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**RELATIONSHIP BETWEEN SPATIAL PRICE TRANSMISSION  
AND GEOGRAPHICAL DISTANCE IN BRAZIL**

***Karla Hernández-Villafuerte***

*Department of Agricultural Economics and Rural Development  
Georg-August-Universität Göttingen*

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# RELATIONSHIP BETWEEN SPATIAL PRICE TRANSMISSION AND GEOGRAPHICAL DISTANCE IN BRAZIL

Karla Hernández-Villafuerte

Department of Agricultural Economics and Rural. Georg-August-Universität Göttingen, Germany

Karla.Hernandez-Villafuerte@agr.uni-goettingen.de

## 1. Introduction

Spatial Cointegration: Price signals transmission across separate markets (Goletti et.al, 1995).

- Indicator of the performance of the market: infrastructure efficiency and transaction costs.

Base on the Law of One Price: prices of the same product in two spatially separate markets would differ only in the transfer costs (Enke, 1951)  $\rightarrow P_t^y = \text{transfercost} + \beta_1 P_t^x$

- Usually  $\beta_1 \neq 1$  WHY?  $\rightarrow$  **Distance**: recently mentioned as a possible explanation. (Goletti, 1995; Rapsomanikis and Karfakis, 2004; Escobal & Vásquez, 2005)
- If the effect is not explain by transfer cost, why does it have an impact?  $\rightarrow$  Are there variables that affect the cointegration and are related with the geographical distance?

## 4. Data

- Prices of rice: ECLAC Chile. Producer monthly data in dollar per kilo.
- Distance: Google maps, road distance in kilometers.

## 5. Methodology: Cointegration Analysis (each pair of markets)

- X = leader and Y = follower: Granger Causality test (Granger, 1969; modified by Dolado & Luetkepohl, 1996)
- Cointegration is tested: Engle and Granger (1987).  $P_t^y = \beta_0 + \beta_1 P_t^x + \lambda t + \mu_t$
- Identified the presence of structural breaks: Bai and Perron (1998), modified using the significant values proposed by Kejriwal and Perron (2008).
- Cointegration allowing structural breaks: Gregory and Hansen (1996)

$$P_t^y = \beta_0^1 + \beta_0^2 \psi^i_{it} + \beta_1^1 P_t^x + \beta_1^2 \psi^i_{it} P_t^x + \delta t + \eta_t$$

- Error Correction Model (ECM). (ECT= $\mu t$ )

$$\Delta P_t^y = \alpha_y ECT + \sum_{j=1}^{n_x} \Gamma_j^y \Delta P_{t-j}^y + \sum_{j=1}^{n_y} \Gamma_j^x \Delta P_{t-j}^x + \alpha_0 + \alpha_1 t + \delta_i D_i + \varepsilon_t^y$$

## 2. Objective

Investigate the influence of geographical distance on the cointegration relationship, isolating the effect of variables linked to the distance.

## 3. Brazil: Land of contrasts

- Fifth biggest country in the world.
- The distance means differences in development, opportunities and culture.
- In Latin America is the biggest producer of rice and 10<sup>th</sup> of per-capita consumption. Net importer: 5% of total world exports.

## 6. Methodology: Principal Component Regression

Dependent Variables ( $y^i$ ):  $\beta_1^1$ ,  $\beta_1^{final}$  (after last break) and  $\alpha_y$

- OLS: alone each **Related Variables (RV)** is used to explained each  $y^i$ .
  - Final set of Independent Variables (X) : Distance + statistically significant RV.
- Multicollinearity is tested: Variance Inflation Factors.

**There is high multicollinearity in the three equations**

- Principal Component Regression (Jolliffe, 2002) : Estimation of  $\theta$  without Multicollinearity

$$Z_j = \sum_{i=1}^n C_{ij} X_i \rightarrow y^i = \sum_{i=1}^k \gamma_i^j Z_i + y^i = \theta_0^i + \sum_{i=1}^k \theta_i^j X_i + \mu$$

Figure 1: Log of Rice Prices. 02/1990 - 01/2006

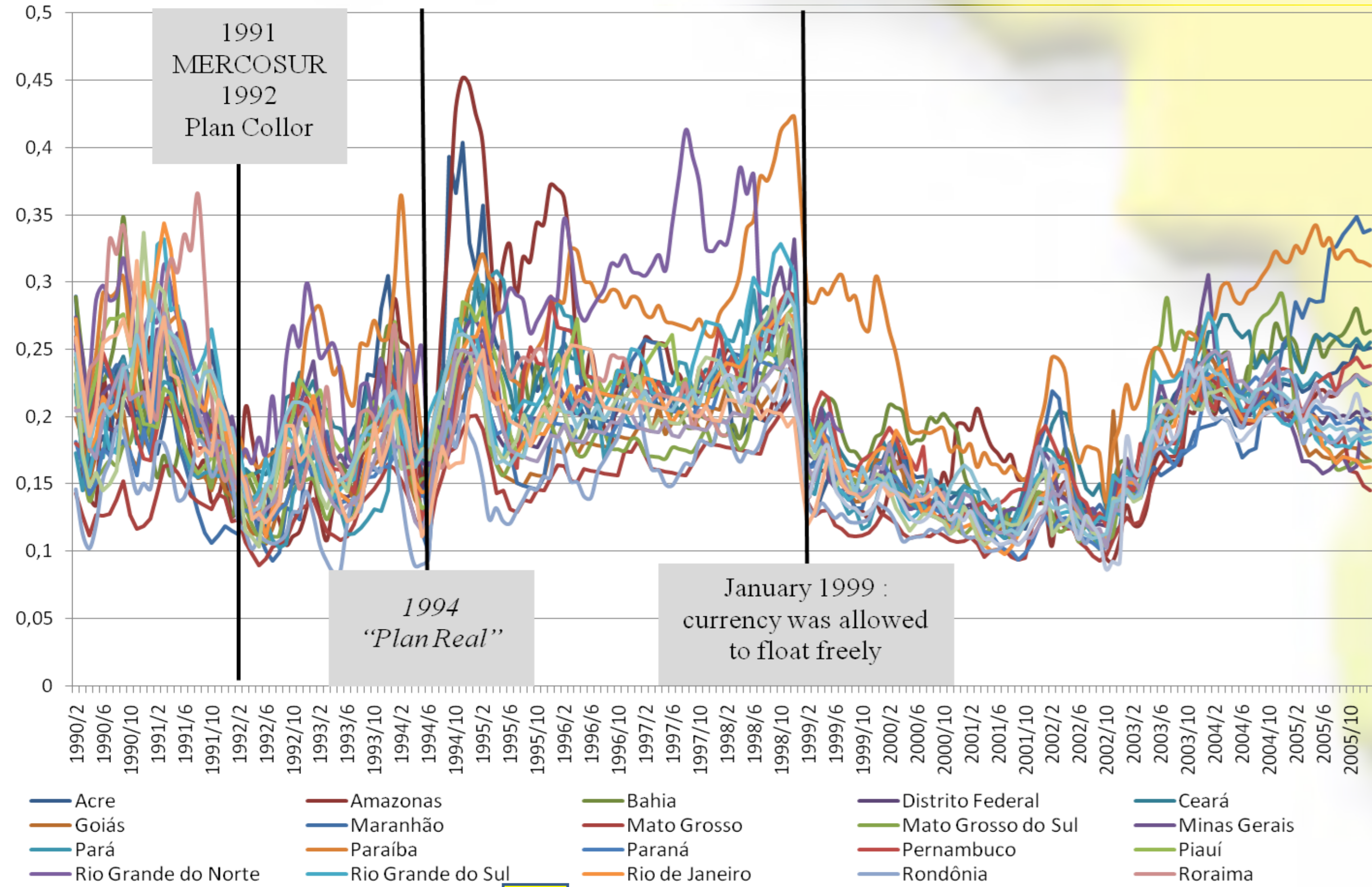
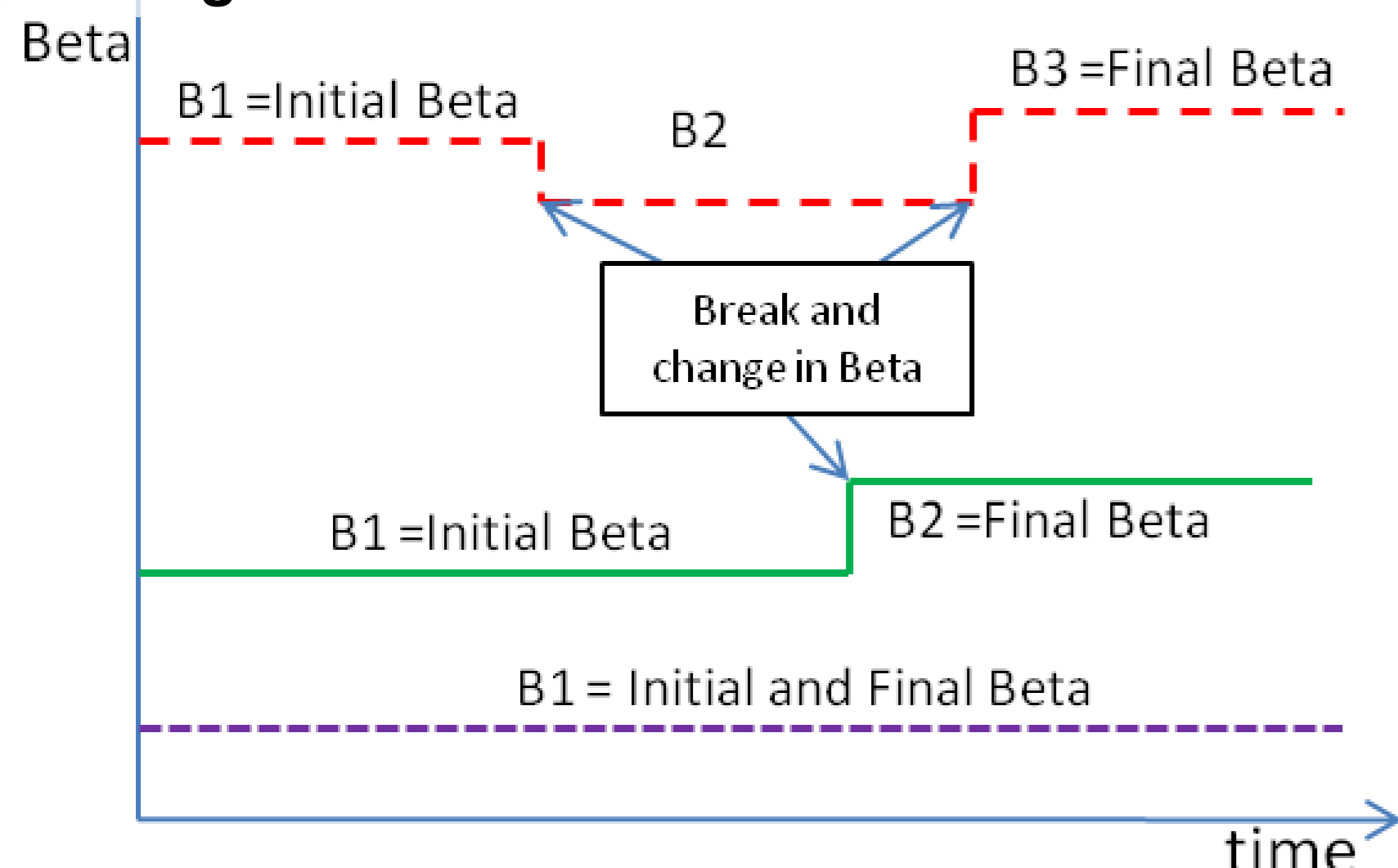


Table 1. Period of significant structural breaks (number of relations)

Period	First Break		Second Break	
	Intercept	Interp - Beta	Intercept	Interp- Beta
1991-1992	15	41	0	0
1993-1994	3	15	9	2
1995-1996	2	17	13	3
1997-1998	3	9	9	3
1999-2000	3	41	29	4
2001-2002	3	9	22	14
2003-2004	1	1	35	12
<b>Total</b>	<b>30</b>	<b>133</b>	<b>117</b>	<b>38</b>

Source: Own Elaboration

Figure 2: Dependent Variable: elasticity of cointegration



## 7. Results and Conclusions

- Weak, negative and significant relation between the distance and the elasticity of cointegration.
- Not significant to speed of adjustment ( $\alpha_y$ )
- Breaks**
  - First break 1992-1994: After the entry in MERCOSUR and Plan Collor.
  - Last break after 1999: Liberalization of the currency.
- Related Variables**
  - Principal producer states : weaker relations.
  - MW and the SE: lowest elasticities.
    - ✓ Except for SE leaders in the initial period and MW leaders in the final.
  - The quality of road has a positive impact for the leader market and a negative for the follower.
  - Access to an export point (coast or border) have strong influence in cointegration.
  - The low % of the Y variance explained, suggest existence of more independent variables.

**Related Variables:** linked to distance and with a possible effect on cointegration

- Importance of the market: Consumption and Production**  $\rightarrow$  The most important consumers and producers are geographically concentrated.
- Location of the market: Region**  $\rightarrow$  Deep differences in natural resources and climate: diverse systems of rice production.
- Paved Roads: Level of state development**  $\rightarrow$  The most developed states have a better road quality (South, Southeast and Middle West)
- Access to international markets: Export points ports and borders**  $\rightarrow$  98% of rice and derived products imports come from Argentina, Uruguay or Paraguay.

Table 2 Principal Component Regression: Elasticity of Cointegration and Speed of the Adjustment

Variables	Initial $\beta^i$		Final $\beta^i$		Alfa $^i$	
	Follower	Leader	Follower	Leader	Follower	Leader
Intercept	89,91		49,53		-12,67	
distance (100km)	0,00		0,00		0,002	
State in the Coast - yes	-3,72	-13,61	1,45	-2,62	0,57	-6,47
Distance to the Principal Port: RIO GRANDE (100km)		-0,01		0,00		0,00
CheckPoint- 0 base category						
CheckPoint- 1-4	2,71	-2,56	-1,67	2,42	-2,06	-0,18
CheckPoint- 5-10	12,08	2,82	2,43	-3,69	-0,31	1,91
Region- North East base category						
Region- North	5,33	1,64	-1,53	1,93	0,44	-0,19
Region- Middle West	-2,42	-5,20	2,10	-2,92	2,91	-0,60
Region- South	-1,01	7,10	0,28	3,26	-0,75	-3,10
Region- SouthEast	2,50	-1,35	-0,18	-2,05	2,58	5,48
Paved Roads (km per each 1000 km <sup>2</sup> )		0,44	-0,01	0,22		-0,10
Consumption per capita			-0,26	0,44		
Population Density			-0,15	0,02		0,05
Principal Producer- yes	-0,48	-4,38	-0,90	-0,45	1,28	-4,54
# components	11		9		15	
% variance explained-X	100,00		100,00		100,00	
% variance explained-Y	41,21		11,99		28,10	
RMSEP adjCV	0,2539		0,3659		0,958	

<sup>i</sup>Represent the percentage effects.

Source: Own Elaboration