Deforestation control, employment and distribution in Brazil

Joaquim Bento de Souza Ferreira Filho

ESALQ/USP, Brazil.

Luis Fernando Guedes Pinto – Imaflora

Vinicius Guidotti de Farias – Imaflora

Gerd Sparovek – USP, Geolab

Background: deforestation control policies in Brazil

- Important part of the transition efforts to a less carbon intensive economy, and a critical policy target in the Brazilian intended Nationally Determined Contribution – iNDC in COP21.

- Restricts agricultural and livestock expansion possibilities, mostly in the agricultural frontier regions, which still concentrates a <u>large share of population</u> and some of the <u>worst welfare indicators in Brazil</u>.

- Few studies in Brazil tried to analyze the social impacts of deforestation control policies in Brazil.

Objective

- Provide a detailed analysis of the spatial pattern of deforestation in Brazil, as well as the legal and bio-physical aspects involved (private/public lands, biome, land quality).

- Analyze (quantify) the potential effects of several deforestation reduction scenarios in Brazil.

- <u>Focus on the trade-off between the environmental gains and the distributive side effects of the policy.</u>

Methodology: CGE model calibrated for year 2005

- Annual recursive dynamic, inter-regional, bottom-up:
    - Stock-flow relation between investment and capital stock, which assumes a 1-year gestation lag;
    - Positive relation between investment and the rate of profit;
    - Relation between wage growth and regional labor supply.
- 15 aggregated regions inside Brazil (bottom-up)
- 38 production sectors.
- 10 types of workers (wage classes)
- 10 household types (income classes)
- <u>ILUC module: tracks land use change by state and by biome (TRANSITION MATRIX)</u>.

Transition matrix on land use change: 1994-2002 (Agricultural Censuses)

São Paulo	Crop	Pasture	PlantForest	Natural forest	Total 1994
Crop	5.4	0.0	0.0	0.4	5.8
Pasture	1.4	6.8	0.0	0.9	9.1
PlantForest	0.0	0.1	0.3	0.1	0.6
Natural forest	0.0	0.0	0.0	9.3	9.3
Total 2002	6.8	6.9	0.4	10.7	24.8

Mato Grosso	Crop	Pasture	PlantForest	Natural forest	Total 1994
Crop	3.5	0.0	0.0	0.0	3.5
Pasture	3.7	17.7	0.0	0.0	21.5
PlantForest	0.0	0.1	0.0	0.0	0.1
Natural forest	0.8	4.0	0.1	60.4	65.3
Total 2002	8.0	21.8	0.1	60.4	90.3

The transition matrix shows Markov probabilities that a particular hectare of land used in one year for some use would be in another use next period.

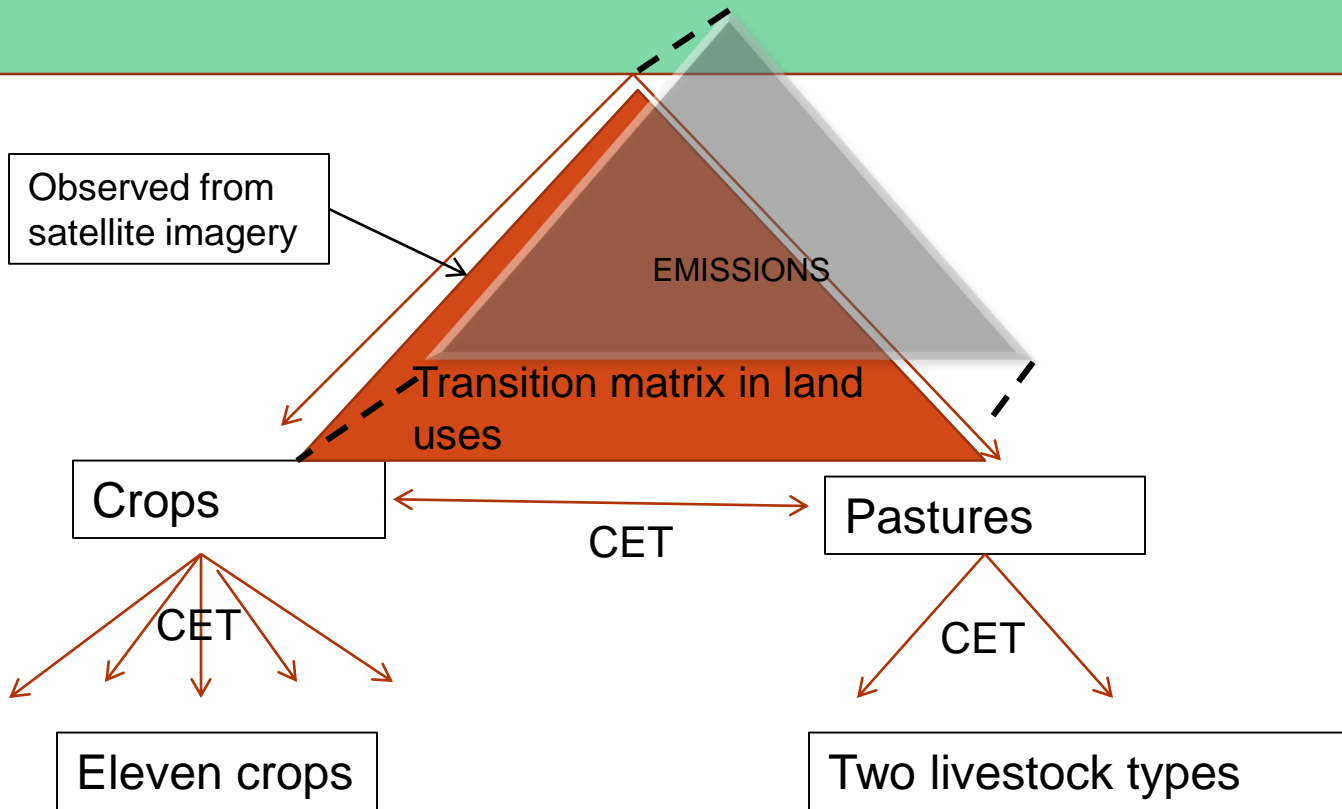Natural forests: 6 biomes

Amazonia | Cerrado | Caatinga | Atl. Forest | Pampa | Pantanal

Observed from satellite imagery

EMISSIONS

Transition matrix in land uses

Crops

CET

Pastures

CET

CET

Eleven crops

Two livestock types

Transition matrix:
    Summary of many different factors affecting deforestation.
    Drives land use between years

Simulation: 2016-2030

- Baseline assumption: deforestation occurs only in states with natural land stocks available (frontier states), until stocks depletion.

Frontier states

Mostly Cerrado

Arch of deforestation, Amazonia + Cerrado biomes

Mata Atlantica
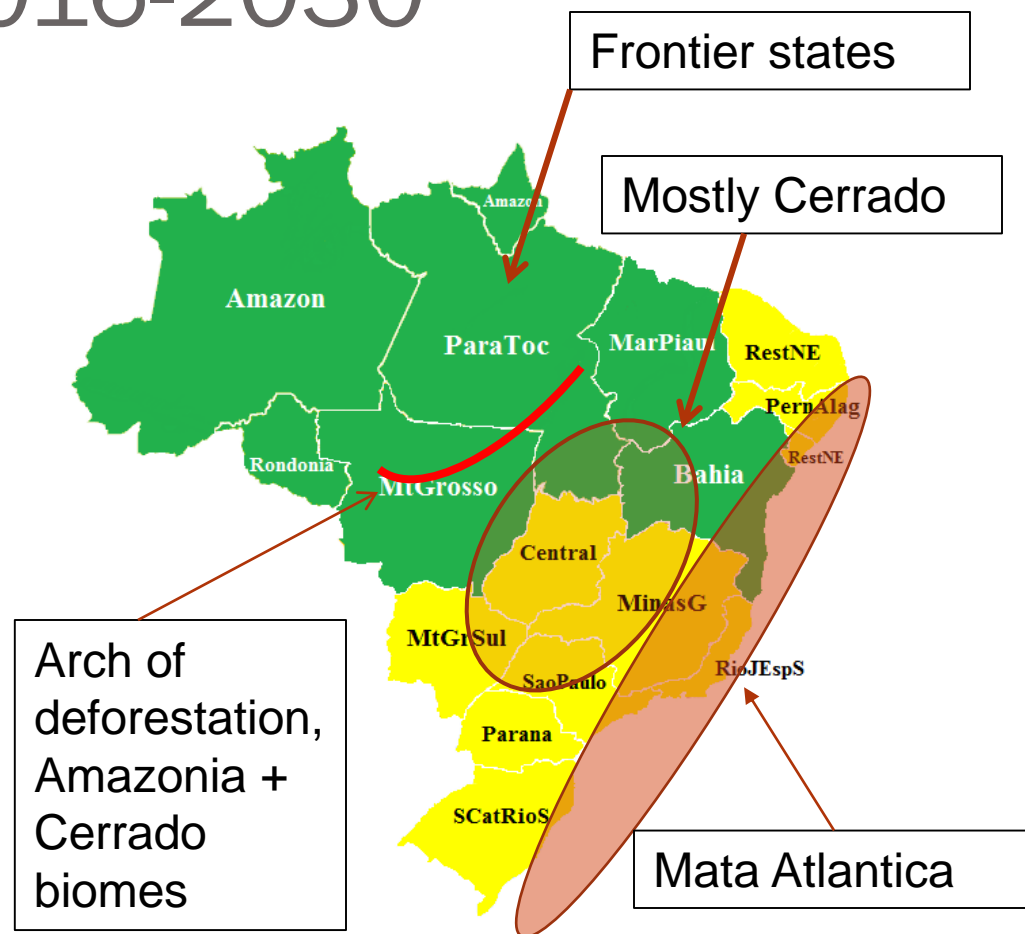
Deforestation scenarios

- Designed with the aid of satellite imagery information.

- Deforestation trends calculated individually by biome and state (or region), distinguished by public and private land.

- In all scenarios we assume that deforestation will occur only on stocks of unprotected native vegetation in relation to the requirements of the Brazilian Forest Code (environmental assets), i.e., only native vegetation outside Permanent Protection Areas (APP) and Legal Reserves (RL).

- In the scenarios deforestation stops when natural stocks run out.

Model baseline

- Historical simulation until 2015.

- Population growth by state: 20.1% increase 2016/2030.

- Real GDP growth 2.5% per year.

- Deforestation by biome and state: 13.7 million hectare (Mha) until 2030:
  - 7.4 Mha in the Amazonia biome (last 5 years average);
  - 6 Mha in the Cerrado biome(last 3 years average);
  - 0.3 Mha in the Mata Atlantica biome(last 5 years average);

- Crop area expansion: 37.5 Mha (2016/2030).

- Forestry area expansion: 7.1 Mha

- Livestock area adjusts to match the difference in area.

Three scenarios

- **Scenario 1 (Dzabs, extreme):** Absolute zero deforestation (2016-2030), both in public and private lands.

- **Scenario 2 (DZ2, higher governance):**
  - <u>Mata Atlântica biome</u>: rate of deforestation on both <u>public and private</u> lands follow the current trend until 2020, reducing until it´s stop in 2030.

  - <u>Amazonia and Cerrado biomes</u>: deforestation in private lands follow the current trend, but only over non-protected natural vegetation (legal deforestation), and only on land stocks of <u>high agricultural suitability</u> (or agricultural aptitude above the 0.80 percentile).

  - **Scenario 3 (DZ3, lower governance):** same as above, <u>irrespective of its agricultural suitability</u>.

Deforestation scenarios
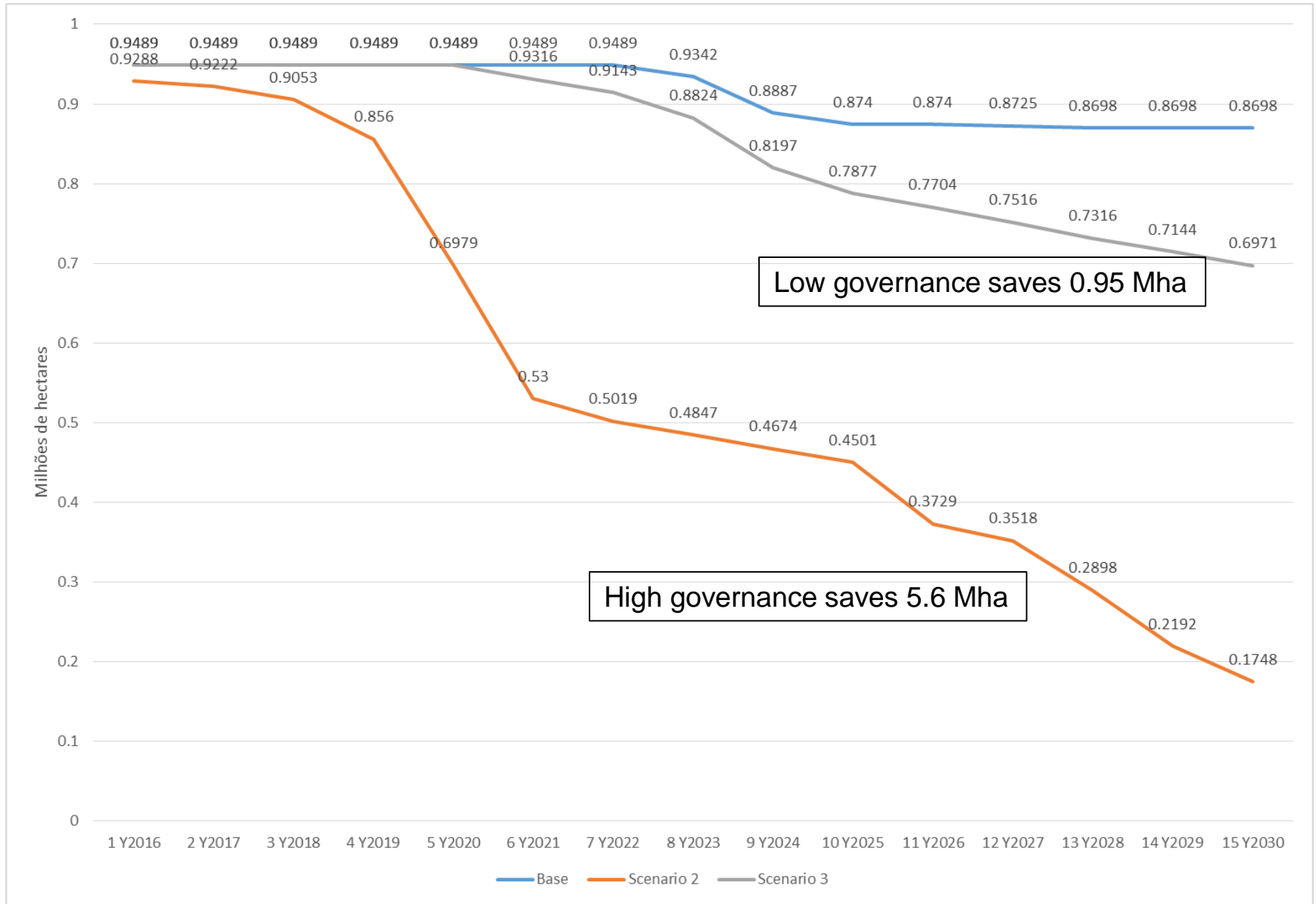
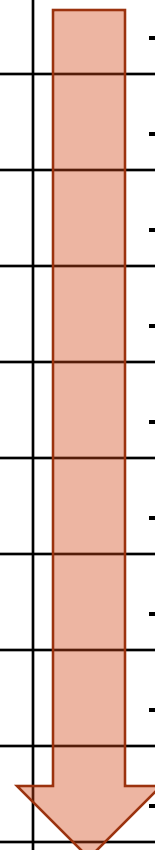# Results: national (% variation accumulated in 2030)

	DZabs	DZ2 (Higher governance)	DZ3 (Lower governance)
Household consumption	-0.58	-0.21	-0.03
Real investment	-3.32	-1.35	-0.22
Real government consumption	-0.58	-0.20	-0.03
Exports volume index	1.94	0.76	0.13
Imports volume index	-0.85	-0.36	-0.06
GDP (real)	-0.62	-0.22	-0.03
Wages (real)	-1.23	-0.48	-0.08
Total GHG emissions	-16.20	-11.91	-3.48

The Brazilian commitment to COP21 is a 37% reduction of total emissions in until 2025, and 43% until 2030.

Real GDP Results (2030)	DZabs	DZ2	DZ3
1 Rondonia	-3.07	-1.53	-0.59
2 Acre	-4.53	-2.88	-0.54
3 Amazonas	-0.55	-0.12	-0.06
4 Roraima	-1.47	-0.32	-0.14
5 Para	-2.05	-1.35	-0.23
6 Amapa	-0.64	-0.19	-0.05
7 Matopiba	-1.04	-0.45	-0.04
8 PernAlag	-0.40	-0.15	-0.02
9 RestNE	-0.44	-0.15	-0.02
10 MinasG	-0.48	-0.13	-0.03
11 SaoPaulo	-0.38	-0.13	-0.01
12 RestSE	-0.17	-0.06	0.00
13 Sul	-0.65	-0.21	-0.02
14 MtGrSul	-1.11	-0.30	-0.04
15 MtGrosso	-3.17	-0.91	-0.14

Results: Percentage changes in real wages, by type of work occupation, accumulated in 2030.

Occupation type	Dzabs	DZ2	DZ3
1 OCC1 (lower wages)	-2.61	-1.08	-0.15
2 OCC2	-2.60	-1.12	-0.16
3 OCC3	-1.70	-0.67	-0.11
4 OCC4	-1.63	-0.64	-0.09
5 OCC5	-1.73	-0.70	-0.11
6 OCC6	-1.59	-0.62	-0.10
7 OCC7	-1.48	-0.58	-0.09
8 OCC8	-1.36	-0.53	-0.09
9 OCC9	-1.09	-0.41	-0.07
10 OCC10 (Higher wages)	-1.06	-0.40	-0.06

Real wages % variation, by occupation, accumulated in 2030
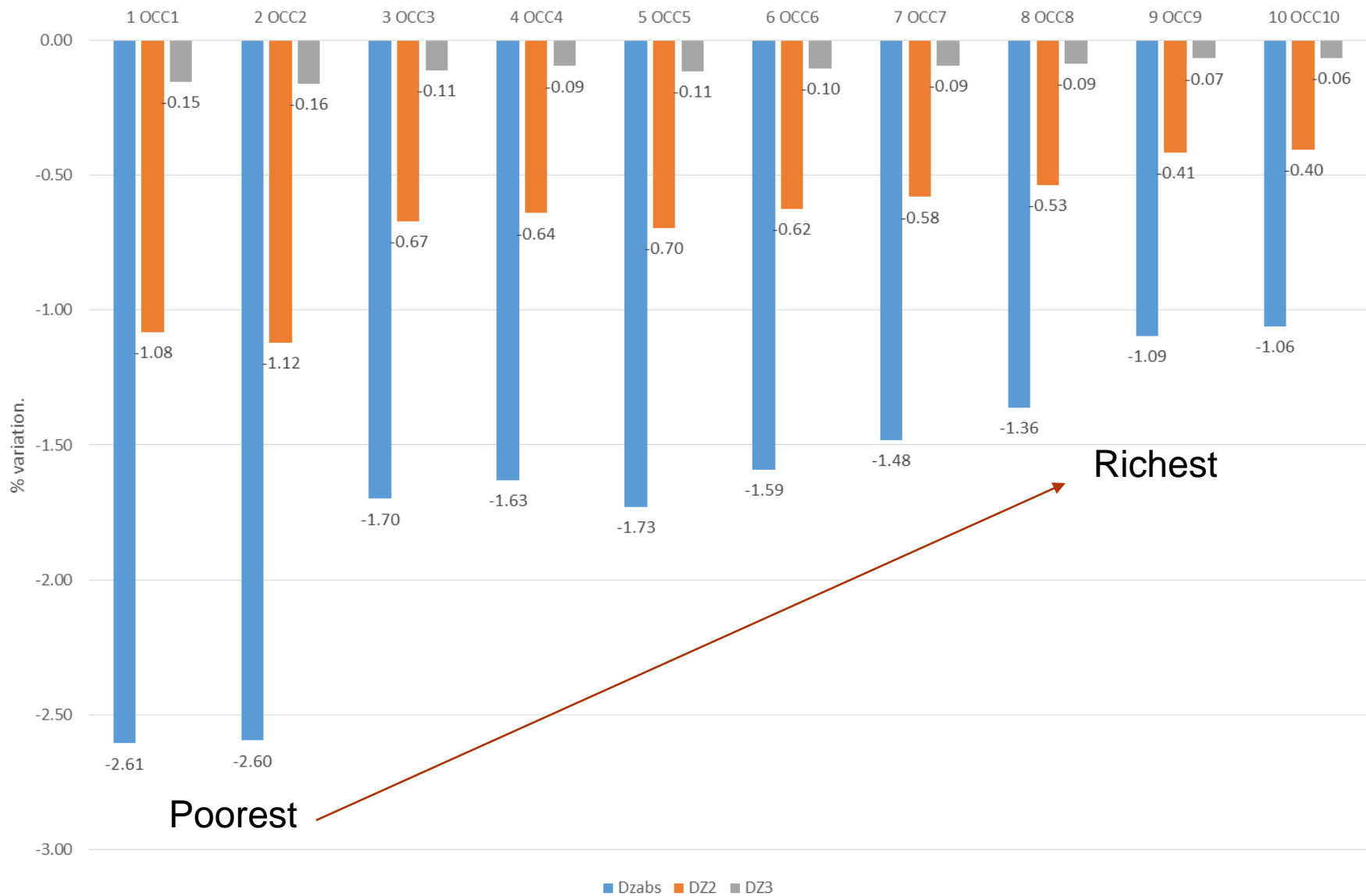
Percentage changes in real household consumption. Accumulated in 2030.

- Lower wages, higher food prices.

- Services expense share of 32% for the richest, 2.2% for the poorest. Services also employs much of the unskilled labor (wage fell). Food prices goes up, services prices goes down, affecting negativelly more the poorest.

Real household consumption	Dzabs	DZ2	DZ3
1 POF1 (poorest)	-1.80	-0.72	-0.10
2 POF2	-1.59	-0.63	-0.09
3 POF3	-1.24	-0.48	-0.07
4 POF4	-1.11	-0.42	-0.06
5 POF5	-0.82	-0.30	-0.05
6 POF6	-0.64	-0.23	-0.03
7 POF7	-0.44	-0.15	-0.02
8 POF8	-0.28	-0.08	-0.01
9 POF9	-0.10	-0.01	0.00
10 POF10 (richest)	-0.03	0.02	0.01

Real household consumption, % variation. Accumulated in 2030
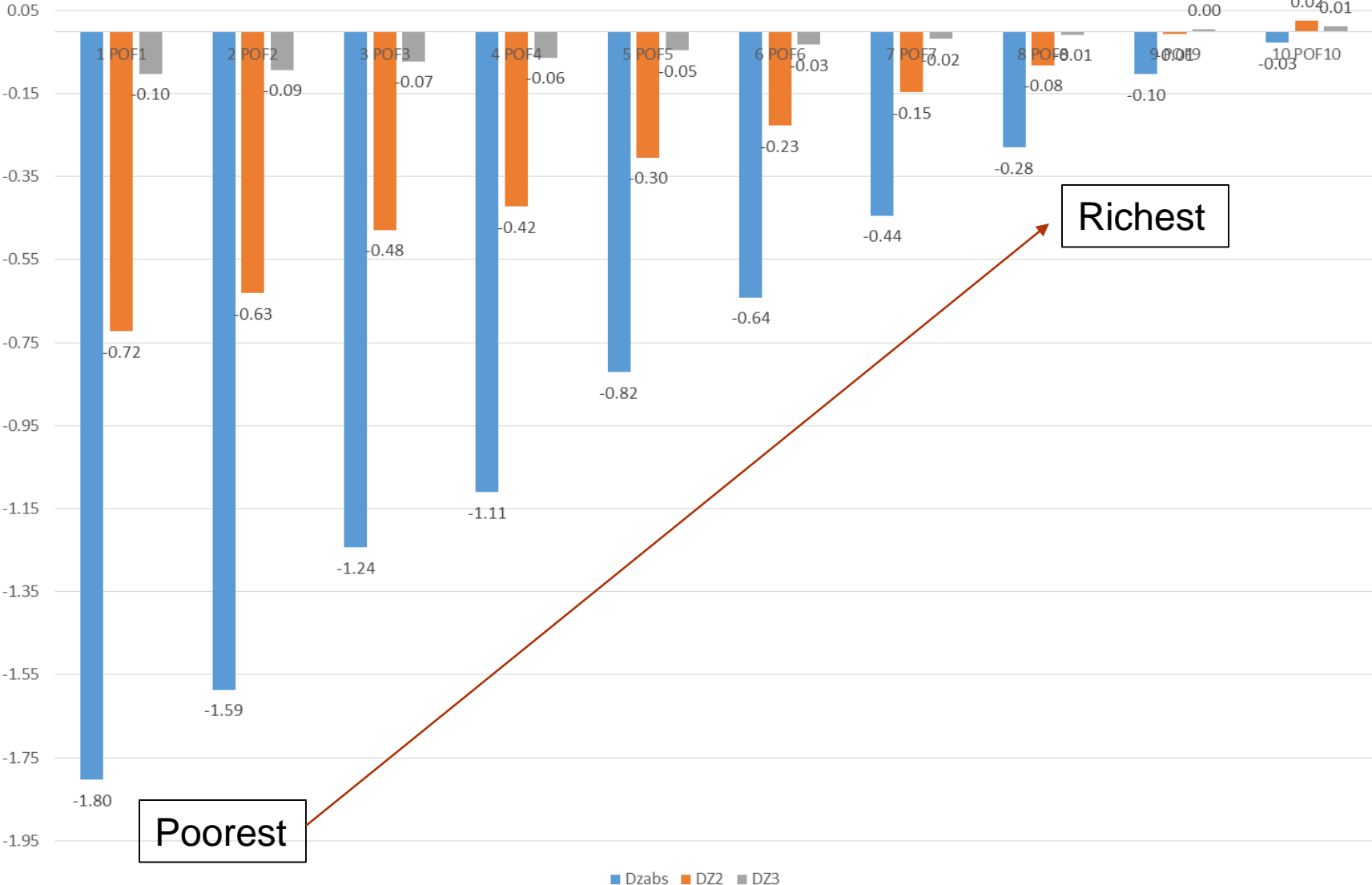
Final remarks

- Environmental policies, like any other policy, may have undesirable indirect outcomes, and this is the case of deforestation control policies in Brazil.

- Together with desired GHG emissions reductions, and in spite of low associated GDP losses in the time span considered, states located in the agricultural frontier would bear a disproportionally high share of this adjustment costs.

- The same is true for the poorest households: the policy has regressive potential, penalizing more the poorest households, both from the income (wages) and the expenditure sides.

Final remarks

- Technological progress could compensate, in terms of livestock supply, the losses of simulated pasture areas.

- Moderate to small incremental gains in productivity, in most cases, would compensate for the effect of reduced pasture caused by reduced deforestation.

- Historical observed rates show that these gains would be possible. Room for public policies that may facilitate the adoption of existing technology.

- This is more a question of relative prices than of technology availability.

- Thank you.

- Email: jbsferre@usp.br