Asymmetries in Commodity Price Behaviour

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Introduction

- Dynamic properties of commodity prices.

- The importance of commodity price dynamics to developing countries.

➢ Cycles
  - Asymmetry

➢ Persistence

➢ Persistence

Characteristics

- Dominated by long periods of doldrums punctuated by sharp upward spikes (Deaton and Laroque 1992)

- Commodity prices record positive skewness, in that the prices show relatively more upward peaks than matching troughs (Deaton 1999)

Characteristics

- Primary commodity prices increase by less than manufacturing goods prices during expansions but fall more during downturns (Prebisch 1950).

- Inventory holding behaviour: For example, in the lead up to the spike, inventories get run down and prices begin to increase. When the stocks reach a critical point, the price spikes. Over the ensuing time period stocks get replenished and the price declines. This decline occurs more gradually than the spike (Carter et. al. 2011).

Persistence to Shocks

- Any shocks are ultimately transitory in nature and that real commodity prices revert to trend or a long run constant (Deaton 1999, Wang and Tomek, 2007)

- Empirical evidence shows that commodity prices tend to persist for a considerable length of time (Cashin et al., 2000) and that this persistence can change over time (Ghoshray 2013).

Trends in Commodity Prices

- Prebisch-Singer hypothesis
- In recent years, support for this hypothesis has begun to wane. [Kellard and Wohar (2006); Ghoshray et. al. (2014)].
- Deaton and Laroque (2003): Prices of commodities in developing countries can be characterized as containing no significant trend by linking commodity price determination to the Lewis (1954) model.

Model

- Two types of asymmetry:
- 1. Persistence below a long run trend/constant; relatively quick reversion to long run trend/constant.
- 2. Relatively more momentum when prices are increasing (decreasing) than opposed to when prices are decreasing (increasing) relative to the long run trend/constant.
- Underlying assumption: Prices should be mean/trend reverting.

Literature Review

- Thirlwall and Bergevin (1985) using regressions with dummy variables find that there is little evidence for the Prebisch (1950) hypothesis.

- Cashin et. al. (2002) adopt the Bry and Boschan (1971) algorithm to examine the duration and magnitude of cycles in international commodity prices. They find evidence that the rate of change of prices during the prices during the boom phase is slightly faster than that of the slump phase.

Econometric Methods

- Specify the commodity price to exhibit trend reverting behaviour:

$$P_t = \alpha + \beta t + \varepsilon_t$$

- Apply an ADF test, on the estimated residuals of the equation above:

$$\Delta\varepsilon_t = \gamma\varepsilon_{t-1} + \sum_{i=1}^{p} \psi_i \Delta\varepsilon_{t-i} + \omega_t$$

where ω_t is white noise and p denotes lags selected using SBC.

- Hypothesis of interest: $H_0: (\gamma = 0)$

Econometric Methods

- **Threshold Autoregressive (TAR) Model (Enders and Granger 1998)**

$$\Delta\varepsilon_t = I_t\gamma_1\varepsilon_{t-1} + (1 - I_t)\gamma_2\varepsilon_{t-1} + \omega_t$$

- where I_t is the Heaviside Indicator function such that:
- $I_t = \begin{cases} 1 \text{ if } \varepsilon_{t-1} \geq \tau \\ 1 \text{ if } \varepsilon_{t-1} < \tau \end{cases}$
- Hypothesis of interest:
- $H_0: (\gamma_1 = \gamma_2 = 0)$ Stationarity
- $H_0: (\gamma_1 = \gamma_2)$ Symmetry

Econometric Methods

- **Momentum-TAR Model (Enders and Granger 1998)**

$$\Delta\varepsilon_t = I_t\gamma_1\varepsilon_{t-1} + (1 - I_t)\gamma_2\varepsilon_{t-1} + \omega_t$$

- where I_t is the Heaviside Indicator function such that:
- $I_t = \begin{cases} 1 \text{ if } \Delta\varepsilon_{t-1} \geq \tau \\ 1 \text{ if } \Delta\varepsilon_{t-1} < \tau \end{cases}$
- Hypothesis of interest:
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More Powerful Tests

- **Lagrange Multiplier (LM) TAR and M-TAR (Lee, Strazicich, Yu 2011)**

$$\Delta P_t = I_t \gamma_1 \tilde{S}_{t-1} + (1 - I_t)\gamma_2 \tilde{S}_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \tilde{S}_{t-i} + \omega_t$$

Where I_t is the Heaviside Indicator function such that:

- $I_t = \begin{cases} 1 \text{ if } \tilde{S}_{t-1} \geq \tau \\ 1 \text{ if } \tilde{S}_{t-1} < \tau \end{cases}$ LM TAR

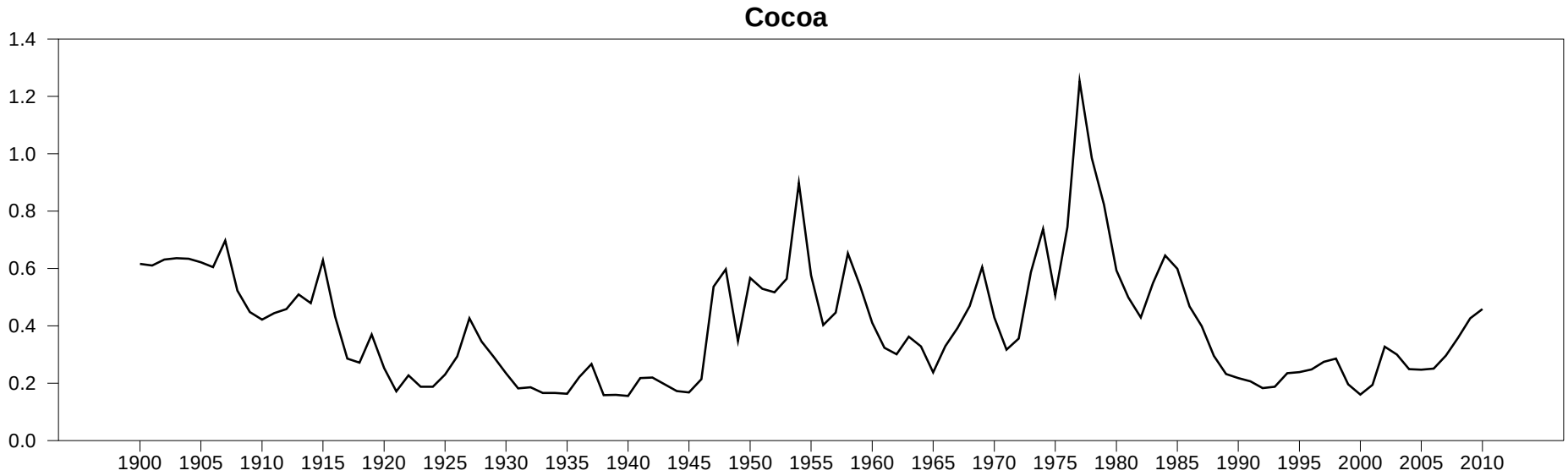
- $I_t = \begin{cases} 1 \text{ if } \Delta\tilde{S}_{t-1} \geq \tau \\ 1 \text{ if } \Delta\tilde{S}_{t-1} < \tau \end{cases}$ LM M-TAR

Data

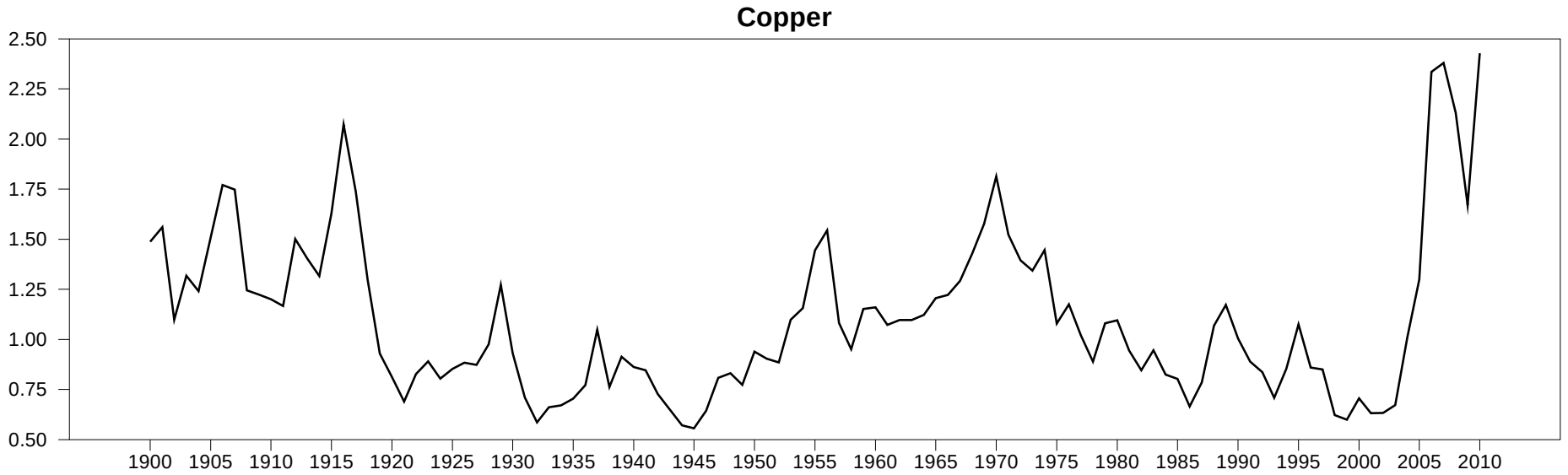
- The primary commodity price series used in this paper have been taken from the well-known and much-used Grilli and Yang (1988) index of 24 commodity prices, deflated by the Manufacturing Unit Value (MUV) index, ranging from 1900 to 1987. We use data extended up to 2010 carried out by Pfaffenzeller. Accessed from http://www.stephan-pfaffenzeller.com/cpi.html.

- Pfaffenzeller *et al.*'s (2007) technical note provides a full description of the calculation and extension of the Grilli-Yang data set.

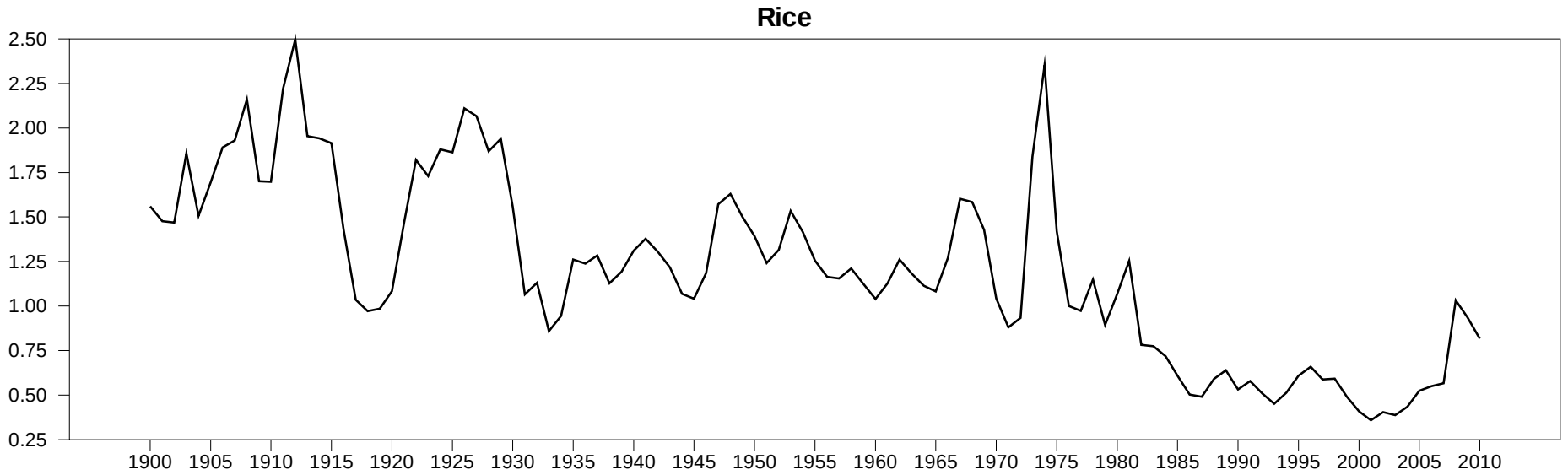
Cocoa: 1900 - 2010



Copper: 1900 - 2010



Rice: 1900 - 2010



Basic Statistics

	Skewness	Kurtosis
Beef	0.50**	-0.87*
Cocoa	1.17***	2.17***
Copper	1.24***	1.67***
Hides	1.38***	1.92***
Lamb	0.37	–0.97**
Lead	0.32	0.49
Rice	0.26	–0.55
Silver	2.86***	11.76***
Sugar	1.88***	5.48***
Timber	–0.09	–0.93*
Tin	1.20***	0.98**
Wheat	0.62**	–0.09
Zinc	2.84***	10.52***

Structural Break* and ADF tests

	ExpW	ETA	U	# Breaks	ADF-t
Beef	0.22	1.47	0.48	0	–3.04
Cocoa^	–0.07	1.39	0.51	0	–2.44
Copper^	0.02	1.76	0.34	0	–2.36
Hides	0.56	2.16	0.50	0	–5.23***
Lamb	–0.26	1.16	0.45	0	–3.12
Lead	–0.17	1.77	0.37	0	–2.62
Rice	–0.25	2.07	0.32	0	–4.38***
Silver	–0.03	1.86	0.38	0	–2.06
Sugar	–0.28	1.97	0.41	0	–4.64***
Timber	–0.19	2.41	0.45	0	–3.76**
Tin	–0.26	1.47	0.51	0	–2.54
Wheat	0.37	1.51	0.33	0	–5.07***
Zinc^	0.11	2.47	0.41	0	–4.76***

TAR Results (EG 1998)

	γ_1	γ_2	$H_0: (\gamma_1 = \gamma_2 = 0)$	$H_0: (\gamma_1 = \gamma_2)$
Beef	–0.21**	–0.12*	4.95	NA
Cocoa	–0.23***	–0.06	4.32	NA
Copper	–0.07	–0.18**	3.30	NA
Hides	–0.47***	–0.32***	10.84***	0.96
Lamb	–0.18**	–0.25***	7.10***	0.41
Lead	–0.07	–0.21***	4.33	NA
Rice	–0.41***	–0.15**	12.86***	5.67**
Silver	–0.12	–0.06	2.32	NA
Sugar	–0.43***	–0.18	12.29***	2.72
Timber	–0.18**	–0.28***	7.37***	0.63
Tin	–0.08	–0.15**	3.48	NA
Wheat	–0.47***	–0.38***	12.02***	0.47
Zinc	–0.43***	–0.24**	12.42***	1.41

M-TAR Results (EG 1998)

	γ_1	γ_2	$H_0: (\gamma_1 = \gamma_2 = 0)$	$H_0: (\gamma_1 = \gamma_2)$
Beef	–0.25***	–0.05	6.60*	3.69**
Cocoa	–0.30***	–0.06	5.84*	5.43**
Copper	0.06	–0.16***	4.47	NA
Hides	–0.68***	–0.27***	8.03***	3.57*
Lamb	–0.19***	–0.32***	7.52***	1.16
Lead	–0.10	–0.19**	3.75	NA
Rice	–0.38***	–0.18**	11.39***	3.19*
Silver	–0.29***	–0.01	7.21**	8.79***
Sugar	–0.23**	–0.46***	12.22***	2.59
Timber	–0.12	–0.32***	11.51***	10.25***
Tin	–0.27***	–0.07	5.09	NA
Wheat	–0.56***	–0.29***	14.33***	4.21**
Zinc	–0.19*	–0.54***	14.70***	5.74**

LM TAR Results (LSY 2011)

	γ_1	γ_2	$H_0: (\gamma_1 = \gamma_2 = 0)$	$H_0: (\gamma_1 = \gamma_2)$
Beef	–0.21**	–0.12*	4.95	NA
Cocoa	–0.23***	–0.06	4.32	NA
Copper	–0.07	–0.18**	3.30	NA
Hides	–0.47***	–0.30**	8.43***	1.24
Lamb	–0.18**	–0.24***	7.07**	0.36
Lead	–0.07	–0.21***	4.33	NA
Rice	–0.41***	–0.15**	12.86***	5.67**
Silver	–0.09	–0.06	1.47	NA
Sugar	–0.42***	–0.19	8.10**	2.43
Timber	–0.23**	–0.33***	7.79**	0.66
Tin	–0.09	–0.14**	3.34	NA
Wheat	–0.36***	–0.32***	6.14*	0.07
Zinc	–0.50***	–0.35***	15.67***	1.02

LM M-TAR Results (LSY 2011)

	γ_1	γ_2	$H_0: (\gamma_1 = \gamma_2 = 0)$	$H_0: (\gamma_1 = \gamma_2)$
Beef	–0.25***	–0.06	6.57**	3.63*
Cocoa	–0.26***	–0.06	4.60*	3.35*
Copper	0.06	–0.16***	4.48*	2.94*
Hides	–0.79***	–0.33***	10.36***	4.58**
Lamb	–0.20***	–0.29***	7.22***	0.62
Lead	–0.13*	–0.15*	3.42	NA
Rice	–0.38***	–0.17**	11.40***	3.20*
Silver	–0.29***	–0.01	6.31**	8.37***
Sugar	–0.25**	–0.40***	7.26**	0.95
Timber	0.07	–0.36***	12.81***	9.43***
Tin	–0.35***	–0.07	8.08***	7.78***
Wheat	–0.48***	–0.23**	8.15***	3.65*
Zinc	–0.20**	–0.53***	14.23***	4.95**

Conclusion

- We find commodity prices to broadly exhibit stationary behaviour with considerable evidence of asymmetries.
- There is no evidence of asymmetric behaviour, as described by Deaton and Laroque (1992).
- The asymmetric behaviour is limited in support of Prebisch (1950); more in favour of the type documented by Carter et. al. (2011).
- Overall, asymmetries do exist and their effect on developing countries may have non-trivial effects which merit further attention.