Asymmetric Price Transmission in the Brazilian Rice Market: A review of methodologies

Jacques Henrique Dias
Doctorate degree student at Universidade Estadual de Maringá

Dr. José Luis Parré
Professor at Universidade Estadual de Maringá

Dr. Waldemiro Alcântara da Silva Neto
Professor at Universidade Federal de Goiás

Universidade Estadual de Londrina

FAUEL

Fundação de Apoio ao Desenvolvimento da Universidade Estadual de Londrina

Abstract

The following lecture is intended to present and briefly discuss some arguments on the price asymmetry literature by applying the most used methodologies to the case of rice market in the Brazilian economy. We aim to assess the econometric models by the aftermath of each of them to that specific case. The results using the Error Correction Model (ECT) indicated that there is some asymmetry but it is not possible to infer that this asymmetry remains to the long run. Previous methodologies also showed that upward and downward price movements between these markets occurred in a different level and/or speed, the variables are significantly different for both rising and falling price phases, which demonstrates that the more sophisticated models can indeed forecast results accurately, shedding light on the output of prior models.

Background

By common sense we can perceive that some markets are not completely integrated, with upward and downward price movements between these markets occurring in different speed, magnitude or both. Price surges and falls may not be equally transmitted throughout a production chain and this has been a matter of concern for many researchers especially in the agricultural economics.

Noteworthy is the fact that economic theory has different ways to explain APT, mostly, market power and other costs inherent to asymmetries on price transmission. First works dealt with these cases as exceptions (Tweeten and Quance 1969, Woffram 1971, Houck 1977, Ward 1982).

A seminal work by Peltzman 2000 demonstrated that the asymmetry in price transmission (APT) could be a rule for the great part of the 282 products assessed in his work.

The literature in this issue is becoming vast, accompanied by the development of new econometrical methodologies applied to APT works (Von Cramon-Taubadel and Loy 1996, Goodwin and Holt 1999, Abdulai 2002).

Main Objectives

This research aims to:

1. Tackle the econometric models by showing the results of these models to the specific case of rice in the Brazilian economy from the price taken by the producers in one node of the chain to price paid by consumers at the end node of this product chain;
2. Apply the ECT methodology to data in order to verify long run equilibria among the series.

Footnote #1

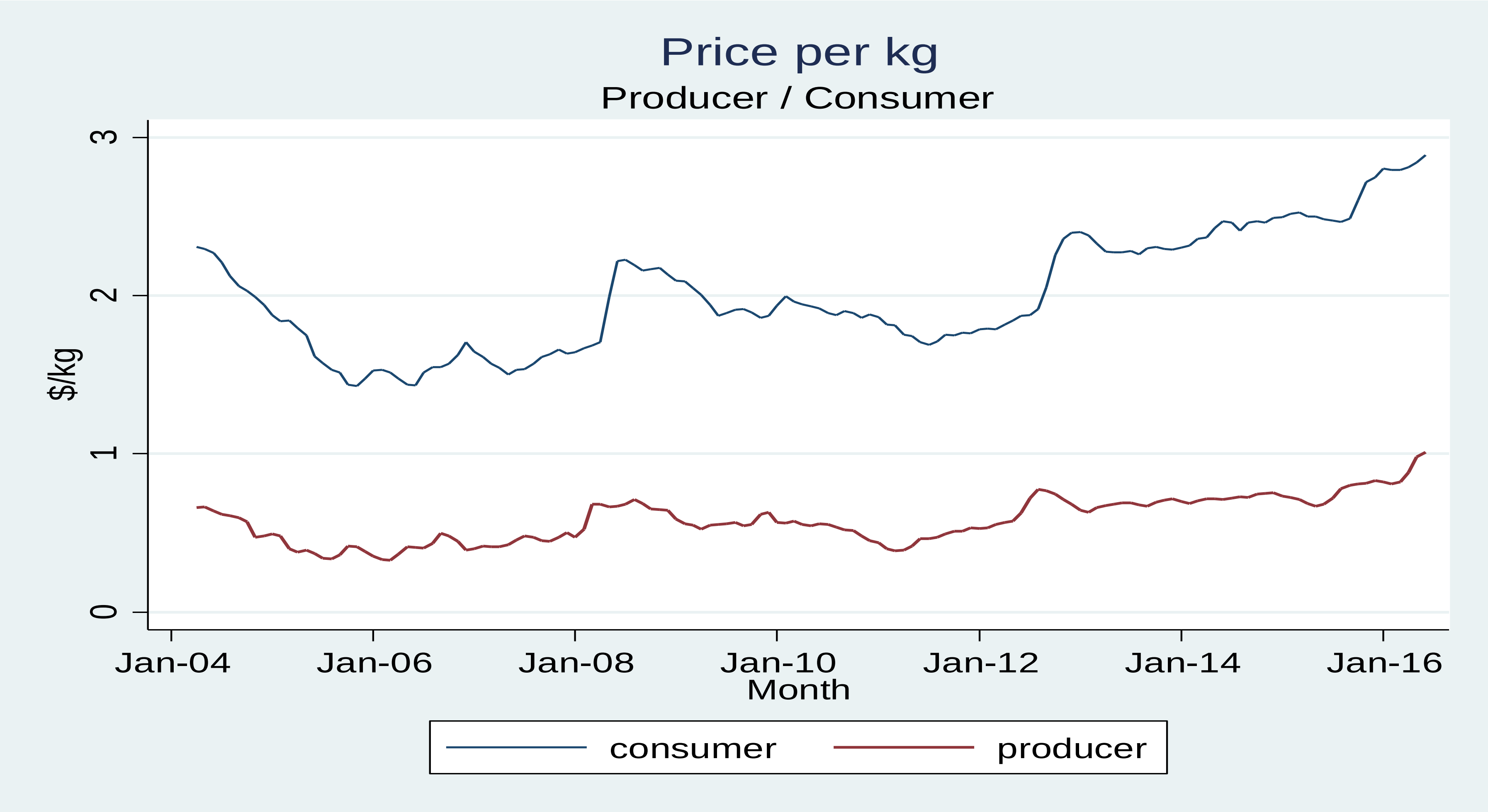
The aftermath of the different models to assess the data might be unclear, but the scope here is merely to use the framework and present what kind of output emerge from the development made by the literature on price asymmetries rather than discussing the details of the pure econometrics outlined in the footnotes of each method.

Data

We used monthly data retrieved from basically two sources: Agrolink for the price (R$/kg) received by the producers in Rio Grande do Sul State and Ibge for the price paid by consumers in the metropolitan area of São Paulo*, the range goes from April, 2004 to June, 2016 which results in 147 observations.

*Up to this presentation.

Graph



Price per kg
Producer / Consumer
$/kg
0
1
2
3
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Jan-14
Jan-16
Month
consumer
producer

```
. describe

Contains data from base.dta
  obs:           147
 vars:            43                          20 Nov 2016 21:29
 size:        48,804
```

Table 1: First Model – Perfect Symmetry Hypothesis

$$p_t^{out} = \alpha + \beta_1 p_t^{in} + \mu_t$$

Table 1

```
. reg a l

      Source |       SS       df       MS              Number of obs =     147
-------------+------------------------------           F(1, 145)     =  628.14
       Model |  16.3310747     1  16.3310747           Prob > F      =  0.0000
    Residual |  3.76984073   145  .025998902           R-squared     =  0.8125
-------------+------------------------------           Adj R-squared =  0.8112
       Total |  20.1009155   146  .137677503           Root MSE      =  .16124

------------------------------------------------------------------------------
           a |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           l |   2.347045   .0936465    25.06   0.000     2.161956    2.532133
       _cons |    .647198   .0560826    11.54   0.000      .536353     .758043
------------------------------------------------------------------------------
```

Where:
a = Consumer price
l = Producer price

Table 2

$$p_t^{out} = \alpha + \beta_1^+ D_t^+ p_t^{in} + \beta_1^- D_t^- p_t^{in} + \varepsilon_t$$

```
. reg a dlp dln
```

Source	SS	df	MS
Model	16.2471573	2	8.12357865
Residual	3.85375816	144	.026762209
Total	20.1009155	146	.137677503

Number of obs	=	147
F(2, 144)	=	303.55
Prob > F	=	0.0000
R-squared	=	0.8083
Adj R-squared	=	0.8056
Root MSE	=	.16359

a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dlp	.6154506	.025046	24.57	0.000	.5659453	.6649559
dln	.6192375	.0270618	22.88	0.000	.5657479	.6727271
_cons	.6271889	.0585941	10.70	0.000	.5113733	.7430046

Table 3

$$p_t^{out} = \alpha + \beta_1^+ \left(p_0^{in} + \sum_{t=1}^{T} D^+ \Delta p_t^{in} \right) + \beta_1^- \left(p_0^{in} - \sum_{t=1}^{T} D^- \Delta p_t^{in} \right) + \varepsilon_t$$

```
. reg a dlp dln sdslp sdsln
```

Source	SS	df	MS
Model	17.8816408	4	4.47041019
Residual	2.21927469	142	.015628695
Total	20.1009155	146	.137677503

Number of obs	=	147
F(4, 142)	=	286.04
Prob > F	=	0.0000
R-squared	=	0.8896
Adj R-squared	=	0.8865
Root MSE	=	.12501

a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dlp	.365551	.0444673	8.22	0.000	.2776476	.4534544
dln	.3849018	.0426076	9.03	0.000	.3006745	.469129
sdslp	1.346419	.1372144	9.81	0.000	1.075172	1.617666
sdsln	1.430627	.1398943	10.23	0.000	1.154082	1.707171
_cons	1.350226	.0913062	14.79	0.000	1.169731	1.530721

Table 4

$$p_t^{out^*} = \alpha t + \beta_1^+ \sum_{t=1}^{T} D^+ \Delta p_t^{in} + \beta_1^- \sum_{t=1}^{T} D^- \Delta p_t^{in} + \varepsilon_t$$

```
. reg ao trend sdslp sdsln, noconstant
```

Source	SS	df	MS
Model	29.4964718	3	9.83215727
Residual	3.42911989	143	.023979859
Total	32.9255917	146	.225517751

Number of obs	=	146
F(3, 143)	=	410.02
Prob > F	=	0.0000
R-squared	=	0.8959
Adj R-squared	=	0.8937
Root MSE	=	.15485

ao	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
trend	.0181211	.0031907	5.68	0.000	.011814	.0244282
sdslp	1.512072	.2039565	7.41	0.000	1.108912	1.915231
sdsln	3.187033	.1215647	26.22	0.000	2.946737	3.427329

Table 5

$$\Delta p_t^{out} = \alpha + \beta_1^+ D^+ \Delta p_t^{in} + \beta_1^- D^- \Delta p_t^{in} + \gamma_t$$

```
. reg a_dif dslp dsln
```

Source	SS	df	MS
Model	.001453185	2	.000726593
Residual	.412907259	144	.002867412
Total	.414360445	146	.002838085

Number of obs	=	147
F(2, 144)	=	0.25
Prob > F	=	0.7765
R-squared	=	0.0035
Adj R-squared	=	-0.0103
Root MSE	=	.05355

a_dif	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dslp	-.1126319	.2130833	-0.53	0.598	-.533807	.3085433
dsln	-.078564	.2950534	-0.27	0.790	-.6617593	.5046312
_cons	.0045618	.0063254	0.72	0.472	-.0079409	.0170645

Table 6

$$p_t^{out^*} = \alpha t + \sum_{j=1}^{K}\left(\beta_j^+ \sum_{t=1}^{T} D^+ \Delta p_{t-j+1}^{in}\right) + \sum_{j=1}^{L}\left(\beta_j^- \sum_{t=1}^{T} D^- \Delta p_{t-j+1}^{in}\right) + \varepsilon_t$$

```
. reg ao trend sp_lag3 sn_lag3, noconstant
```

Source	SS	df	MS
Model	29.3655256	3	9.78850855
Residual	3.54926287	140	.025351878
Total	32.9147885	143	.230173346

Number of obs	=	143
F(3, 140)	=	386.11
Prob > F	=	0.0000
R-squared	=	0.8922
Adj R-squared	=	0.8899
Root MSE	=	.15922

ao	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
trend	.0431707	.001439	30.00	0.000	.0403258	.0460156
sp_lag3	-.4143414	.3105817	-1.33	0.184	-1.028378	.1996954
sn_lag3	3.810546	.1251109	30.46	0.000	3.563195	4.057897

Table 7

$$\Delta p_t^{out} = \alpha + \sum_{j=1}^{K} (\beta_j^+ D^+ \Delta p_{t-j+1}^{in}) + \sum_{j=1}^{L} (\beta_j^- D^- \Delta p_{t-j+1}^{in}) + \gamma_t$$

```
. reg d1.a sp_lag3 sn_lag3
```

Source	SS	df	MS
Model	.164777822	2	.082388911
Residual	.24424521	140	.001744609
Total	.409023032	142	.002880444

Number of obs	=	143
F(2, 140)	=	47.22
Prob > F	=	0.0000
R-squared	=	0.4029
Adj R-squared	=	0.3943
Root MSE	=	.04177

D.a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sp_lag3	.7187662	.0810674	8.87	0.000	.5584916	.8790408
sn_lag3	-.0321469	.0085626	-3.75	0.000	-.0490757	-.0152181
_cons	-.0469352	.0089789	-5.23	0.000	-.064687	-.0291834

VECM – Vector Error Correction Model

Steps (pre-estimation procedures):

1. Causality;
2. Unit Root;
3. DFA (Augmented Dickey Fuller);
    1. Model Selection: Trend and/or Constant Term
4. Coefficients.

Causality

- Granger Causality Test*:

As expected, from all previous work assessed, the price paid by consumer is determined by the price received by producers based on better results for the chi squared*. Tests were performed with 2, 5 and 12 lags experimentally. (Brandão, 1985 apud Aguiar, 2004).

* Stationarity assumed.
*For 2 and 12 lags we cannot reject the possibility of the consumer price determining the producer price

Unit Root

Dickey Fuller test and Phillips-Perron gave the same results, but for PP-Test we used 5 lags. (Aguiar, 2004)

```
. pperron a, lags(5)

Phillips-Perron test for unit root                 Number of obs   =       146
                                                   Newey-West lags =         5

                          ---------- Interpolated Dickey-Fuller ----------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic         Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -1.014           -19.953           -13.792           -11.061
 Z(t)            -0.380            -3.495            -2.887            -2.577
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9134
```

ADF - Regressions

Three different regression were performed to ascertain a better goodness of fit, the model with trend and constant term was choosed.

Coefficient

Only the model with trend and constant term showed a negative L1 coefficient.

Dickey-Fuller test for unit root Number of obs = 146

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.684	-4.025	-3.444	-3.144

MacKinnon approximate p-value for Z(t) = 0.2429

D.a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
a						
L1.	-.0453532	.0168997	-2.68	0.008	-.0787588	-.0119476
_trend	.0006186	.0001459	4.24	0.000	.0003303	.000907
_cons	.0495247	.0274004	1.81	0.073	-.0046375	.1036869

Johansen cointegration test

The series are cointegrated in order I(1), so, a VEC model is proposed (Taubadel & Loy, 1996).

Johansen tests for cointegration

Trend: constant — Number of obs = 141

Sample: Oct-04 - Jun-16 — Lags = 5

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	18	511.67099	.	47.4944	15.41
1	21	527.68919	0.20325	15.4580	3.76
2	22	535.41822	0.10384		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	18	511.67099	.	32.0364	14.07
1	21	527.68919	0.20325	15.4580	3.76
2	22	535.41822	0.10384		

Model:

$$\Delta p_t^{out} = \alpha + \beta t + \sum_{j=1}^{K}\left(\beta_j^{+} D^{+} \Delta p_{t-j+1}^{in}\right) + \sum_{j=1}^{L}\left(\beta_j^{-} D^{-} \Delta p_{t-j+1}^{in}\right) + \varphi^{+} ECT_{t-1}^{+} + \varphi^{-} ECT_{t-1}^{-} + \gamma_t$$

Results

1. The results imply in a faster adjustment for rising price phase, generally 2 periods, and a slower adjustment in falling prices phase, more than 4 lagged values were significant;
2. The series converge;

3. An alternative model with cumulative values for the dummy of price difference was not significant;

4. The number of zeros in this model is a matter of concern;

5. Positive sign of the coefficients for rising phase.

Producer Price Rising

lags	Coefficient	Standard Error	P>|z|
_ce1	-0.777264	0.0947465	0
L1			
1	-2.228368	0.2659797	0
2	-1.118815	0.2797338	0
3	0.0801676	0.2433794	0.742
4	-0.0564704	0.1776471	0.751

Producer Price Falling

lags	Coefficient	Standard Error	P>|z|
1	-1.293027	0.2090468	0
2	-0.9329264	0.2086226	0
3	-0.5686962	0.1821531	0.002
4	-0.4489684	0.150468	0.003

Autocorrelation

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	14.2018	9	0.11533
2	14.1578	9	0.11682

Thank You!

Contact:

jacqueshenrique@yahoo.com.br

jhenriquesdias@uel.br

Obs: Stata Code and Database are avaiable for those who wants to help me

References

- Abdulai, Awudu. "Using threshold cointegration to estimate asymmetric price transmission in the Swiss pork market." *Applied Economics* 34, no. 6 (2002): 679-687.
- Aguiar, Danilo RD. "Impacto dos custos de comercialização nas margens produtor-varejo de arroz e de feijão em minas gerais1." *Teoria e Evidência Econômica, Passo Fundo* 12, no. 22 (2004): 51-76.
- Brandão, Antonio Salazar P. "Moeda e preços relativos: evidência empírica." *Brazilian Review of Econometrics* 5, no. 2 (1985): 33-80.
- Cramon-Taubadel, Stephan, and Jens-Peter Loy. "Price asymmetry in the international wheat market: Comment." *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 44, no. 3 (1996): 311-317.
- Goodwin, Barry K., and Matthew T. Holt. "Price transmission and asymmetric adjustment in the US beef sector." *American Journal of Agricultural Economics* 81, no. 3 (1999): 630-637.
- Houck, James P. "An approach to specifying and estimating nonreversible functions." *American Journal of Agricultural Economics* 59, no. 3 (1977): 570-572.
- Peltzman, Sam. "Prices rise faster than they fall." *Journal of political economy* 108, no. 3 (2000): 466-502.
- Tweeten, Luther G., and C. Leroy Quance. "Positivistic measures of aggregate supply elasticities: some new approaches." *American Journal of Agricultural Economics* 51, no. 2 (1969): 342-352.
- Ward, Ronald W. "Asymmetry in retail, wholesale, and shipping point pricing for fresh vegetables." *American journal of agricultural economics* 64, no. 2 (1982): 205-212.
- Wolffram, Rudolf. "Positivistic measures of aggregate supply elasticities: some new approaches—some critical notes." *American Journal of Agricultural Economics* 53, no. 2 (1971): 356-359.