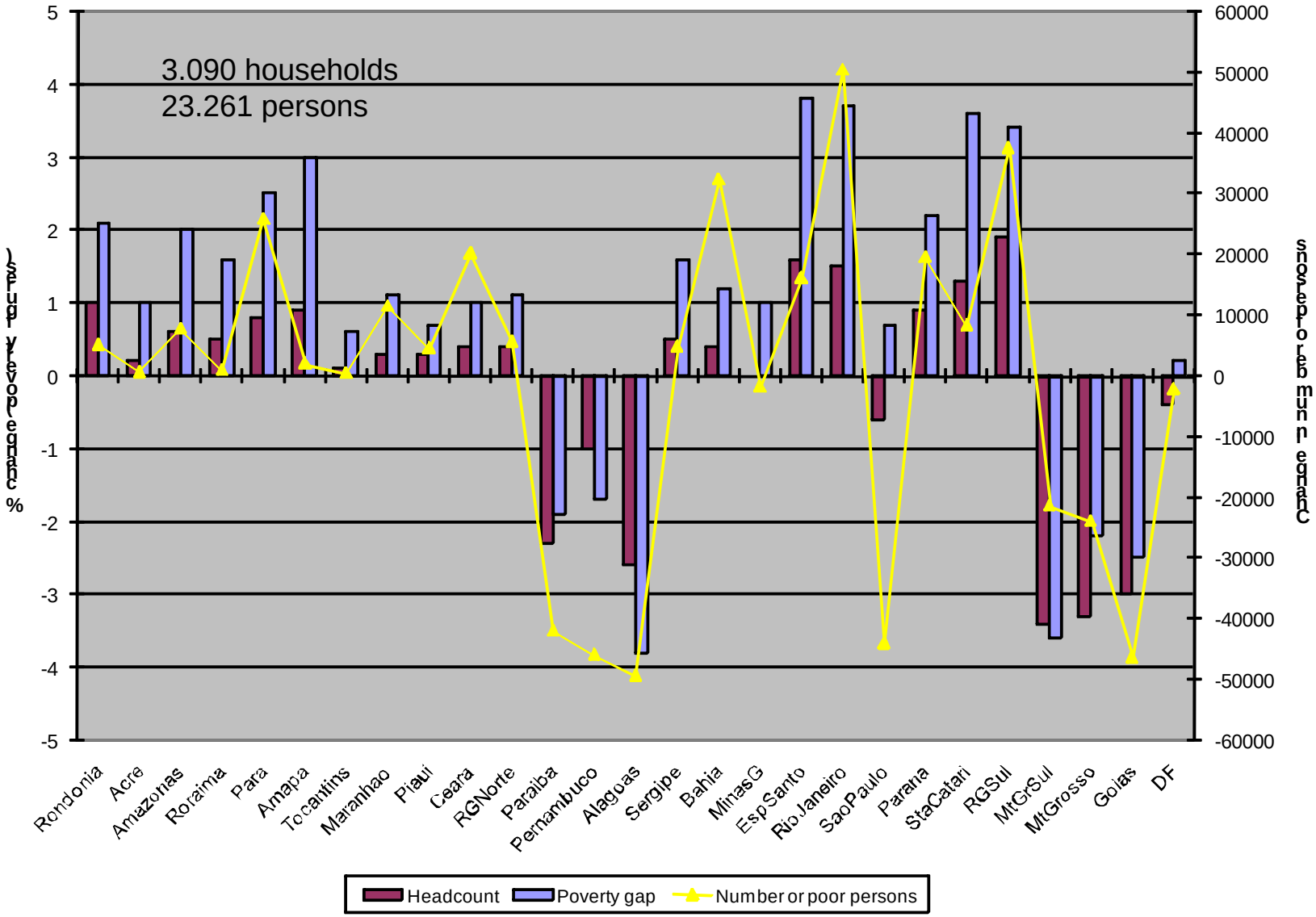
Table 14. Model results. Household poverty and income distribution results. Percent variation.

Household Income class	Average nominal income	Consumer Price Index	Average real income	Headcount ratio (FGT0)	Average poverty gap (FGT1)
1 POF[1]	2.31	0.04	2.27	-0.67	-0.83
2 POF[2]	0.42	0.02	0.4	-1.08	0.85
3 POF[3]	0.4	0.01	0.39	0.79	9.6
4 POF[4]	0.33	-0.01	0.34	12.43	48.67
5 POF[5]	0.24	0.01	0.23	45.77	157.73
6 POF[6]	0.17	0.01	0.16	138.01	681.39
7 POF[7]	0.07	0.01	0.06	370.87	2012.78
8 POF[8]	-0.09	0.02	-0.11	0	0
9 POF[9]	-0.27	0	-0.27	0	0
10 POF[10]	-0.32	-0.04	-0.28	0	0
Original values (base year)	-	-	-	0.28	0.12
Percentage change	-	-	-	-0.02	0.83
GINI (percentage change)			-0.01		

The increase in poverty gap is related to the fall in OCC1 wages

Wage class	Percentage change
OCC1	-0.50
OCC2	-0.26
OCC3	0.60
OCC4	0.45
OCC5	1.10
OCC6	0.65
OCC7	1.63
OCC8	1.15
OCC9	0.30
OCC10	-0.31

Wage bill in SP concentrates in the medium range


3.090 households
23.261 persons
5
4
3
2
1
0
-1
-2
-3
-4
-5
60000
50000
40000
30000
20000
10000
0
-10000
-20000
-30000
-40000
-50000
-60000
Rondonia
Acre
Amazonas
Roraima
Para
Amapa
Tocantins
Maranhao
Piaui
Ceara
RGNorte
Paraiba
Pernambuco
Alagoas
Sergipe
Bahia
MinasG
EspSanto
RioJaneiro
SaoPaulo
Parana
StaCatari
RGSul
MtGrSul
MtGrosso
Goias
DF
Headcount
Poverty gap
Number or poor persons

Final remarks

- Fall in poverty and inequality, increase in poverty gap.
- Small variations.
- Labor demand increases appears in Sao Paulo and Center-west Brazil. This will slow down the fall in unskilled labor demand induced by harvest mechanization.
- Food x energy dilemma: Brazil?
- Main problem: redistribution of economic activity in Brazil, with losses for Northeast Brazil and Rio de Janeiro.

Gracias

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