NEDUR
Núcleo de Estudos em Desenvolvimento Urbano e Regional
Universidade Federal do Paraná

SENSED
space, society and development
PRINT - UFPR

Convergence Clubs in Agricultural Land Prices Parana, Brazil

Alexandre A. Porsse[Φ] • Luana Rebouças[Ω]

Alexandre Peña[Δ]

[Φ] Professor of the Department of Economics at Federal University of Parana

[Ω] Master Student at the Graduate Program in Development Economics

[Δ] Master by the Graduate Program in Development Economics

UFPR Universidade Federal do Paraná
PPGDE Programa de Pós - Graduação em Desenvolvimento Econômico - UFPR
CAPES
PrInt

Roteiro

- Motivation
- Objectives
- Overview on Parana
- Database
- Empirical strategy
- Results
- Final remarks
- Further research

Motivation

- According to the “law of one price” (LOP), differences observed in the prices of a homogeneous good in spatially separate markets should be explained only by transportation cost and other transaction costs. Thus, price differences may exist in the short term but should not be persistent in the long term (Stigler and Sheerwin, 1985; Waights, 2018).
- The validity of LOP implies market efficiency and convergence of prices in the long term. However, refutation of this law suggest the market would be subject to arbitrage.
- Land is immobile and hence is not well known how arbitrage processes could work. Regional market power could exist since land is not mobile, restricting the convergence of prices in different regions.

Motivation

- There are few studies investigating the dynamic of prices for agricultural land markets and those which have been done usually are for developed countries.
- Considering international literature, the evidences founded suggest that LOP not applies to the land market even in urban or rural spaces: Cecchetti, Mark and Sonora (2002), Kim and Rous (2012), Abbott, and De Vita (2013), Yang, Ritte and Odening (2017).

Motivation

- For Brazil, there is only one study focusing the dynamic of agricultural land prices (Malassise, Parré and Fraga, 2015):
  - It aimed to investigated the factors which explain price differences in agricultural land for the municipalities of Paraná state.
  - This study conducted a simple regression testing for convergence and founded evidences of β-convergence for the agricultural land prices in Parana but did not addressed spatial aspects.

Objectives

- Empirically test if LOP applies to the agricultural land market of Parana, Brazil.
- Evaluating the pattern of spatial heterogeneity in the convergence process of land prices in order to identify the formation of convergence clubs.

Why Parana?

- First and important, due data availability at the municipal level.
  - To accomplish the Law 9.393/1996, the Secretary of Agriculture in Parana realizes an annual survey on agricultural land prices since 1998.
- Second, agricultural land is more concentrated than income.
  - Gini for Parana: 0.777 (land in 2006) and 0.542 (income in 2010)
- Third, the spatial distribution of land rights was historically very complex in Brazil as well in Parana:
  - Phase 1 (1648 – 1822): land right was distributed by the imperial system known as “Sesmarias” to reinforce the political power of the Emperor, being the genesis of the high level of land concentration
  - Phase 2 (1822 - 1850): period without a formal regulatory policy which conducted to conflicts due irregular land tenure
  - Phase 3 (1850 -): the Law of Land approved in 1850 effectively create the private land market, but a lot of conflicts remained until the launching of the Law of Land Reform in 1964

A brief overview of Parana

GDP: BRL 402 billions (2016)

Population: 11.3 millions (2018)

GDP per capita: BRL 35,726

HDI: 0,749 (2010)

Area: 199,308 Km^2

Demographic density: 56.9

Number of municipalities: 399

Main agricultural products:

soybean, corn, wheat, sugar cane, manioc, potato

Main industrial products:

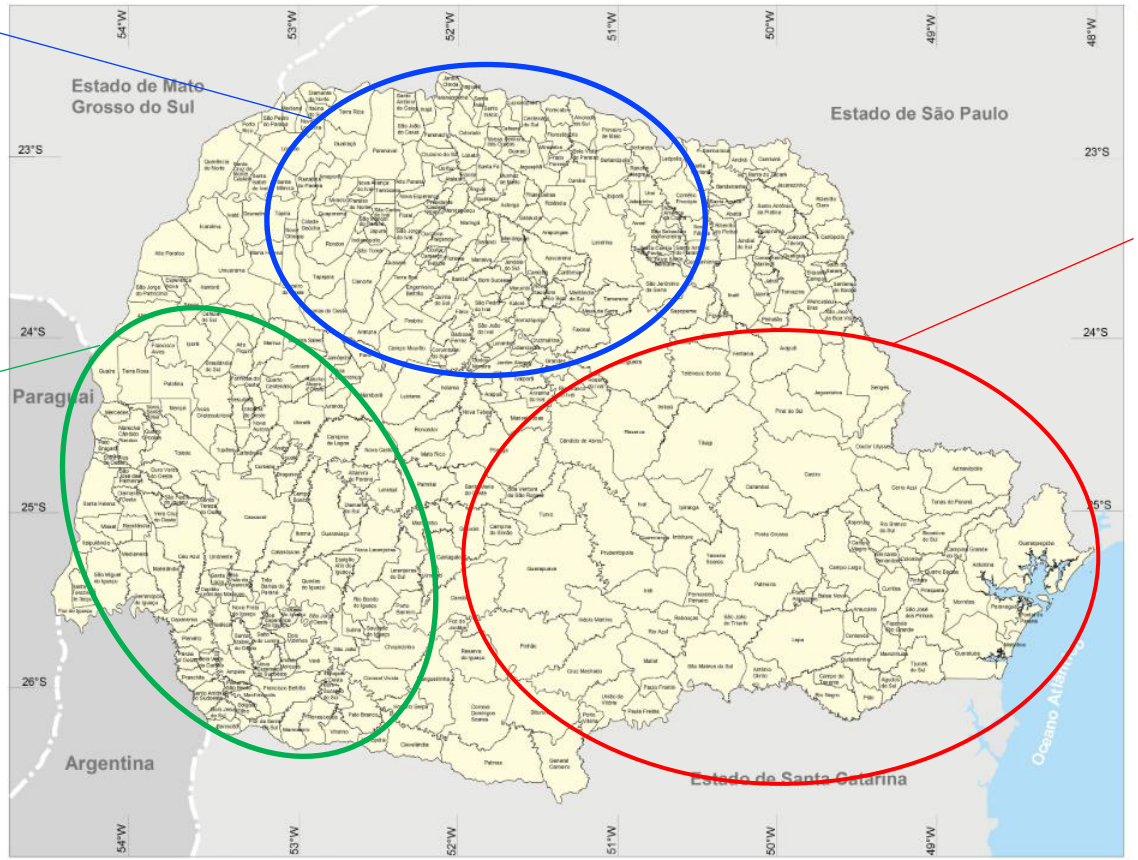
food products, vehicles, chemicals, refined petroleum, wood products, paper, machinery and equipment, rubber and plastics products

A brief overview of Parana

Municipalities of Parana

Land distributed through a mercantil system organized by the Britsh company “Brazil Plantations Syndicate Ltda" (1924-1951)

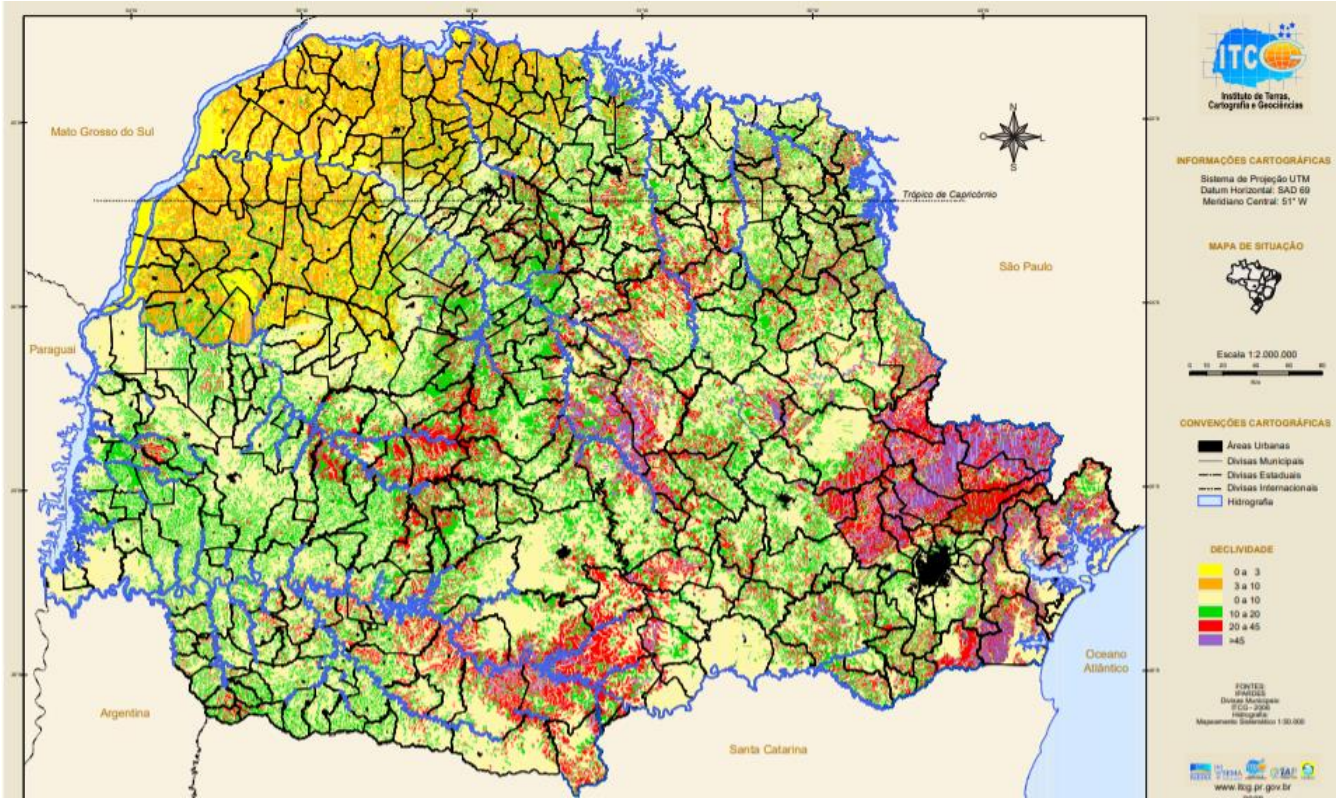
Land distributed through a conflituous process due irregular land tenure, also estimulated by the local colonization company CIPLA (1951-1973)



Land distributed through the imperial system known as Sesmarias

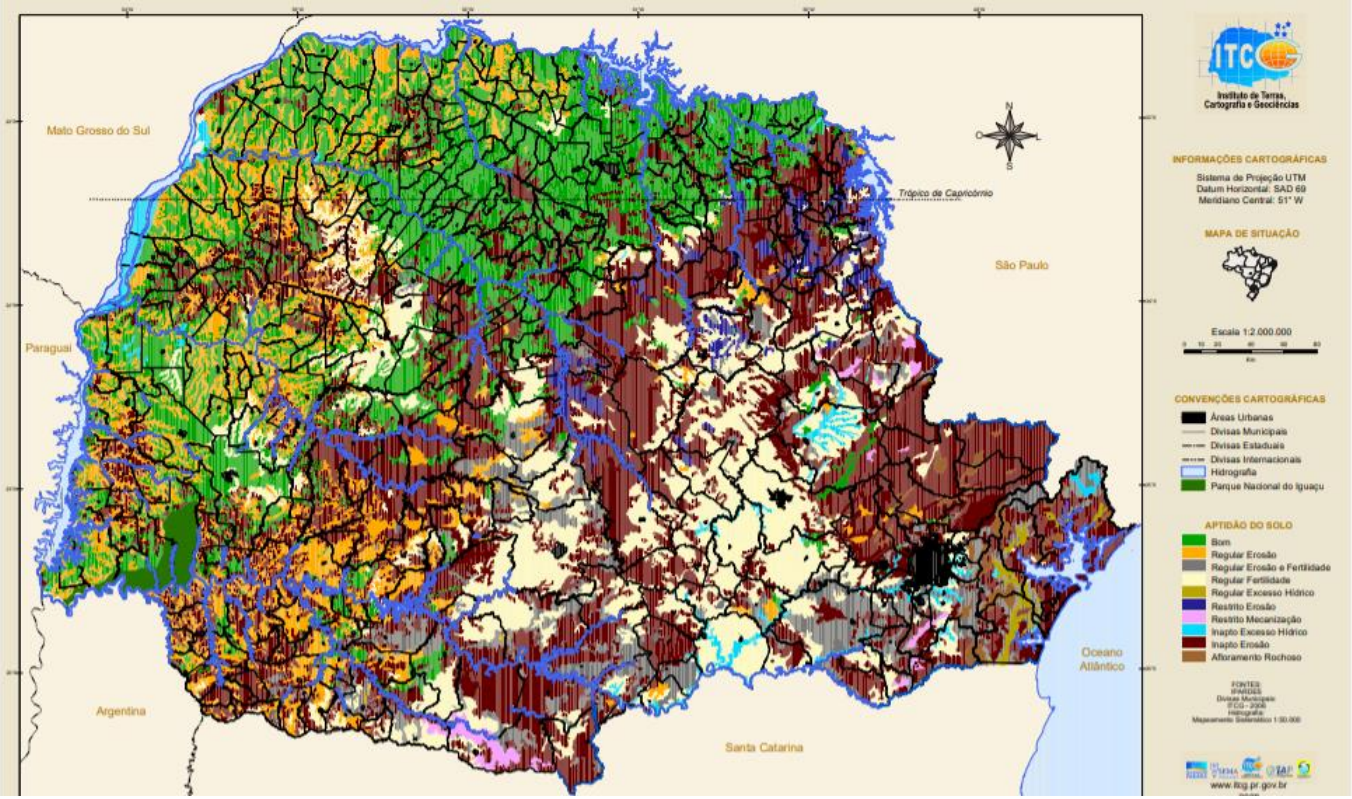
A brief overview of Parana

Slope of land



A brief overview of Parana

Quality of land for agricultural production



A brief overview of Parana

- Purple (dark red) soils
  - Good conditions for agricultural production, rich in nutrients
  - 177 municipalities

- Mixed soils
  - Regular conditions for agricultural production
  - 261 municipalities

- Sandy soils
  - Limited conditions for agricultural production, poor in nutrients and low water holding capacity
  - 109 municipalities

Database

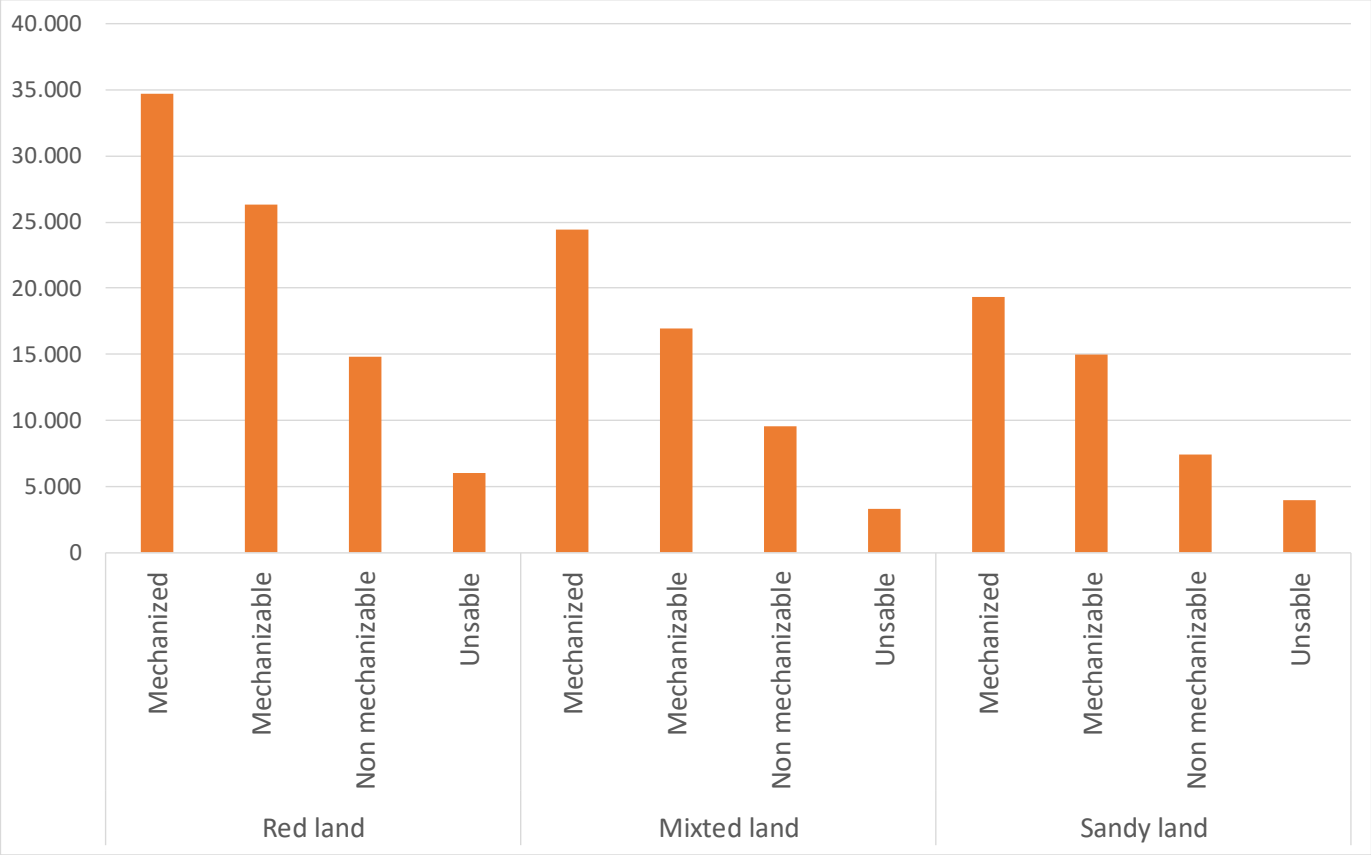
- Prices of agricultural land for the Parana's municipalities segmented by type of soils and classes of mechanization:
  - Types: purple, mixed, sandy
  - Classes: mechanized, mechanizable, non-mechanizable, unusable
- Period: 2006-2016
- Source: Department of Rural Economics at the Secretary of Agriculture of Parana

Database

Classes	Description
Mechanized	Areas without restrictions for soil preparation and planting, whose topography is appropriated for operations with motorized agricultural machines and implements, being used for agricultural production with machines and implements.
Mechanizable	Areas without restrictions for soil preparation and planting, whose topography is appropriated for operations with motorized agricultural machines and implements, being used for agricultural production without machines and implements.
Non-mechanizable	Areas with restrictions for soil preparation and planting due inappropriate topographic conditions but usable for production with rudimental techniques such animal traction.
Unusable	Aareas inappropriated for agricultural produciton due bad soil conditions or that are permanent preservation reserves.

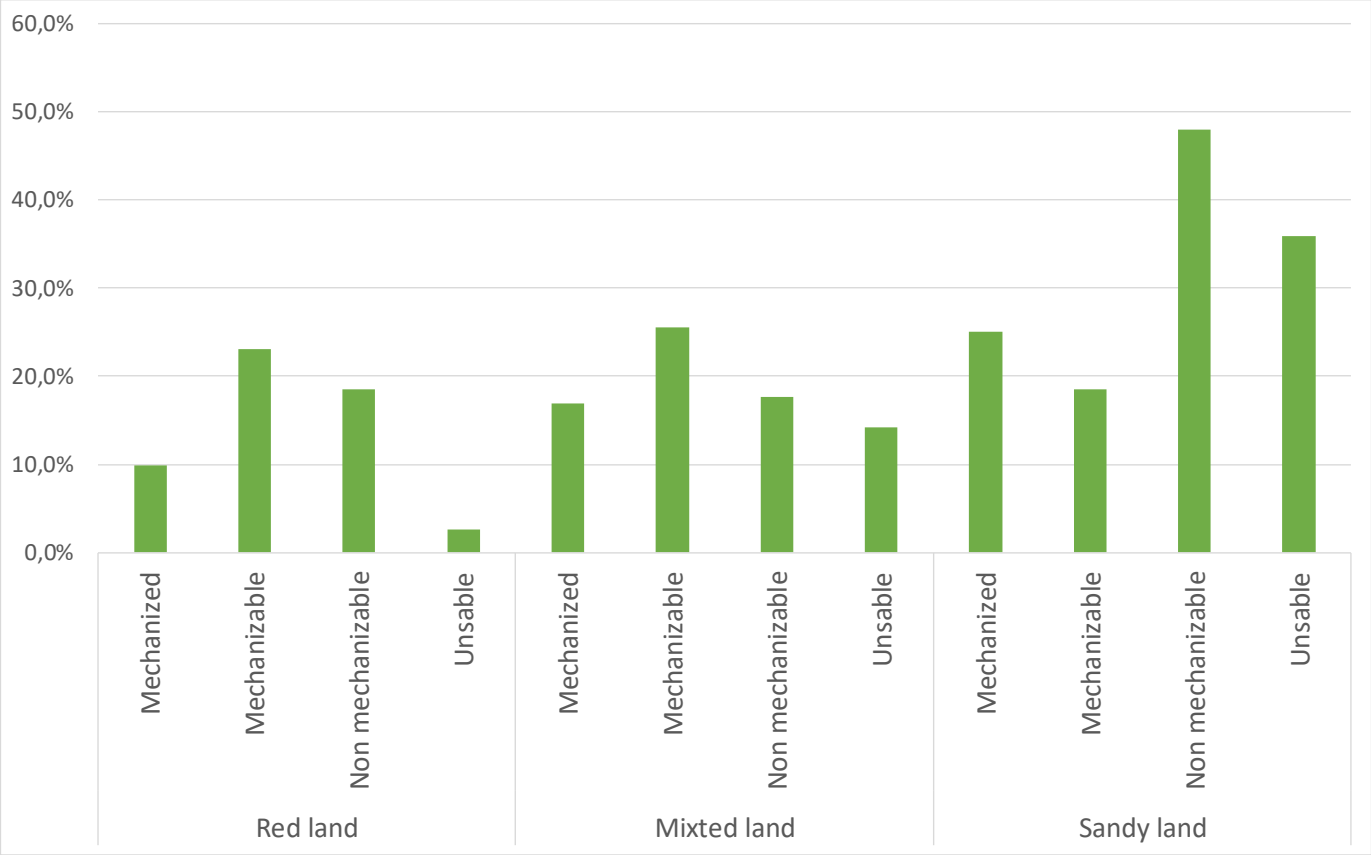
Database

Average prices per hectare in 2006 (BRL)



Database

Growth of land prices: 2006-2016 (%)



Empirical strategy

- Absolute convergence equation (Barro, 1991 and 1997; Clay and Sala-i-Martin, 1992; Bernard and Durlauf, 1996):

Global model: $$ln\frac{Pt_{i,T}}{Pt_{i,0}} = \alpha + \beta\ lnPt_{i,0} + \varepsilon_i$$

- Specification adapted to be estimated by geographically weighted regression (GWR):

Local model: $$ln\frac{Pt_{i,T}}{Pt_{i,0}} = \alpha(u_i, v_i) + \beta(u_i, v_i)\ lnPt_{i,0} + \varepsilon_i$$

Empirical strategy

- The GWR estimator produce an OLS estimation in which data are spatially weighted (Fotherigan,Brunsdon and Charlton, 2002):

$$\hat{\beta}_i = (X'W_iX)^{-1}X'W_iy$$

- The estimation requires the use of a spatial kernel function for grouping the data. In this study it was used an adaptative bi-square kernel function defined as follow:

$$w_{ij} = \begin{cases} \left[1 - \left(d_{ij}/d_{iN}\right)^2\right]^2 & if\ j \text{ is the closest } neighbor \text{ of } i \\ 0 & otherwise \end{cases}$$

Empirical strategy

- Steps in the empirical analysis:

  1. Estimation of global and local regression models

  2. Checking the adjustment performance of these models using R^2 and AICc

  3. Cheking for geographical variability in coefficients using the Diff of Criterion statistic recommended by Fotheringam, Brundson and Charlton (2002)

Results

Statistics of adjustment performance for global and local models

	Soils	Global Model		Local Model	
		R^2	AICCc	R^2	AICCc
Purple	Mechanized	0.0633	-60.5302	0.6558	-199.1523
	Mechanizable	0.3579	-11.0063	0.6220	-31.6905
	Non mechanizable	0.3925	28.8401	0.7682	-74.6194
	Unusable	0.4368	136.1668	0.8956	-69.8864
Mixed	Mechanized	0.1843	-36.9016	0.7856	-331.6565
	Mechanizable	0.3907	-13.9148	0.7127	-108.3574
	Non mechanizable	0.3672	111.4490	0.7823	-90.9084
	Unusable	0.5710	349.3680	0.8622	133.0901
Sandy	Mechanized	0.7129	-104.3228	0.8415	-149.7643
	Mechanizable	0.6491	-8.0716	0.7564	-22.7503
	Non mechanizable	0.1925	36.0419	0.8151	-42.4580
	Unusable	0.0674	110.9869	0.8940	-14.5552

Results

Test for geographical variability on coefficients of local models

Soil		Alfa coeff.	Beta coeff.
Purple	Mechanized	-574.2284	-724.6835
	Mechanizable	-227.6685	-330.9864
	Non mechanizable	-680.8778	-1850.1645
	Unusable	-525.5523	-282.5811
Mixed	Mechanized	-343.1069	-2003.9364
	Mechanizable	-191.3563	-896.5466
	Non mechanizable	-397.9837	-1455.5939
	Unusable	-226.8517	-273.8501
Sandy	Mechanized	-51.9258	-87.0850
	Mechanizable	-158.4861	-448.8419
	Non mechanizable	-226.4232	-294.5514
	Unusable	-236.5321	-227.5978

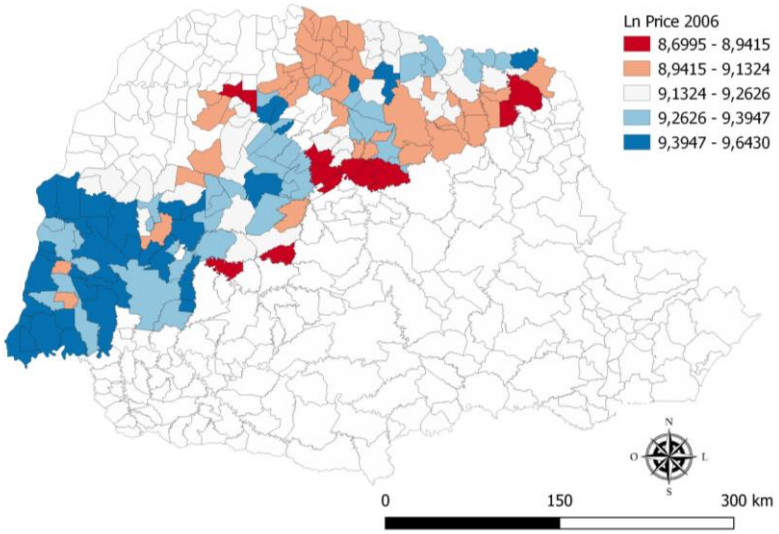
Results

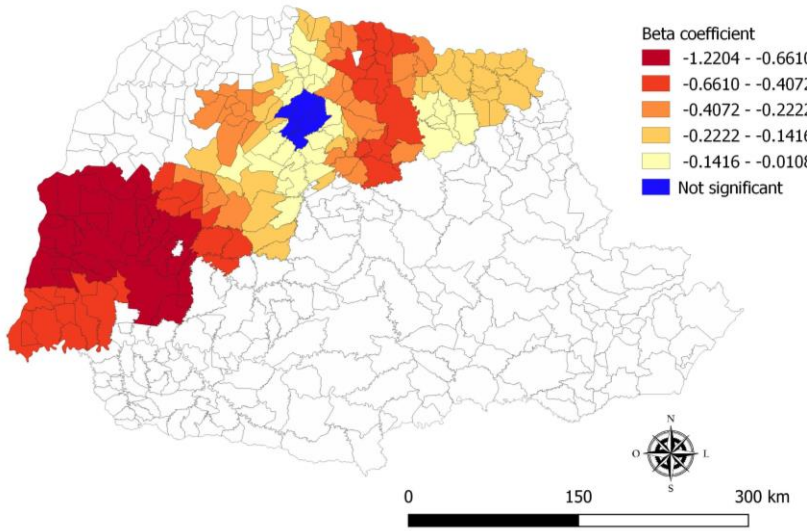
Summary results of the Beta coefficients in the local regressions

Soil		Mean	SD	Lower Q	Median	Upper Q
Purple	Mechanized	-0.3841	0.3099	-0.5878	-0.2959	-0.1511
	Mechanizable	-0.6294	0.1540	-0.7553	-0.6655	-0.5122
	Non mechanizable	-0.6368	0.2390	-0.7802	-0.6250	-0.5009
	Unusable	-0.5541	0.2888	-0.8335	-0.6638	-0.2083
Mixed	Mechanized	-0.4736	0.1701	-0.5773	-0.4708	-0.3663
	Mechanizable	-0.5359	0.1881	-0.6875	-0.5072	-0.3754
	Non mechanizable	-0.5960	0.2326	-0.7507	-0.5815	-0.4260
	Unusable	-0.7213	0.3240	-0.9351	-0.7545	-0.4904
Sandy	Mechanized	-0.7410	0.2304	-0.9105	-0.6514	-0.5578
	Mechanizable	-0.9239	0.2116	-1.1111	-1.0379	-0.6568
	Non mechanizable	-0.6072	0.1206	-0.6955	-0.6490	-0.4942
	Unusable	-0.7039	0.3976	-0.9890	-0.9427	-0.1125

Results

Purple mechanized land

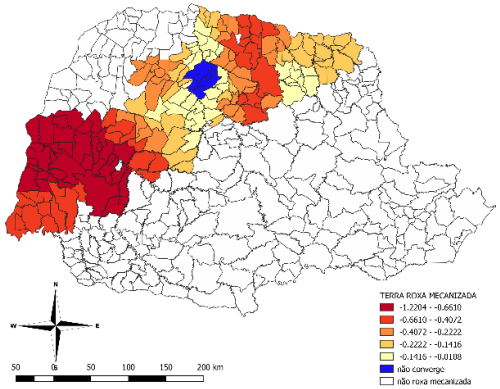




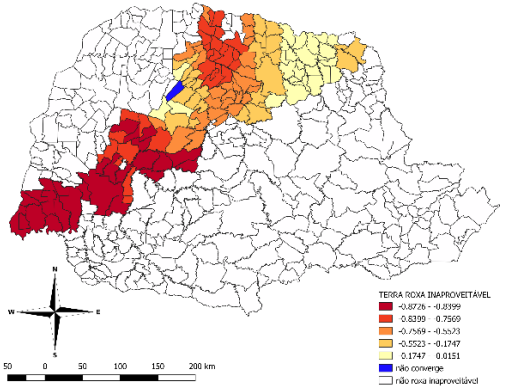
Results: β coefficients

Purple land

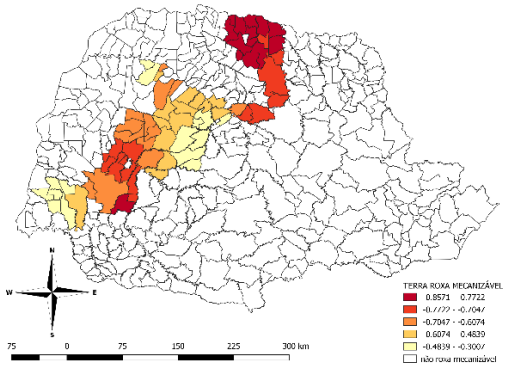
Mechanized



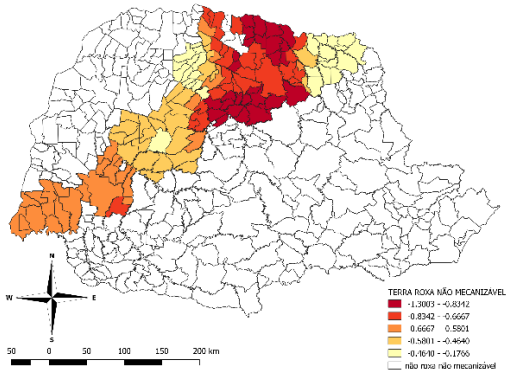
Unsuable



Mechanizable



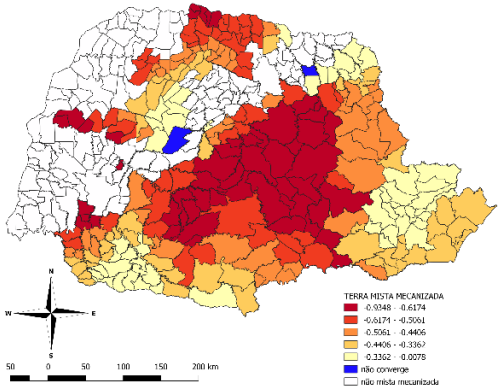
Non Mechanizable



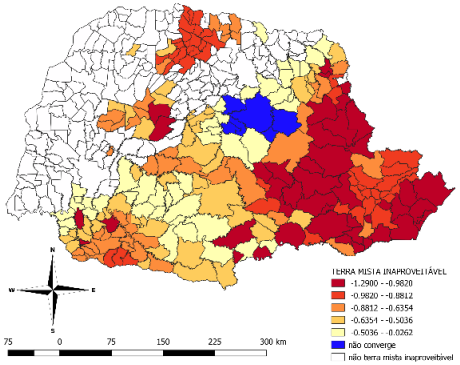
Results: β coefficients

Mixed land

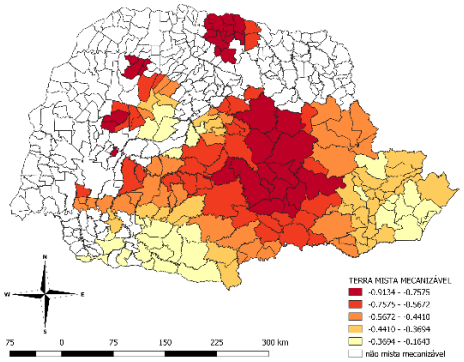
Mechanized



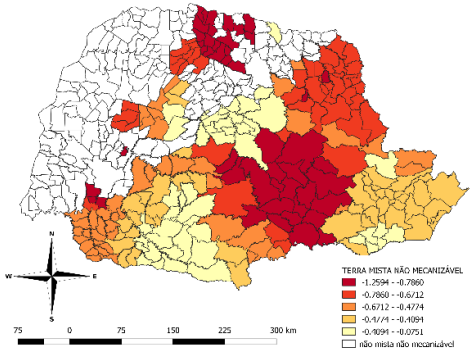
Unsuable



Mechanizable



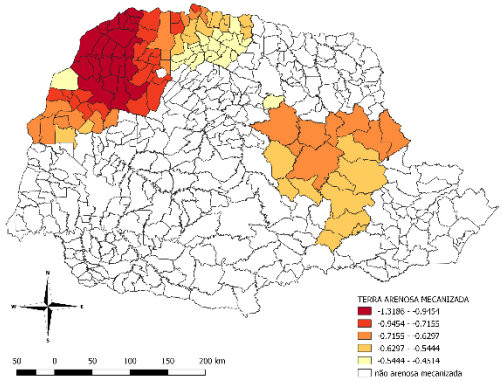
Non Mechanizable



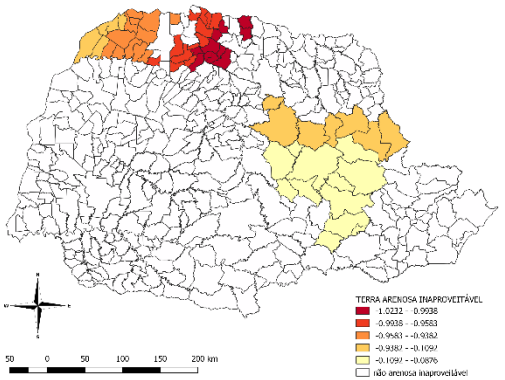
Results: β coefficients

Sandy land

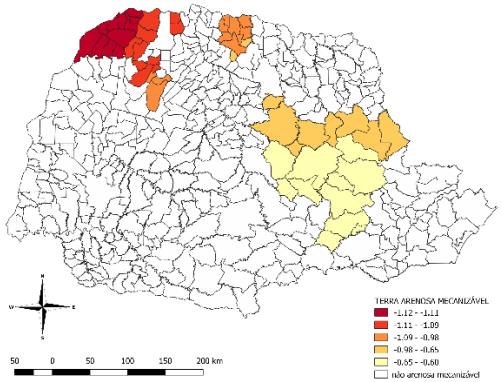
Mechanized



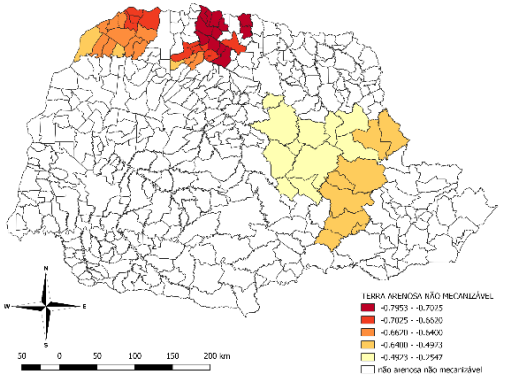
Unsuable



Mechanizable



Non Mechanizable



Final remarks

- By using GWR technique we have identified expressive heterogeneity in the convergence process of land prices for the municipalities in Parana state.
- The results imply the rejection of LOP and are consistent with the formation of convergence clubs, which means the dynamic of convergence in some municipalities are different from others. Thus, in the long term, prices differences of agricultural land do not necessarily converge to the same steady state.
- The regions pertained to the convergence clubs seem to be in some extent composed by neighboring municipalities that have similar natural and socioeconomic conditions.
- Further empirical analysis is necessary to infer the reasons for the failure of the LOP and for understating which factors would be the source of inefficiencies in the agricultural land market of Parana.

Further research

- Expanding the time range of the data to the period 1998-2018.
- Testing the robustness of the results using other procedures:
  - Correction of t-test in the GWR (Silva and Fotheringham, 2015)
  - Multiscale GWR (Fotheringham, Yang and Kang, 2017)
- Explore potential factors explaining the spatial heterogeneity observed in the convergence process:
  - Concentration of land
  - Agricultural credit mechanisms
  - Specialization and diversification
  - The role of commodity prices and local specialization

Thank you!

Alexandre A. Porsse
porsse@gmail.com

NEDUR

Núcleo de Estudos em Desenvolvimento Urbano e Regional

Universidade Federal do Paraná

Av. Prefeito Lothário Meissner, nº 632 – Setor de Ciências Sociais | UFPR

www.nedur.ufpr.br

nedur.ufpr@gmail.com