Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011.

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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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) → $P_t^y = transfercost + \beta_1 P_t^x$

- Usually $\beta_1 \neq 1$ WHY? → ***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?→ Are there variables that affect the cointegration and are related with the geographical distance?

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 10th of per-capita consumption. Net importer: 5% of total world exports.

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)

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

$$P_t^y = \beta_0^1 + \beta_0^i \psi^{i}_{t\tau} + \beta_1^1 P_t^x + \beta_1^i \psi^{i}_{t\tau} P_t^x + \delta t + \eta_t$$

5. Error Correction Model (ECM). (ECT=μt)

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

6. Methodology: Principal Component Regression

Dependent Variables ($\mathbf{y^i}$): β_1^1 , β_1^{final} (after last break) and α_y

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

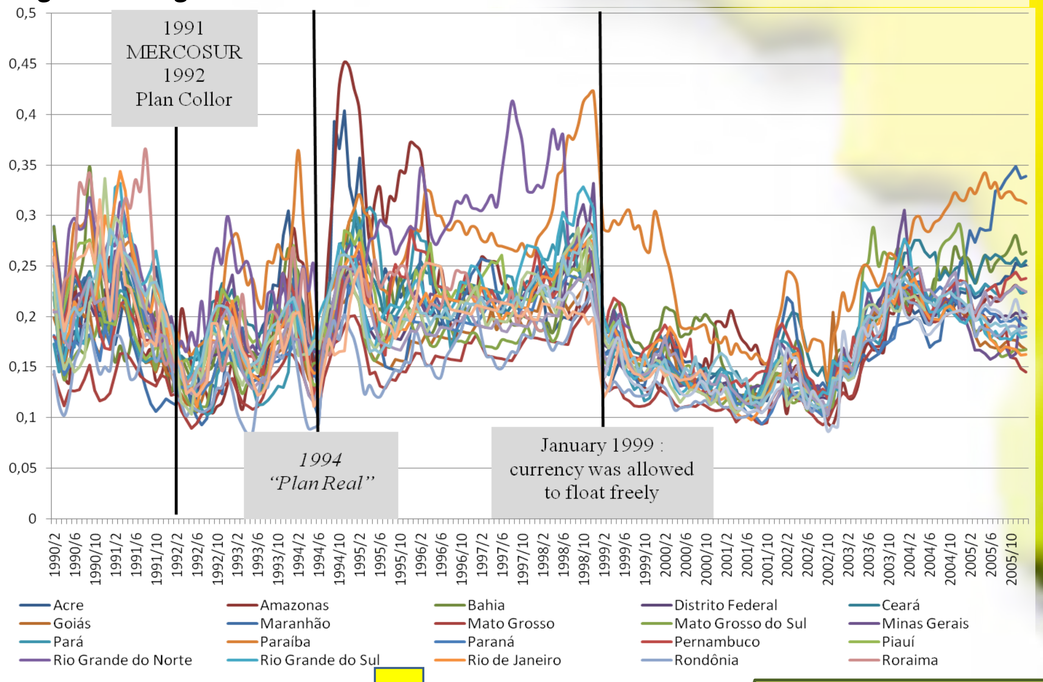
There is high multicollinearity in the three equations

1. Principal Component Regression (Jolliffe, 2002) :

Principal Component Analysis + OLS Equation = Estimation of θ without Multicollinearity

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

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



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

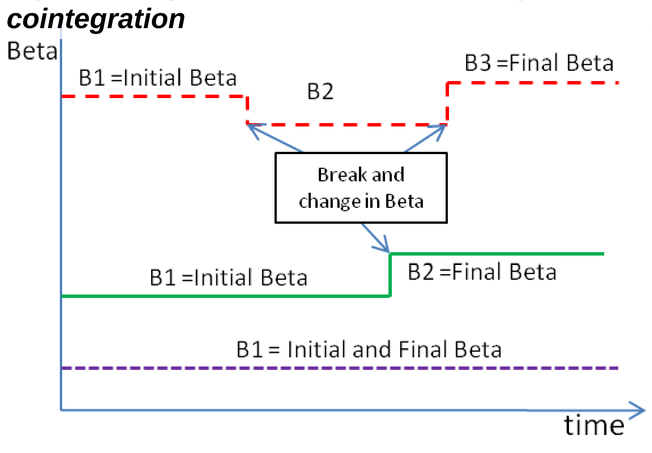
Importance of the market: Consumption and Production	• The most important consumers and producers are geographically concentrated.
Location of the market: Region	• Deep differences in natural resources and climate: diverse systems of rice production.
Paved Roads: Level of state development	• The most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

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

	First Break		Second Break	
Period	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
Total	***30***	***133***	***117***	***38***

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 (α_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.

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

Variables	Initial β^i		Final β^i		Alfa ^{i}	
Intercept	89,91		49,53		-12,67	
distance (100km)	0,00		0,00		0,002	
	Follower	***Leader***	***Follower***	***Leader***	***Follower***	***Leader***
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 Weast	-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^2)		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	

[i]Represent the percentage effects.

Source: Own Elaboration