The Deterministic and Speculative Component of the Terms of Trade of Primary Commodities: an "Eclectic" Real Option Value Approach

P. L. Scandizzo, **S. Savastano**, A. Vezzani

University of Rome Tor Vergata, and CEIS

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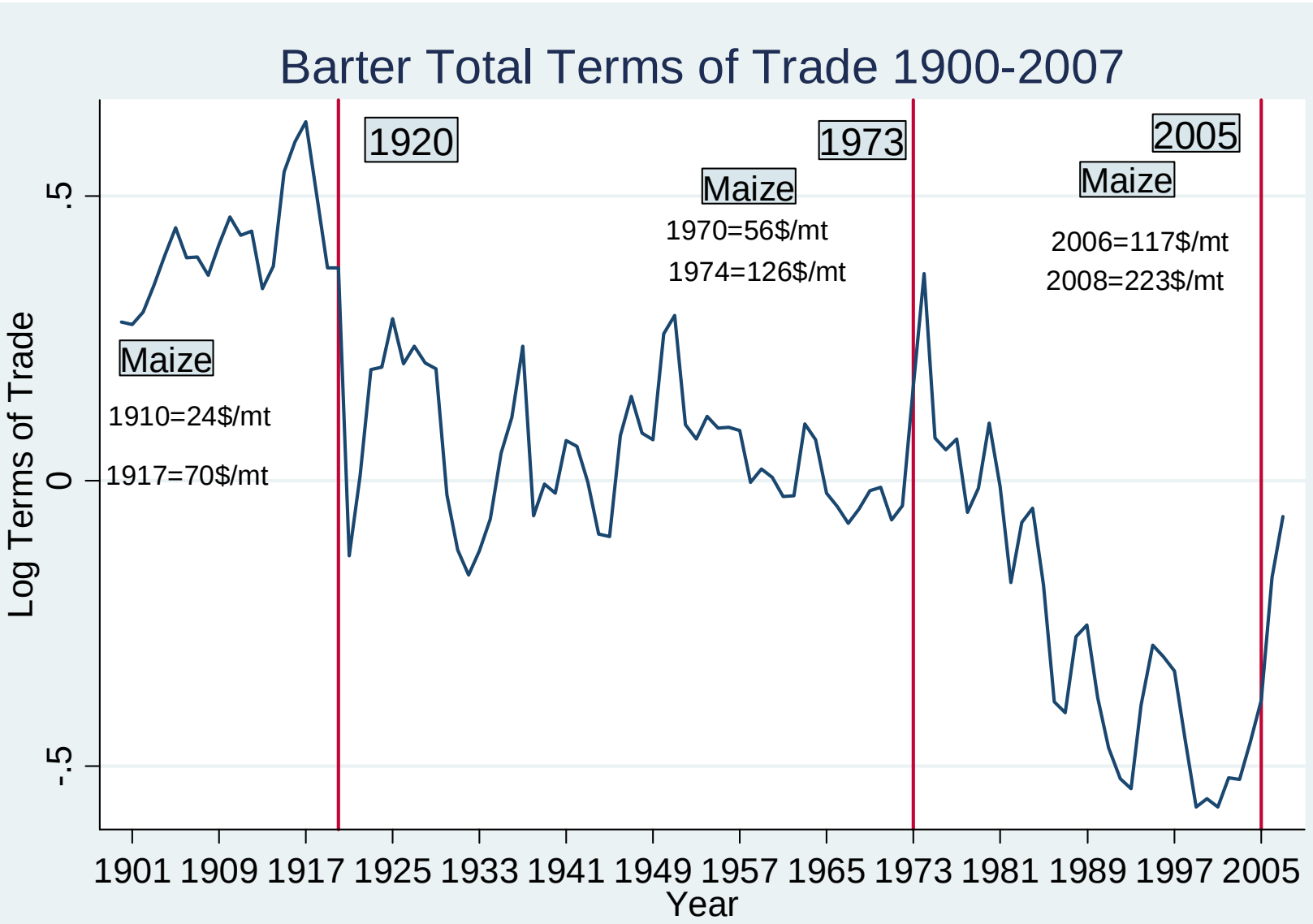
Objectives

- To test the Prebisch-Singer Hyp of secular decline of terms of trade using the longest annual time series (Scandizzo Diakossavas, 1991, Grilli and Yang 1988, and Pfaffenzeller 2007)
- Investigate whether the pattern of commodities terms of trade due to trend, and cycle, volatility
- Encompass in a same framework trend cycle and volatility by analyzing the fundamental component and the speculative component of price series
- bring together the issues of secular trends, long term cycles and variance over time.

Motivations

- Update the pioneering work of Scandizzo and Diakossavas (1991), with a longest time series and most recent econometric techniques
- Understand the role of agriculture, and primary commodities in the international development agenda
- Investigate the relationship between primary goods, and manufacture on a long term price series, and analyze the short term variation.
- Although it is widely accepted that volatility of agriculture prices is extremely important, there are few studies that attempt to bring together the issues of secular trends, long term cycles and variance over time
- Short term variation, in a long term perspective, refers to the problem of persistence of long term variance



Source: Authors' computation from Pfaffenzeller et al. (2007)

Consensus

- “Old Wine Story” (Singer, 1991) : PS Hyp. Secular Decline of Ag. Terms of Trade => demand for agricultural products rises less quickly than for manufactured goods and services as economic growth occurs and incomes rise
- Long term decline or short term variation?
- World Bank (1996) IMF (Wilson, 1994) supporting this empirical evidence of a long term decline trend rather than a cyclical behavior, thereby recommending developing countries to diversify their exports towards manufactured goods
- Since 1991, a plethora of empirical works testing PS Hyp.

  Controversial Results based on econometric techniques, period of time, single commodtiies.

Two Schools of Thought

1. **Test the long run validity of the PB hypothesis, => investigate the relationship between primary goods, and manufacture on long term price series.**

   Scandizzo Diakossavas (1991), Grilli-Yang (1988), Cuddington- Urzúa (1989), Powell (1991), Ardeni & Wright (1992), Cuddington (1992), Reinhart & Wickham (1994), Zanias (2005), Baltagas & Holt (2009)

2. **Analysis of the short term variation of agriculture price series**

   Sapford and Singer (1998) , Cashin et. al. (1999), Deaton and Laroque (1992; 1995; 1996), Gustafson (1958), Williams and Wright (1991), Cafiero (2002), Cafiero and Wright (2006), Cafiero, Bobenrieth E., Bobenrieth J. & Wright (2009)

GLS on Total TOT : Trend, Structural Breaks, and Slopes
Period: 1900-2007

	Log Total Terms of Trade		
	Base	**With SB**	**With SB and Slope**
Time Trend	**-0.007*** **	-0.004	**-0.002***
SB 1921		0.446***	**0.373*** **
SB 1973		0.137	
Slope from 1973			**-0.007****
Constant	0.396***	0.085	0.113
Observations	108	108	108
R-squared	0.2	0.25	0.38
DW test	1.68	1.59	**1.60**

Trend: Long term change in mean
Secular decline of 0.7% and 0.2%/year

SB: Change in the pattern of the distrib.
SB 1921: Bef. 1921 TOT were 37% higher than after 1921

Contrary to Powell (1991), Cuddington and Urzua (1989), Ardeni and Wright (1992) Not a SB 1973

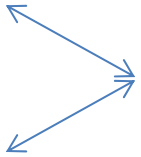
Slope: Bef. 73 price reduction is lower than after 73
Price reduction of 0.7%/year versus 0.2% of long term trend

DW lies in zone of indecision

Cannot Reject PS Hyp but marginal

Example Log Maize/MUV

	Maize	Maize with SF
Time Trend	-0.010***	-0.007***
Structural Break 1921		0.114
Slope after 1973		-0.013**
Constant	0.794***	0.668***
Observations	108	108
R-squared	0.23	0.32
DW Stat	1.79	1.75



Long term Trend Marginal from 1% to 0.7%/year
Price reduction Slope after 1973 larger than long term average reduction

DW slighlty significant

Preliminary Results:
Test of the Long Term Trend

- **BTTs** of primary commodities do appear to exhibit **a small negative trend**, of about -1% per year (Total TOT, Metal, Food, Non Food Indexes, 24 Commodities)

- **Trend remains constant** (except for the aggregate food index, which shows a significant quadratic component) **and roughly of the same size until 1973, and worsens after this year**;

- Both the years before 1921 and after 1973 exhibit different levels and trend coefficients.

- **These results confirm the consensus of the recent literature** and, to some extent, are similar to the ones obtained by Diakossavas and Scandizzo. **They do not allow to draw firm conclusions** both because of the **small nature of the effects detected** and because, in spite of the GLS method used, the residuals of **all regressions exhibit heteroskedasticity.**

Short term variation as persistence of long term variance: A theoretical model

- Model for a representative firm risk neutral firm of a developing country
- We assume that the terms of trade index P, expressed as a ratio between export and import prices, is governed by a stochastic process of the geometric Brownian motion variety

$$dP = \nu P dt + \sigma P d\zeta$$

- The main reason why the terms of trade may behave stochastically is that they are the price of an asset (foreign exchange), which is traded in the international markets and, as such, tracks fundamentals subject to external shocks affecting its trade [Dixit, 1993, p. 29].

Real Option Theory

- Standard Obj. of the firm max present value of the stream of future benefits=> Net Present Value (NPV)
- BUT Real Option Value Theory tells
- ENPV =NPV + Options created – Options destroyed
- The objective is to determine the optimal value of the firm (Bellman Optimal Condition)

$$\rho V dt = \max\{[PQ(K) - I]dt + E[dV(K,P)]dt\}$$

= extended net presetn value of the firm is equal present vale of net benefit + the expacted value of the option created. Irreversible investment consists in expanding the imports of manufacture goods.

- Solving Value Matching, Smooth Pasting, Applying Bellman optimality conditions, and Ito's Lemma, we obtain the value of the firm

$$V = P\frac{Q}{\delta} + AP^{\beta} \qquad \beta = \left[\frac{\left(1/2\sigma^2 - \alpha\right) \pm \sqrt{\left(1/2\sigma^2 - \alpha\right)^2 + 2\rho\sigma^2}}{\sigma^2}\right] \qquad (9)$$

The value of the firm equals the expected present value of optimum profit plus a contingent value. This contingent value reflects the speculative opportunities as (Dixit and Pindyck,1994, p.181-182) i.e. the speculative bubbles that may be associated with an expected depreciation of the currency, that may lead operators to value the exporting firm above its fundamentals **. ⇔ to the opportunity for the firm to grow through an increase in investment if terms of trade improve**

the Unit Value of Production

$$V/Q = P_s = \frac{P}{\delta} + \frac{A}{Q}P^{\beta}$$

1. fundamental price component , representing the present value of future revenues and,
2. an option value depending both on the level and the volatility of such a component.

Two Stage Estimate of the Speculative Component

- Traditional approach GLS with trend, SB and slopes
- But heteroschedastcity in errors (lowDW)
- Two Stages Estimate :
- Arch on TOT with traditional approach (with trend SB and slope)

$$p_t = \log P_t = a + bt + cD_{73}t + \gamma D_{21} + \lambda d_{73} + u_t$$

- Compute Variance, Beta, and Speculative Component
- GLS of residuals over speculative components
- Not heteroschedastic and high value of the coeff of Speculative component

Empirical Results
First Stage

	Total TOT	**Metal**	**Food**	**Non Food**
Trend	-0.002**	-0.001**	-0.005**	-0.004**
Structural Break 1921	0.263**	0.472**	0.229**	0.022
Slope 1973	-0.018**	-0.017**	-0.006**	-0.022**
Constant	0.170**	0.167**	0.395**	0.248**
ARCH				
L1	0.578*	0.940**	0.534*	0.882**
Constant	0.008**	0.008**	0.010**	0.009**
Observations	108	108	108	108
Chi2	785	484.4	405.2	788

Second Stage: Impact of the Speculative Component

	Total TOT	Metal	Food	Non Food
Speculative Component	1.145**	0.458**	0.870**	0.966**
Trend	0.005**	0.003**	0.007**	0.005**
Constant	-1.471**	-0.732**	-1.379**	-1.241**
Observations	108	108	108	108
R-squared	0.62	0.38	0.82	0.64
DW stat.	2.04	2.07	1.89	2.09

Conclusions

- The question of the decline of terms of trade is controversial if it disregards the distribution of the possible declines (quantile regressions – and state space regressions)
- We have found some validation of the hypothesis that BTTs can be decomposed into a fundamental and an option-like speculative component, whose size depends and presumably feeds back into historical volatility
- More research is needed, however, to establish whether such a finding is robust and can be interpreted with confidence as something that can be useful not only for better understanding price dynamics, but also for policy purposes.