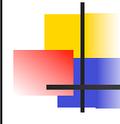# An Application of Time Series Panel Econometrics to Gravity Models

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Introduction

- Gravity models are a popular method for estimating bilateral trade flows.

- Researchers have assumed stationary time series to estimate gravity models.

- The basic gravity model relates trade flows to gross domestic product (GDP).
 - Individual country trade flows and GDP are most likely non-stationary.

Introduction

- If the variables are non-stationary, a different statistical setup needs to be used

- Ghazalian and Furtan recently studied the impact of innovations on trade in the primary agricultural and process food sector. The authors conclude that:
  - research and development (R&D) in the primary agricultural sector has a positive impact on primary and processed food trade
  - R&D in the processing sector has a negative impact on processed food trade

Introduction

- In this study, we revaluate Ghazalian and Furtan's model to test if extra information can be found by using cointegration techniques.
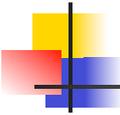
Panel Non-stationary Econometric Methods

- Recent developments in econometric literature (Phillips and Moon, 1999, Econometrica)

- Several Surprising results:
  - Panel heterogeneity is allowed
  - Consistent estimates result under both spurious regression and cointegration

Panel heterogeneity

- The spurious regression and cointegration models cannot be distinguished empirically.

- Average response coefficient can be estimated from the pooled data even if the panels are heterogeneous.
  - Economy wide impacts (useful for macro-policy analysis)

Panel homogeneity

- Are homogeneous panels unimportant?

- Average response coefficients mask important individual effects.
  - Distributional effects of policy

- We can study both heterogeneous and homogeneous panels, depending on the research objectives.

Panel Cointegration and Trade Models

- Reasons for heterogeneity in gravity models:
  - Culture
  - Language
  - Regional trade agreements
  - Innovations, Research and Development

- Studies have used deterministic variables to explain heterogeneity (especially dummy variables)

- Unclear how well simple one time shifts capture true time series properties of data

Panel Cointegration and Trade Models

- Stationary panel econometrics impose that heterogeneity is due to fixed and random effects

- Panel homogeneity can be tested within a cointegration framework in a more general and perhaps more meaningful way.

- Tests of cointegration within a homogenous panel still represents a reduction of a non-stationary set of variables to stationarity.

Panel Cointegration and Trade Models

- A test of cointegration can be interpreted as a test for homogenous panels.

- Represents a nonparametric testing approach to identify homogenous regions in trade.

- Null hypothesis is cointegrated and homogeneous
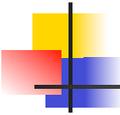
Approach to Identifying the Importance of R&D in trade

- The use of cointegration as a specification test

- Identifying appropriate trends/dummy variables in model specification is not important.

- Use the same data and specification as Ghazalian and Furtan

Econometric Methods

- Estimated the long-run relationships using Canonical Cointegrating Regression (CCR).

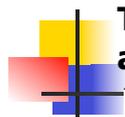- Use the variable addition approach to test for cointegration.

Table 1. Cointegration tests for primary agriculture gravity models

Model	Variable Addition Test [1]
Complete Model	
Base	<0.000
Demeaned and Detrended	0.357
Excluding R&D	
Base	0.011
Demeaned and Detrended	0.001

[1] Probability values for the J_1 variable addition test

Table 2. Cointegration tests for processed food sector gravity models

Model	Variable Addition Test [1]
Complete Model	
Base	<0.000
Demeaned and Detrended	0.384
Excluding R&Ds	
Base	<0.000
Demeaned and Detrended	0.026

[1] Probability values for the J_1 variable addition test

Table 3. Stochastic variable estimates for primary agriculture gravity models

Variable	Base	Estimate Demeaned and Detrended	Ghazalian and Furtan
GDP	0.901 *	0.475 *	--
Intermediate Inputs	0.583 *	0.768 *	0.474 *
Capital Rent	-2.799 *	-0.004	-0.684 *
Wage Rate	0.053	-0.327	-0.071 *
R&D	0.431 *	0.084 *	0.784 *

Table 4. Stochastic variable estimates for processed food gravity models

Variable	Estimate Base	Demeaned and Detrended
GDP	0.811 *	0.491 *
Intermediate Inputs	1.296 *	0.546 *
Capital Rent	2.844 *	-0.225
Wage rate	-0.745 *	-0.152
R&D processed sector	-0.370 *	0.124
R&D Primary sector	0.228 *	-0.080

* Significant at the 5% level or higher

Tale 4. Stochastic variable estimates for processed food gravity models

	Estimate	
Variable	**Restricted Model [1]**	**Ghazalian and Furtan**
GDP	0.495 *	--
Intermediate Inputs	0.576 *	1.070 *
Capital Rent	-0.220	-0.401 *
Wage rate	-0.161	-0.644
R&D processed sector	0.020 *	-0.570 [a]
R&D Primary sector	0.020 *	0.735 [a]

* Significant at the 5% level or higher
[1] Restricted model in not rejected at 5% significance level
[a] Significant at the 1% level or higher

Conclusions

- R&D is important in explaining the long run changes in agricultural trade flows.
  - positive impact for both types of R&D
  - Agricultural trade is highly inelastic to changes in R&D.

- More important to incorporate stochastic variables (like R&D) than to add deterministic variables

Conclusions

- Scope for further research:
  - The explanation of idiosyncratic trends
  - Development of more meaningful panel unit tests
  - Cross sectional dependence
  - Zero observations?
  - More countries (developing economies)
  - Maximum likelihood estimator