ANALYSIS OF THE PRICE FORMATION PROCESS FOR WHITE AND REFINED SUGAR IN SÃO PAULO AFTER DEREGULATION OF THE SUGAR AND ALCOHOL SECTOR

Cinthia Cabral da Costa[1]
Heloisa Lee Burnquist[2]

Abstract

This article used econometric models to investigate the price relation between white and refined sugar market prices for the state of Sao Paulo, Brazil. The analysis focused on the sugar market in its post-deregulation period, from April 1997 to May 2000. It has been considered that prices adjust by excess demand between the producer and wholesale levels, while the retail prices adjust to an expected price. The results are mostly according to the hypothesis proposed. They provide an indication about the percentage impact of price change at one market level upon prices at another market level. However, contrary to what has been expected, it has been observed that the retail price of white sugar has a positive influence on the product's demand. This was related to the absence of substitute products.

Key-words: sugar, deregulation, prices, market.

1. Introduction

This article analyzed the price formation process through the marketing channels for white and refined sugar in the state of São Paulo.

[1] Agronomist, Ph.D. candidate graduate student at the Applied Economics – DEAS/ESALQ/USP. Piracicaba, São Paulo, Brazil. C.P. 9. E-mail: cccosta@carpa.ciagri.usp.br
[2] Professor of the Economics, Administration and Sociology Department - DEAS/ESALQ/USP. Piracicaba, São Paulo, Brazil. C.P. 9. Email: hlburnqu@esalq.usp.br

It has been considered that the way by which price shocks are transmitted among the market levels is fundamental information for market agents. The analysis comprises the market post-deregulation period in order to verify how the sugar price formation process has evolved in a free-market context.

While the Brazilian sugar market was regulated, the government established prices and quantities produced. The progressive reduction in government intervention and the strong incentive to the private sector to take on marketing administration has been promoted since the beginning of the 90s. This has motivated a growing number of analyses of the sector's performance. In this context, the identification of mechanisms that determine how markets work has assumed increased importance as they provide useful information to efficiently restructure the market.

Theory sustains that market structure has a great influence in price determination. Besides that, prices are subject to supply and/or demand shocks at the different market levels. These factors determine the means of price transmission as well as its intensity between different market levels (Burnquist, 1986).

In the sugar marketing system, the producer level is represented by a total of 135 sugar mills in São Paulo. About 36 of these mills are associated to Cooperative of Cane, Sugar and Alcohol Producers of São Paulo- Copersucar — and have their production commercialized by the cooperative.

In this study, the market agents considered as the intermediate level between producer and retailer in this sugar marketing system are limited to the wholesalers responsible for packing the sugar in 5 kg bags and selling it at the retail level, due to restricted data availability. Through the years, the sugar mills have been progressively assuming the wholesalers' tasks. The sales have been usually made such that the retailer is responsible for carrying the product from the sugar mill to the market.

Contrary to what is observed at the wholesale, the sugar retailing is not concentrated and the participants are heterogeneous, comprising small stores and supermarkets.

2. The economic model

The previously characterized sugar market structure suggests that the price formation process can be explained through a short-term disequilibrium model, as defined by Heien (1980) and Barros (1990). Apparently, in these markets, production and wholesale prices continually adjust to the disequilibrium between supply and demand. Initially, the changes in retail prices occur in partial adjustments until reaching equilibrium prices. Therefore, the adjustment in retail prices of white sugar is represented in this study by the following equations[3]:

$$v_t - v_{t-1} = \alpha(v_t^* - v_{t-1}) \tag{1}$$

where: $v_t^* = b_1 a_t + b_2 z_{1,t}$ (2)

and v is the retail price of white sugar; α is the velocity of adjustment of this price; a is the wholesale price; $z_{1,t}$ is the price of the sale inputs for the retail market (for example, price of transport); and b_1 and b_2 are technical production coefficients, with b_1 and $b_2 > 0$.

Substituting equation (2) in (1) and rearranging the terms, we obtain:

$$v_t = (1 - \alpha) v_{t-1} + \alpha b_1 a_t + \alpha b_2 z_{1,t} \tag{3}$$

The demand for white sugar in the retail market (V^D_t) is considered to be a linear function of its own retail price.

$$V_t^D = \theta_0 + \theta_1 v_t \tag{4}$$

Assuming that the demand function in negatively inclined, we have $\theta_1 < 0$.

The analytical model assumes that the retail market for refined sugar can be represented in a similar manner to that described for the white sugar market.

In the present analysis, the proposed model considers that the wholesale prices for white sugar, as well as the production levels for white and refined sugar, adjust for disequilibrium between supply and demand, and are represented by an excess demand for the product, that

[3] The subscripts "*t*" e "*t*-1" refer to time, where "*t*-1" is a one lag period with respect to period "*t*".

can be represented as[4]:

$$a_t - a_{t-1} = \delta(A_t^D - A_t^S) \tag{5}$$

$$pac_t - pac_{t-1} = \delta(PAC_t^D - PAC_t^S) \tag{6}$$

$$r_t - r_{t-1} = \delta(R_t^D - R_t^S) \tag{7}$$

where A represents the quantity of white sugar at wholesale; PAC, the quantity of white sugar at the producer level; R, the quantity of refined sugar at the producer level; a is the wholesale price; pac, the price of white sugar at the producer level; r, the price of refined sugar at the producer level and δ is the velocity of the price adjustment, by excess demand, at the market levels considered for the analysis.

The quantities demanded are obtained by the conversion of the demand for sugar in the previous period. Therefore, we have:

$$A_t^D = b_1 V_{t-1}^D \tag{8}$$

$$PAC_t^D = \beta_1 z_{4,t-1} + \beta_2 a_{t-1} + \beta_3 r_{t-1} \tag{9}$$

$$R_t^D = b_1 V_{t-1}^D \tag{10}$$

where V^D is described in equation (4), with $b_1>0$. That is, it is assumed that an increase in the quantity demanded at retail, leads to an increase in the quantity white sugar demanded at wholesale and at the producer of refined sugar in the following period. This occurs in order to replace stocks at this second market level (equations 8 and 10). While $z_{4,t-1}$ (equation 9) represents the prices of the final industrial products, lagged one period, that use white sugar as an input (such as soft drinks and sweets). It is also assumed that the price decrease in wholesale white sugar (a_{t-1}), refined sugar (r_{t-1}) and in $z_{4,t-1}$, occurring at the previous period, tends to increase the quantity demanded of white sugar at the producer level (PAC^D_t). Therefore, the parameter β_1, β_2 and β_3 of equation (9) are less than zero.

The equations that represent the sugar supply are the following:

4 The subscripts "D" e "S" indicate quantity demanded and supplied, respectively.

$$A_t^S = \varpi_0 pac_t + \varpi_1 a_{t-1} \quad (11)$$
$$PAC_t^S = \gamma_1 pac_{t-1} + \gamma_2 ph_t + \gamma_3 pi_t + \gamma_4 ni_t \quad (12)$$
$$R_t^S = \phi_0 pac_t + \phi_1 r_{t-1} \quad (13)$$

Where ph_t is the price hydrous ethanol and p_{it} is the price of anhydrous ethanol, both at the producer level and at period t, while ni_t is the price of sugar at the international market.

The expected signs for the coefficients of equations (11), (12 and (13) are the following:

a) Equation (11): ϖ_0 <0, indicating that a price reduction for white sugar at the producer in the present period will favor the acquisition of white sugar by the wholesaler in the same period. For the parameter ϖ_1 the relation is expected to be direct, that is ϖ_1 >0. Therefore positive variations in price at wholesale in the previous period stimulate the increase in the quantity of white sugar supplied in the wholesale market in the following period;
b) Equation (12): the price of white sugar at the producer in the previous period has a positive effect in the quantity supplied the following period ($\gamma_1 > 0$). The prices of anhydrous and hydrous ethanol in period t, are inversely related to the quantity of sugar supplied in period t (γ_2 and γ_3 <0). Therefore, when positive variations occur in the price of ethanol, the production ration is modified, reducing the quantity of sugar to increase the quantity of ethanol produced. Increases in international sugar prices, tend to expand its exports and consequently reduce the supply of white sugar in the domestic market (γ_4<0).
c) Equation (13): changes in the price of white sugar at the producer is inversely related to the quantity of refined sugar acquired in the same period (ϕ_0<0), while increases in prices of refined sugar in the previous period stimulate the supply of sugar in the following period ($\phi_1 > 0$).

Therefore, considering the substitutions for the supply and demand equations in the equation for adjustment due to excess demand, we have that the prices are represented by the following equations:

$$a_t = \delta b_1 \theta_0 + \delta b_1 \theta_1 v_{t-1} - \delta \varpi_0 pac_t + (1 - \delta \varpi_1) a_{t-1} \quad (14)$$
$$pac_t = -\varsigma \gamma_0 + \varsigma \beta_1 z_{4,t-1} + \varsigma \beta_2 a_{t-1} + \varsigma \beta_3 r_{t-1} - \varsigma \gamma_2 ph_t - \varsigma \gamma_3 pi_t - \varsigma \gamma_4 ni_t + (1 - \varsigma \gamma_1) pac_{t-1} \quad (15)$$
$$r_t = \lambda b_1 \theta_0 + \lambda b_1 \theta_1 v_{t-1} - \lambda \phi_0 pac_t + (1 - \lambda \phi_1) r_{t-1} \quad (16)$$

The analysis of the intensity of price transmission considers the estimation of the elasticity of price transmission. This measures the percent impact of a price change at one level of the market on the price at another level. Therefore, for the coefficients estimated in the price formation models, to directly express the estimated values of the elasticity of price transmission, the price series were transformed to their logarithmic form.

3. Time Series Analysis

3.1 Data

Table 1 presents the variables used in this study and their description. The time series represents the period between April 1997 and May 2000, the price of white sugar at the producer, wholesale, and the prices for refined sugar at the producer are the price indicators obtained by CEPEA/ESALQ/USP (Centro, 2000).

Table 1. Variables used in the study

Variable	Description	Representation in the Economic Model
Lppac	Logarithm of the price of white sugar at the producer	***Pac***
Lpaac	Logarithm of the price of white sugar at wholesale	a
Lpva	Logarithm of the price of white sugar at retail.	v
Lppar	Logarithm of the price of refined sugar at the producer	r
Lpvar	Logarithm of the price of refined sugar at retail	v
Lpni	Logarithm of the price of sugar in the international market	***ni***
Lpph	Logarithm of the price of hydrous ethanol at the producer	***ph***
Lppi	Logarithm of the price of anhydrous ethanol at the producer	***pi***
Lpb	Logarithm of the price of soft-drinks (index)	z_4
Lptr	Logarithm of the price of transport (index)	z_1

The Brazilian sugar market was deregulated in the early 1990s. However, the period of the study started at April 1997, due to a methodology review used by CEPEA to calculate its price index.

The refined sugar price index for wholesale is the sugar price index included in the Consumer Price Index published by the DIEESE in its monthly report (Departamento, 2000). The white sugar at retail was also obtained from DIEESE data, as the price of staple products in the municipality of São Paulo (Departamento, 2000).

The international price of raw sugar was based on a price series of New York spot market prices, published by the International Sugar Organization - ISO. These prices were converted from dollars to reais by using the monthly average or the exchange rate (Conjuntura, 2000).

Transport price, calculated by the IBGE (Instituto, 2000), was used as a "proxy" for the price of marketing inputs at the wholesale. The relation between white sugar price at the producer level and the price at industries that use it as input was specified using the price of non-alcoholic beverages as a "proxy", obtained from the Conjuntura Econômica periodical (Conjuntura, 2000). It was considered that most of the products specified as non-alcoholic beverages use sugar as inputs. It has been reported that the soft-drinks industry consumes about 38% of all the industrial sugar consumption (Carvalho, 2000).

The series used for anhydrous and hydrated ethanol price received by the producer are the CEPEA's price indicators. Since these price series started to be published after April 1998, a wholesale price series was calculated for these products, considering a fixed margin based on the value calculated for May 1998[5].

4. Results

4.1. Tests for unit root

The time series of the variables included in the econometric model were evaluated with respect to its stochastic properties, using Augmented Dickey Fuller test for unit roots, as described in Dickey and Fuller (1981). The tests involve the estimation of the following equations[6]:

---

[5] Margin for May 1998 = (retail price of May 1998) - (producer price of May 1998).

[6] The symbol "D" corresponds to the first difference of the price series. The subscript "*t - j*" with *j* varying from 1 to *n*, represents the *n* lags of the differenced *x*.

$$\text{(a)}\quad \Delta x_t = \alpha + \theta T + \beta\ x_{t-1} + \sum_{j=1}^{n} \gamma_j \Delta x_{t-j} + e_t$$

$$\text{(b)}\quad \Delta x_t = \alpha + \beta\ x_{t-1} + \sum_{j=1}^{n} \gamma_j \Delta x_{t-j} + e_t$$

$$\text{(c)}\quad \Delta x_t = \beta\ x_{t-1} + \sum_{j=1}^{n} \gamma_j \Delta x_{t-j} + e_t$$

where: $\boldsymbol{x}$ - represents a price series of the proposed model; α - estimated constant term; θ, β and γ_j - estimated coefficients; where

$\beta = \sum_{j=1}^{n} \gamma_i - 1$; $\boldsymbol{T}$ = deterministic trend; and $\boldsymbol{e}_t$ - residuals.

The number of lags (n) included is determined as to turn the residual series ($\boldsymbol{e}_t$) into a "white noise" process (stationary series). A procedure that has been usual to determine the number of lags is to use the Akaike (AIC) information criterion and the Schwarz (SC) test. These criterions are useful to indicate the number of lags that will present the lower value of variance of the residuals.

The test can be conducted after determining the correct version of the model, by considering a general specification, including constant and trend. The model specification is determined by eliminating its non-significant terms, according to procedure presented by Enders (1995).

The results of the test for unit roots are summarized in Table 1. For most of the variables included in the model, the stationary hypothesis is accepted at 1% significance level, with the variables expressed in their first differences, indicating the presence of only one unit root.

For all the variables analyzed, the high values of the "Q" Box-Pierce statistic indicate that the null hypothesis of the test, which indicates the existence of residual autocorrelation, can be rejected.

Table 1 – Results of the unit root tests, statistics ττ, τμ e τ[7]

Variable	Lags (n)	Model (a) H_0: $\beta = 0$	Model (b) H_0: $\beta = 0$	Model (c) H_0: $\beta = 0$	Model (c), variable with one lag H_0: $\beta = 0$
lppac	1	-2.01	-2.04	-0.47	-3.55*
Lpaac	1	-2.21	-2.23	-0.66	-3.41*
lpvac	1	-2.06	-2.05	-0.93	-2.98*
lppar	1	-2.02	-2.07	-0.83	-3.40*
lpvar	1	-1.95	-2.02	-0.99	-2.74*
lpni	1	-3.55**	-3.30**	-0.44	-5.02*
lpph	1	-1.6	-1.38	-0.77	-2.98*
lppi	1	-1.62	-1.58	-0.63	-4.66*
lpb	1	-2.04	-1.001	2.23**	-3.98*
lptr	1	-1.60	-0.26	1.61	-2.41**

Source: research results
*Significant at 1% level, critical value = -2,65, for model (c)
**Significant at 5% level, critical value = -1,95, for model (c).

4.1. Cointegration analysis

According to the method described by Engle and Granger (1987), the existence of cointegration consists on testing the stationary properties of the residual of the estimation of a vector y_t composed of two variables integrated of order one. The cointegration equation assumes the following form:

$$y_{1t} = \theta + \lambda y_{2t} + u_t \tag{17}$$

where u_t represents the residual of the regression. The test consists in verifying the stationary characteristic of $u_t = y_{1t} - \theta - \lambda y_{2t}$, as described in item 4.1. When these residuals are stationary, this implies that the linear combination of the variables is stationary, despite the fact that each of these are integrated of order one when taken separately. This indicates that the variables present a long-run relationship. In that case, $\boldsymbol{u_{t-1}}$ is an error correction term that reintroduces important long-run

[7] The critical values used for the tests are described in: Fuller, W. A. **Introduction to statistical time series**. New York, John Wiler. 1976 e Dickey, D.A.; Fuller, W. A. Likelihood ratio statistics for autoregressive time series with a unit root. **Econometrica**, Illinois, v.49, n.4, p.1057-72, 1981.

information that can be lost by taking the variables in their first differences.

Cointegration tests were conducted in the present study for the variable sets determined by the model of price formation at different market levels, defined by equations (3), (14), (15) and (16). Table 2 describes the estimated regressions and the stationary test results for their residuals. Cointegration is tested by taking the residual of the estimated regressions and verifying if it presents unit roots in its formation process. The values for the "t" test must be, however, based on statistics specifically developed for cointegration tests.

The test results for cointegration are presented in Table 2, together with the number of lags determined to specify the correct model for testing. The results indicate that the variables included in each of the equations presented are cointegrated. The high values of the Q statistics indicate that, in general, the models were correctly specified for stationarity tests.

Table 2 – Cointegration tests Results

Regression estimated for testing for cointegration among the variables		Results of stationary tests applied to the regression residual – cointegration test[1]	
lppac = 1,2 + 1,35 lpaac - 0,55 lppar + 0,27 lpni - - 0,19 lpb + 0,09 lpph + 0,04 lppi	(15) $R^2 = 0,95$	t = - 5.55519* Q (%) = 0.911 n = 1	CV (5%) = -5.15
lpaac = 0,0424 + 0,532 lppac + 0,603 lpvac	(14) $R^2 = 0,97$	t = - 4.7606* Q (%) = 0.796 n = 1	CV (5%) = -3.5
lppar = 0,072 + 0,375 lppac + 0,856 lpvar	(16) $R^2 = 0,95$	t = - 3.167** Q (%) = 0.75 n = 1	CV (10%) = -3.16
lpvac = 0,025 + 0,7008 lpaac + 0,0002 lptr	(3) $R^2 = 0,88$	t = - 3.02*** Q (%) = 0.85 n = 6	CV (25%) = -2.63
lpvar = 0,66 lppar + 0,006 lptr	(3) $R^2 = 0,90$	t = - 3.5* Q (%) = 0.99 n = 4	CV(5%) = -3.5

*Significant at 5% level.
**Significant at 10% level.
***Significant at 25% level

4.1. Estimation Results

The equations were estimated with the variables taken in first differences, in order to obtain efficient and unbiased estimators, since the tests indicated they were non-stationary in levels with one unit root. When the variables are taken in first differences, however, important long-run information can be lost.

The existence of cointegration determined among the variables included in each of the specified equations indicates that an error correction model specification can be used. This means that an error correction term can be included in the equation with the variables in first difference, such that important long-run information is not effectively lost. The error correction term consists of the residual term of the cointegration regression taken with one period lag and included in the model with the variables in difference, resulting in the error correction model.

A instrumental variable simultaneous equation procedure was used for the estimation since the model indicates that prices are determined simultaneously by excess demand at the different market levels, including: producer's white sugar price, producer's refined sugar price and wholesaler's white sugar price. The results are presented in Tables 3 and 4 for the white and refined markets, respectively. The values presented in brackets refer to the significance level of the Student "t" test.

The columns in Table 3 present the estimated coefficients for equations (3), (14) and (15), respectively. The R^2 values indicated a good adjustment quality of the estimated equations except for the equation that represents white sugar price at the producer level. The high values of the Box Pierce "Q" statistic indicate a low probability of residual autocorrelation of those equations.

The estimated coefficients at the white sugar producer price formation presented the expected signs (as described by equations (9) and (10) at item 2). On the demand side, the variables lagged by one period, representing the wholesale (Δ paac) and industrial product that uses sugar as an input (Δ pb), showed negative estimated coefficients, as expected. The coefficients estimated for the supply side variables were all positive. These included a one lag price of producer (Δ ppac) and price of producer for hydrated ethanol (Δ pph) and the international market price (Δ pni). However, the low adjustment quality of the estimated supply equation may explain some of the signs that were changed with respect to the model expectations, such as the demand side variable (Δ ppar - refined sugar at the producer level) and the supply side variable (Δ ppi - anhydrous ethanol price for producers).

A reasonable explanation for the model's specification problem is the large number of explanatory variables included, together with the relatively limited extension of the time series data available for the estimates. In addition, the large number of variables included may result in multicolinearity problems. Therefore, the results related to price formation at the white sugar producer level will not be explored in this study.

The wholesale level price formation of white sugar, as described by equation (8) of the economic model, presents the expected positive coefficients for the variables that represent white sugar producer price (Δ ppac) and wholesale price (Δ paac), both lagged for one period. Therefore, the price elasticity of transmission from producer to wholesaler of white sugar was estimated as 45% for the short-run. The short-run price elasticity of transmission for the lagged wholesale price was estimated as 37%. The positive sign of the coefficient for the lagged retail white sugar price (Δ pvac), which is not according to what was expected while considering equations (4) and (6) at item (2), may be justified by the fact that white sugar is more accessible in terms of price with respect to refined sugar. Therefore, even considering the positive variation of the retail white sugar price, in general terms, its value will not be set higher in absolute terms than the refined sugar price. Considering the results, there are indications that an increase in white sugar demand at retail has an impact of about 25% on the wholesale price in the short-run.

Table 3 – Estimates of price formation at producer, wholesale, and retail levels for the white sugar market in São Paulo state, April 1997 to May 2000[9]

Exogenous Variables and Statistics	Endogenous Variables		
	Price growth rate at the producer level $\Delta lppac_t$	Price growth rate at the wholesale level $\Delta lpaac_t$	Price growth rate at the retail level $\Delta lpvac_t$
$\Delta lppac_t$	-	0.45 (0.00)	-
$\Delta lppac_{t-1}$	0.86 (0.01)	-	-
$\Delta lpaac_t$	-	-	0.23 (0.00)
$\Delta lpaac_{t-1}$	-0.88 (0.06)	0.37 (0.00)	-
$\Delta lppar_{t-1}$	0.30 (0.53)	-	-
$\Delta lpvac_{t-1}$	-	0.23 (0.13)	0.41 (0.00)
Δlpb_{t-1}	-1.64 (0.33)	-	-
$\Delta lpni_t$	0.08 (0.63)	-	-
$\Delta lpph_t$	0.54 (0.04)	-	-
$\Delta lppi_t$	-0.26 (0.40)	-	-
$\Delta lptr_t$	-	-	0.007 (0.70)
ep_{t-1}	-0.592 (0.22)	-	-
ea_{t-1}	-	-0.67 (0.00)	-
evc_{t-1}	-	-	-0.27 (0.01)
R^2	0.44	0.88	0.71
Q (%)	4.49 (0.87)	12.84 (0.17)	5.94 (0.74)

Source: Research

[9] The variables ep_{t-1}, ea_{t-1} e evc_{t-1} represent the error correction term referent to models at the producer, wholesale and retail levels, respectively

The signs of the coefficients in the equations relative to white sugar price formation at retail were what was expected. The price transmission elasticity in the short-run for white sugar at the wholesale (Δ paac), for transport price (Δ ptr) and for the lagged retail white sugar price (Δ pvac) resulted as 18%, 1% and 53%, respectively, with respect to the retail white sugar price. The marketing input at retail was not well represented by transport price (Δ ptr), given the low significance level of the estimated coefficient for that variable.

Table 4 presents the coefficient estimates of the price formation model at the producer and wholesale level for refined sugar, in the second and third columns respectively.

The coefficients presented the expected signs, according to the economic model. Therefore, the white sugar price variable at the producer level (Δ ppac) and the lagged refined sugar price at the producer level (Δ ppar) are positively related at the price formation of refined sugar producer, as expected according to equation (16). The short-run price transmission elasticities of the lagged variables represented as Δppac and Δ ppar for the refined price at the producer level were estimated as 38% and 72%, respectively.

The estimated coefficient for the refined sugar price at retail (Δ par) presented a negative sign, as proposed by the relation expressed by equation (3), presenting a short-run price transmission elasticity from retail to refined producer price of -29%. Therefore, it is observed that the adjustments at the refined sugar market differ from those of the white sugar market. At the refined sugar market, retail prices show a greater sensitivity to demand changes.

Table 4 – Estimated price formation at the producer and retail levels for the refined sugar market in São Paulo state, April 1997 to May 2000[10]

Exogenous variables and Statistics	Endogenous variables	
	Growth rate of price at producer level - $\Delta lppar_t$	Growth rate of price at retail level - $\Delta lpvar_t$
$\Delta lppac_t$	0.38 (0.00)	-
$\Delta lppar_t$	-	0.34 (0.00)
$\Delta lppar_{t-1}$	0.72 (0.00)	-
$\Delta lpvar_{t-1}$	-0.29 (0.28)	0.28 (0.00)
$\Delta lptr_{t-1}$	-	0.006 (0.64)
epr_{t-1}	-0.35 (0.02)	-
evr_{t-1}	-	-0.26 (0.01)
R^2	0.67	0.82
Q (%)	5.96 (0.74)	3.81 (0.92)

Source: Research.

Comparing the results presented in Tables 3 and 4, it can also be observed that the white sugar price at wholesale (Δ paac) is affected in the short-run primarily by the white sugar price at the producer (Δ ppac), according to an 88% level of adjustment, while the refined sugar price at the producer level (Δ ppar) is mostly affected by its own lagged price together with the white sugar producer price (Δ ppac). The adjustment level of the refined sugar price at producer level presents a lower adjustment level: 67%. A probable explanation for this result is that the services provided by the producer of white sugar for the white sugar wholesale level are lower than those included at the refined producer level.

[10] The variables **epr_{t-1}** e **evr_{t-1}** represent the error correction term related to the producer and retail models, respectively.

Similarly to what was observed for white sugar, the estimated coefficient for the marketing input, represented by transport price (Δ ptr) in the model, has also resulted in a low significance level in this relation.

Contrary to what was observed for the white sugar, the refined wholesale price showed a greater influence of the producer level (Δ ppar), presenting an estimated short-run price transmission elasticity of producer to wholesale price of 34%. The estimated coefficient signs of the price formation equation at this market level were positive for the refined sugar price at the producer level, as well as for transport price and the own lagged retail price, which is according to the economic model proposed at item 2 of this paper.

The long run relation between the explanatory variables in the price formation process, represented by the error correction term, was significant for price formation at all levels included for the analysis (Tables 3 and 4). Therefore, considering the explanatory variables as a group, the long run relation impact upon the price formation process for the producer, wholesale, and retail at the white sugar market were of 59%, 67% and 27%, respectively. The impact of this same variable upon the refined producer and retail prices were of 35% and 26%, respectively.

5. Conclusions

The results lead to the conclusion that, in general, the price formation process of the sugar market for the period under analysis can be explained by a short-run disequilibrium model, according to which shock at supply and demand cause changes at the producer and wholesale levels in a simultaneous form. Considering the short-run, the estimated equation related to price formation at the white sugar producer level did not present good results. In all other estimated equations, the variables included as explanatory were significant, with the exception of transport price. Therefore, the work indicates estimated magnitudes of the influence of shocks at the various market levels, which can be important information for market agents.

It is suggested, however, that this model should be re-estimated from time to time for the sugar market, including information as it becomes available, since the number of observations available to conduct the estimations were limited. Besides that, the market is going through an adjustment process since deregulation was imposed. That could mean that price behavior is still not consolidated and could change as the restructuring evolves.

References

BARROS, G. S. C. Transmissão de preços pela central de abastecimento de São Paulo, Brasil. **Revista Brasileira de Economia,** v.44, n.1, p.5-20, jan./mar. 1990.

BURNQUIST, H. L. **A questão da causalidade entre preços a diferentes níveis de mercados agrícolas.** Piracicaba: ESALQ, 1986. 83p. Dissertação (Mestrado) - Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo.

CARVALHO, J. C. C. Pesos diferentes. **Agroanalysis**, v.20, n.3, p.41-45. mar. 2000.

CENTRO DE ESTUDOS AVANÇADOS EM ECONOMIA APLICADA (CEPEA). **Indicadores. Açúcar. Álcool.** http://www.ciagri.usp.br/~cepea (julho de 2000)

CONJUNTURA ECONÔMICA. Fundação Getúlio Vargas, v.51 a 54, 1997 a 2000.

DEPARTAMENTO INTERSINDICAL DE ESTATÍSTICA E ESTUDOS SÓCIO-ECONÔMICOS. **Boletim mensal.** São Paulo: DIEESE, n.193 a 219, 1997 a 2000.

DICKEY, D.A.; FULLER, W. A. Likelihood ratio statistics for auto-regressive time series with a unit root. **Econometrica**, Illinois, v.49, n.4, p.1057-72, 1981.

ENDERS, W. **Applied econometric time series.** New York: Willey. 1995. 433p.

ENGLE, R. F. & GRANGER, C. W. J. Cointegration and error correction: representation, estimation and testing. **Econometrica,** v.55, p.251-276, 1987.

HEIEN, D. M. Markup pricing in a dynamic model of food industry. **American Journal of Agricultural Economics**, v.62, p.10-18. 1980.

INSTITUTO DE PESQUISA ECONÔMICA APLICADA. Ipeadata. Tema: Preços. IBGE/SNIPC. Transportes. http://www.ipeadata.gov.br/ (agosto de 2000).