THE DETERMINANTS OF BRAZILIAN PULP EXPORTS FROM 1980 TO 2001

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Abstract:
This paper makes an econometric analysis of the determinants of Brazil's pulp exports. The time period from 1980 to 2001 is considered for estimating a supply equation of pulp exports. Exogenous variables considered were: price of Brazilian exported pulp, production cost of Brazilian pulp, productive capacity, exchange rate between dollar and domestic currency and lagged pulp exports. It was observed that Brazil's pulp exports have responded little to price fluctuation; however, these exports are strongly affected by productive capacity, exchange rate fluctuation and lagged pulp exports. Those results are consistent which the fact that a large share of market-oriented pulp production is headed to foreign markets and that production is sold to these markets partially independent of the current prices that are clearing pulp market.

Key words: exports, pulp, econometric model, Brazil.

1) Introduction

This study makes an econometric analysis of the determinants of Brazil's pulp exports. The period under consideration is from 1980 to 2001, for which data was available for estimating a supply equation to pulp exports.

According to FAO, Brazil produced 7.39 million tons of pulp in 2001, which answered for 4% of the total world production of pulp. In relation to exports, Brazil was the 4th largest pulp exporting country, which demonstrates a significant participation in the world market of pulp.

Brazilian production of pulp began to increase in 1950. However, until 1960, production basically attended to the domestic market. In 1961, Brazil exported 3.3 thousand tons of pulp. Since then, exports have been increasing continually, reaching 39.4 thousand tons in 1970, 890.5 thousand tons in 1980, 1.03 million tons in 1990 and 3.25 million tons in 2001 (according to FAO dataset). This growth of exports was possible because some enterprises were established in Brazil in order to attend foreign markets, producing market-oriented pulp[1]. This is the case of

Cenibra, Aracruz and it will be the case of Veracel, which will begin its operation in 2005. Other companies also generate surpluses for export, such as Suzano and VCP.

As a consequence of the installation of pulp producing companies oriented to foreign market and the growth of pulp exports, the US$ revenues for pulp exports increased. In 1970, pulp exports generated US$ 5.7 millions in revenue; in 1980, US$ 364 million; and in 2001, US$ 1.2 billion. These values represented 0.3%, 1.8% and 2% of total Brazilian exports, respectively.

In this context, this paper analyzes the factors that are the main determinants of the Brazil´s pulp export growth, from the perspective of an exporting country. Therefore, this study estimates a supply equation for pulp exports. The information generated in this study is useful to researches and policy-makers concerned with the Brazilian pulp industry.

This study is organized in six sections, including this introduction. Section 2 reviews the literature about the topic in discussion. Section 3 analyzes the evolution of Brazilian pulp production and export from 1980 to 2001, and points out the tendency of the Brazilian pulp industry towards to foreign markets. Section 4 discusses the econometric model and the data that were used. Section 5 presents the estimates of regressions and provides a discussion about them. Finally, section 6 brings some conclusions.

2) Review of Literature

A review of the literature about Brazilian pulp exports shows a shortage of updated and innovative analyses. Few econometric studies seeking to better understand and forecast the behavior of the pulp market have been done in Brazil. We could just find two studies about that issue.

Silva (1996) attempted to specify and estimate the structural relations of the Brazilian pulp market. Dynamic models of total supply and domestic and export demands were estimated. These models express the market relations for short and long periods. The period analyzed was from 1978 to 1993. The main conclusions of Silva's work (1996) were that the price elasticity of pulp supply was 0.11 and 0.18 in short and long-run, respectively, indicating that the supply is inelastic in relation to pulp price. In addition, for the domestic demand of pulp, the price elasticity was –0.12 and –0.18, for short and long-run, respectively, indicating that the demand is also inelastic in relation to pulp price. Income elasticity was 1.14 and 1.17 for short and long-run, respectively. The latter implies that the domestic demand is more sensitive to income fluctuations

than to price variations. In relation to export demand, the results were similar. The price elasticity was –0.17 and –0.37, for short and long-run, respectively, while the income elasticity was 0.67 and 1.14, respectively. Consequently, export demand is more sensitive to income fluctuations of importing countries than to pulp price variations. The demand for pulp export showed little sensitivity to paper and cardboard price fluctuation.

Oliveira's study (1995) used an international trade model to estimate the pulp import demand from seven main importing markets, i.e., the United States, Japan, Italy, Germany, France, England and Belgium. In addition, Oliveira built a world model for international pulp trade to simulate the effects on the prices and on the flow of this product caused by any exogenous shock on the international market. The main conclusions of Oliveira's work (1995) is that the exogenous changes that stimulate the growth of pulp demand in Japan and Europe benefit all exporting countries, with more advantages for Canada and the United States, which are the biggest suppliers of Japanese and European markets. Increase in US pulp production results in the largest price decreases on international market, affecting the trade flows of exporting countries. Pulp taxation in the European markets is harmful for all exporting countries, while the increase in the production of Brazilian pulp had practically no effect on the international flow and prices of pulp.

There are others studies about Brazilian pulp industry and its exports, but they do not run regressions about pulp exports. Hilgemberg (2000) analyzed Brazil´s pulp industry organization and its ways for dealing with international environmental barriers. Cruz (2001) analyzed some features about world trade of pulp and paper and Brazil´s participation in this market.

3) Evolution of Brazilian pulp production and export

The world production of pulp amounted 183,498,592 tons in 2001, which represented a growth of 10.6% in relation to the 1990 production. According to FAO data[2], North America is the largest producing region of pulp, responsible for 43.2% of the world pulp production in 2001. Europe and Asia come next with 24.9% and 22%, respectively, of world production of pulp.

The United States and Canada are the biggest world pulp producers. They contributed with 42.5% of the world production in 2001. At the same year, the Scandinavian countries (Finland, Sweden and Norway) jointly produced 13.5% of the world production of pulp.

According to Cherkassiky (1998)[3], cited by Oliveira (1995), these countries have been losing competitiveness to the North Americans and, more recently, to the Latin-Americans and Iberians.

Among the Asian countries, China stood out as the largest pulp producer of the continent in 2001, producing 18.38 million tons. Consequently, China reached the 3rd place in the world production of pulp.

In this context, Brazil was the 7th largest producing country of pulp in 2001. In comparison with 1961, in which Brazil produced 329,200 tons, there was a jump to 7.39 million tons of pulp in 2001. According to Pizzol & Bacha (1998), this growth was partly due to the fiscal incentives and credits granted to producing companies of pulp located in Brazil. In the 1970s, due to the 2nd National Plan of Development, the paper and pulp sector had a boost, practically duplicating their production. The 1980s and 1990s witnessed outstanding support by BNDES (Brazilian Social and Economic Development Bank) for the plans of expanding the paper and pulp companies.

Graph 1 shows the Brazilian pulp production and exportation in the time period from 1980 to 2001. As can be observed, Brazil increased its pulp production and exports significantly. It was possible partially because of advantages from production cost reductions and of fiscal and credit incentives directed towards exports. This large growth in Brazilian pulp production improved Brazil's ranking in the world production of this product.

(Graph 1, Page 10)

In 1989, Brazil exported 1,001,500 tons of pulp, increasing to 3,253,800 tons in 2001. Therefore, 225% growth in export took place in these 13 years. Brazil also produced 4,423,000 tons of pulp in 1989, which grew to 7,390,000 tons in 2001 (according to FAO). Thus, there was a growth of 67% in pulp production during that period. This shows a marked tendency towards exportation in the Brazilian pulp industry. In 1989, exports represented 22.6% of the Brazilian pulp production and in 2001 that percentage was up to 44%.

It can be concluded from this data, that sales to the foreign market represented a stimulus for Brazilian pulp production. These growing foreign sales were possible because Brazil increased its competitiveness in pulp production. Production cost of each pulp ton come down from US$ 490 in 1980 to US$ 359 dollar in 2001. Also, Brazil improved the quality of exported

pulp, reaching European standard and avoiding importing barriers established by European countries in the past (Hilgemberg and Bacha, 2003).

The main exporting countries of pulp at the world market are Canada, the United States, Sweden, Brazil, Chile and Finland. Together they control more than 72% of world exports. It can be observed that Brazil was the 4th largest world exporter of pulp in 2001, with 3.25 million tons exported.

Data in table 1 shows that Brazil has been increasing its share in the total world production and exportation of pulp. In 1970, Brazil was responsible for only 0.65% of the world pulp production, increasing this participation to 4.02% in 2001. In regards to the total world exportation of pulp, Brazil had a more expressive share growth. From an inexpressive participation of 0.0026% in 1970, the country jumped to 8.69% in 2001.

(Table 1, Page 10)

It is worth to point out that at the moment Brazil is the largest producer in the world of eucalyptus pulp, which was introduced to the international market in the 1970s by countries that were, at that time, non-traditional producers, such as Brazil, Portugal and Spain.

4) Econometric model and data set used

As pointed out by microeconomics text-books (see, for example, Parkin, 1998), among the main determinants of good supply are its price, its cost of production and its availability. In the case of Brazilian pulp exports, the amounted received by the exporter depends on US dollar price of pulp (P) and of exchange rate (ER). The availability of the product can be measured by the productive capacity (IC), and the cost of production (CP) should be measured in the same international currency as the price, in other words, in dollar per ton. Because of an expressive amount of exports occur under the form of contracts, which have long duration, an important determinant of the exports is the lagged export quantity (Y_{-1})

The generic equation for Brazilian pulp exports (Y) is:

$$Y = f(P, CP, IC, ER, Y_{-1}) \quad (1)$$

The linear form of this equation is:

$$Y = \alpha + \beta_1 \cdot P + \beta_2 \cdot CP + \beta_3 \cdot IC + \beta_4 \cdot ER + \beta_5 \cdot Y_{-1} \qquad (2)$$

Where $\beta_1 > 0,\ \beta_2 < 0,\ \beta_3 > 0,\ \beta_4 > 0 \text{ e } \beta_5 > 0.$

Data set from 1980 to 2001 is used to estimate equation (2). Because a longer dataset was not available, we could not work with a longer period. The software used to run regressions was *Econometric Views*.

The quantity of pulp exported (Y), as well as its US$ price per ton (P), was collected from FAO[4]. The price of pulp (P) is given in dollars. It is calculated by dividing the exported value (dollars FOB) by the quantity of pulp exported. In this way, the nominal price is obtained.

The production cost of pulp (CP) is also given in dollars. They are from RISI (Resource Information Systems). As shown in table 2, the total cost of bleached eucalyptus kraft pulp in Brazil has been decreasing during the 1980s and 1990s.

(Table 2, Page 11)

Three alternatives for P and CP are considered for estimating the equation (2): first, the current values from P and CP are used; second, the deflated values considering the WPI-USA are utilized; and third, the values of P and CP are deflated by the CPI-USA.

The productive capacity (IC) is measured in tons, and that data is from Brazilian Association of Pulp and Paper (Bracelpa). This variable is important in the determination of the pulp supply, since the enlargement of an industrial plant constitutes an irreversible strategy and it can imply changes on the industry structure. Usually, it is more profitable for companies to operate close to their productive capacity. The complexity of the modern process of pulp and paper production generates large-scale economies, what are reached with high rates of productive capacity utilization.

Real value of exchange rate is calculated considering the WPI-USA and Brazil's IGP-DI. IPEA data set was used for calculating this value.

5) Results

Initially, the equation (2) was run taking data at the same year and using the three versions for price and production cost variables (as pointed out above). Problems of auto-correlation among the residues were not observed, but the coefficient estimated for the price variable is negative and the coefficient for the production cost variable is positive. Therefore, a new estimate was ran by lagging the price in one period of time and maintaining the CP, IC and ER variables at the moment t and using the lagged dependent variable as an explanatory variable. In this case, the coefficient of the price variable became positive (which was expected) but the coefficient of the production cost variable still remained positive, in other words, contrary to the one expected. Next, regressions were estimated taking the data in neperian logarithms. The coefficient of the CP variable continued to be positive. The appendix shows some regressions ran. Other regressions (not shown in the appendix), omitting explanatory variables, were done, but this did not improve the results.

Among the regressions ran, the best in statistical terms is the following (in which the price and production cost are deflated by the WPI-USA):

$$\underset{}{Y_t = -3{,}733{,}554} \underset{(-3.5333)^a}{+ 378.4704 \cdot P_{t-1}} \underset{(1.2157)^d}{+ 1{,}880.049 \cdot CP_t} \underset{(2.3383)^b}{+ 0.4539 \cdot IC_t} \underset{(4.9024)^a}{+ 204{,}857.5 \cdot ER_t} \underset{(3.2779)^a}{+ 0.5804 \cdot Y_{t-1}} \underset{(5.0751)^a}{}$$

$$R^2_{adjust} = 0.9808 \qquad n = 21 \qquad F = 205.1613^a \qquad DW = 2.6631^{IC}$$

Where: the values between parentheses beneath the estimated coefficients refer to the *t-student* statistics, with *a* indicating the coefficient is statistically significant at 1% level; b, significant at 5% level; c, significant at 10% level; d, significant at 25% level. IC indicates the Durbin Watson statistic is inconclusive.

In this equation, the signs of P, IC, ER and Y_{t-1} coefficients are similar to ones expected, but the sign of the CP coefficient is the opposite of one expected. IC, ER and Y_{t-1} coefficients are statistically different from zero at 1% level. CP coefficient is statistically different from zero at 5% level and P coefficient is statistically significant only at 25% level.

F-statistic presents high statistical significance (at 1% level) rejecting, therefore, the hypothesis that the all coefficient are equal to zero. The adjusted determination coefficient (R^2 adjust.) was 0.9808, which indicates that 98.1% of the variations on pulp exports are explained

by the independent variables present in the model. The Durbin-Watson statistic was shown to be inconclusive.

Considering the above equation, price elasticity can be calculated by using the following equation: $\varepsilon_p = 378{,}4704 \cdot \frac{\overline{P}}{\overline{y}}$, where $\overline{P}$ is the average of prices and $\overline{y}$ is the average of the pulp quantity exported.

The price elasticity found was 0.111, indicating that the supply of pulp is inelastic in relation to its price fluctuations. The elasticity of pulp exports in relation to the productive capacity and to the exchange rate were 1.60 and 0.50, respectively.

Both facts the price variable was statistically significant at only 25% level and the supply was inelastic to price fluctuations are coherent with the fact that Brazil's large exporting companies of pulp have contracts for exportation, in which the exported quantity of pulp changes little with the price fluctuations in a short period. As commented in the introduction of this paper, some large producing and exporting companies in Brazil were installed to attend to foreign markets. And the foreign partners had already established export contracts where the quantity exported change little with the price fluctuations.

The fact that CP coefficient shows positive sign in all regressions ran, and was statistically significant, does not have an economic explanation. The correlation between P and CP variables is 0.60, which does not indicate a high multicolinearity in the regression.

6) Conclusions

This study performed an econometric analysis of the determinants of Brazil's pulp exports in the period from 1980 to 2001. The main variables determining pulp exports are: pulp price in dollar, cost of production (in dollar), productive capacity, real value of exchange rate and lagged quantity of exported pulp. It was verified that the Brazilian pulp exports answer little to price oscillation, being affected mainly by the productive capacity, by the exchange rate and by the lagged quantity exported. These results are consistent with the fact that an expressive share of the market-oriented pulp industry was established to attend to foreign markets, independent of the price fluctuations that are happing at the market in short periods.

The result from this paper is similar to the one found by Silva's (1996) study, what considered data from 1978 to 1993. The latter found price elasticity for pulp supply was 0.11 and

0.18 at short and long-run, respectively. This paper, considering data from 1980 to 2001, found price elasticity at short-run is 0.111. Therefore, one can conclude that the price elasticity of supply did not change during the 1990s.

In addition to previous studies, this paper found the main determinants of pulp exports are productive capacity, exchange rate and lagged exported quantity of pulp. An increase of 10% in the productive capacity generates a 16% increase in the pulp exports, and 10% depreciation in the real exchange increases pulp exports by 5%.

The findings of this paper suggest the best policy to enlarge Brazilian exports of pulp is to stimulate the construction of new plants of pulp, especially ones with foreign partners which assure future demand for exported pulp.

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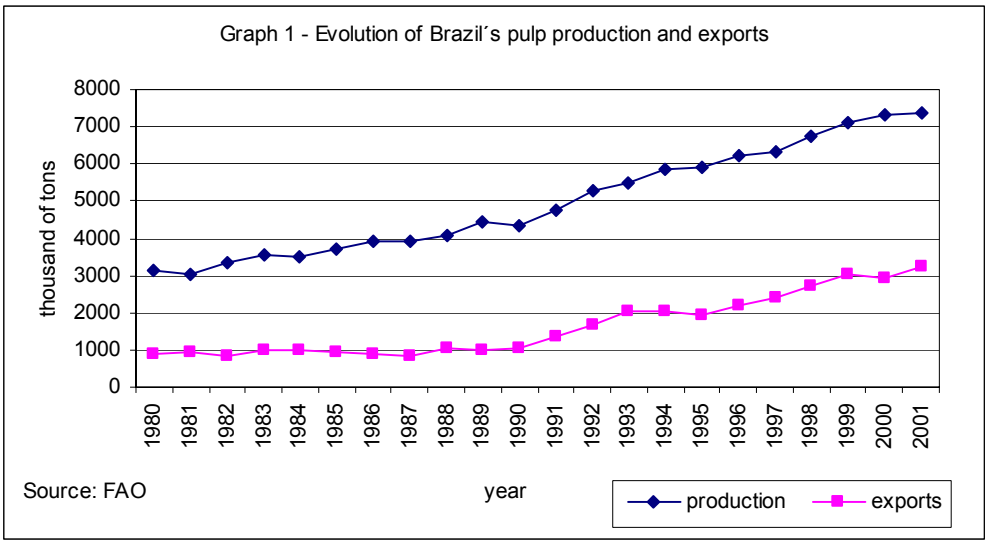

Table 1– Shares of Brazil in the world production and exports of pulp – selected years

Country	1970		1980		1990		2001	
	Prod (%)	**Exp (%)**	**Prod (%)**	**Exp (%)**	**Prod (%)**	**Exp (%)**	**Prod (%)**	**Exp (%)**
The United States	35.34	13.64	35.51	14.32	33.99	20.13	28.89	14.70
Canada	15.78	31.5	15.33	35.48	13.77	32.21	13.57	29.56
Sweden	7.61	23.07	6.68	15.04	5.97	11.65	6.20	7.76
Finland	5.78	11.94	5.48	8.91	5.28	5.73	6.08	4.54
Portugal	0.42	0.022	0.52	0.022	0.88	4.48	0.98	0.026
Brazil	0.65	0.0026	2.45	0.045	2.63	4.35	4.02	8.69
Russia	6.23	0.029	6.56	0.041	6.07	0.025	3.28	4.58

Source: FAO

Table 2 –exported quantity of pulp (Y) in tons, price (P) in dollars, Cost of Production (CP) in dollars, productive capacity in tons, Exchange Rate (ER) in December 2002 reais per dollar, Wholesale price index (WPI) and Consumer price index (CPI).

Year	Y (tons)	P (dollar per ton)	CP (dollar per ton)	IC (tons)	ER (reais per dollar)	WPI-USA	CPI-USA
1980	890,500	409.08	490	3,596,950	4.61	71.9831	54.0742
1981	951,000	384.36	525	3,807,650	4.24	78.5565	59.6522
1982	824,600	337.74	519	3,956,750	4.26	80.1362	63.3271
1983	986,100	315.12	436	3,979,850	5.45	81.1447	65.3615
1984	975,600	406.33	421	4,111,100	5.58	83.0793	68.1833
1985	929,800	299.04	410	4,302,200	5.72	82.6799	70.6114
1986	879,500	366.92	404	4,453,050	5.05	80.2885	71.9239
1987	814,200	488.56	403	4,557,700	4.58	82.4060	74.6145
1988	1,061,300	588.95	431	4,991,000	4.06	85.7191	77.6058
1989	1,001,500	685.72	447	5,040,350	3.24	89.9673	81.3519
1990	1,035,200	578.55	528	5,111,050	2.85	93.1735	85.7432
1991	1,376,800	429.30	473	5,507,250	3.30	93.3805	89.3744
1992	1,678,623	443.32	456	6,576,850	3.38	93.9349	92.0814
1993	2,043,397	352.33	460	6,586,300	3.05	95.3109	94.7993
1994	2,060,373	411.03	435	6,657,700	2.45	96.5467	97.2711
1995	1,957,905	531.74	490	6,812,050	2.18	100.0000	100.0000
1996	2,171,700	443.33	486	7,146,650	2.20	102.3446	102.931
1997	2,387,400	401.97	491	7,455,000	2.18	102.2777	105.337
1998	2,699,500	367.92	463	7,749,350	2.20	99.7395	106.973
1999	3,014,250	394.99	374	7,902,650	3.12	100.5745	109.313
2000	2,917,200	527.23	396	7,902,650	2.93	106.3857	113.004
2001	3,253,800	369.06	359	8,199,100	3.44	107.5614	116.198

Source: Y and P were collected from FAO; CP came from RISI; IC obtained from Bracelpa (2003). ER is from Bacha (2004. p.144) and every dollar is measured in December 2002 reais. The WPI and CPI of the USA are from IPEADATA.

Appendix – Test of regressions

Values between parents under the coefficients are *t-student* statistics. Letter *a* indicates the coefficient is 1% statistically significant; b, 5% level; c, 10% level; d, 25% level. Durbin Watson statistics are inconclusive (IC) or not significant (ns).

REGRESSIONS USING NOMINAL VALUES FOR PRICE AND COST OF PRODUCTION

1) Using price (P_t), cost of production (CP_t), productive capacity (IC_t), Exchange rate (ER_t) and lagged exports (Y_{t-1}):

$$\begin{array}{lccccc} Y_t = & -1{,}221{,}722 & -596.2958 \cdot P_t & +460.45 \cdot CP_t & +0.3122 \cdot IC_t & +72{,}555.55 \cdot ER_t \\ & (-0.8764)^{d} & (-1.5696)^{c} & (0.3564)^{ns} & (3.5469)^{a} & (0.7647)^{d} \end{array} + 0.5504 \cdot Y_{t-1} \quad (4.9149)^{a}$$

$R^2_{adjust} = 0.9798$ n = 21 $F = 195.1567^{a}$ $DW = 1.8905^{IC}$

2) Using lagged price (P_{t-1}), cost of production (CP_t), productive capacity (IC_t), Exchange rate (ER_t) and lagged exports (Y_{t-1}):

$$\begin{array}{lccccc} Y_t = & -2{,}898{,}875 & +208.1448 \cdot P_{t-1} & +1{,}682.998 \cdot CP_t & +0.3627 \cdot IC_t & +186{,}033.5 \cdot ER_t \\ & (-2.6853)^{a} & (0.5855)^{ns} & (1.5222)^{c} & (4.2085)^{a} & (2.4471)^{b} \end{array} + 0.5995 \cdot Y_{t-1} \quad (4.7370)^{a}$$

$R^2_{adjust.} = 0.9770$ n = 21 $F = 171.0927^{a}$ $DW = 2.3230^{IC}$

3) Using neperian logarithm in the above situation:

$$\begin{array}{lccccc} \ln Y_t = & -21.1538 & -0.0201 \cdot \ln P_{t-1} & +0.8238 \cdot \ln CP_t & +1.4043 \cdot \ln IC_t & +0.504 \cdot \ln ER_t \\ & (-3.0615)^{a} & (-0.1578)^{ns} & (1.9492)^{b} & (3.8178)^{a} & (2.2095)^{b} \end{array} + 0.5660 \cdot \ln Y_{t-1} \quad (3.7535)^{a}$$

$R^2_{adjust} = 0.9643$ n = 21 $F = 108.9733^{a}$ $DW = 2.6750^{IC}$

REGRESSIONS CONSIDERING PRICE AND PRODUCTION COSTS AT 1995 PRICES (WHOLESALE PRICE INDEX-USA, 1995=100)

4) Using price (P_t), cost of production (CP_t), productive capacity (IC_t), exchange rate (ER_t) and lagged exports (Y_{t-1}):

$$Y_t = \underset{(-1.4358)^c}{-2{,}117{,}165} \underset{(-0.9552)^{ns}}{-353.1848 \cdot P_t} + \underset{(0.9903)^{ns}}{1{,}042.416 \cdot CP_t} + \underset{(3.2811)^a}{0.3740 \cdot IC_t} + \underset{(1.4640)^c}{117{,}753.7 \cdot ER_t} + \underset{(4.7579)^a}{0.5334 \cdot Y_{t-1}}$$

$R^2_{adjust} = 0.9801$ $\quad n = 21$ $\quad F = 198.0177^a$ $\quad DW = 2.1778^{IC}$

5) Using lagged price (P_{t-1}), cost of production (CP_t), productive capacity (IC_t), Exchange rate (ER_t) e lagged exports (Y_{t-1}):

$$Y_t = \underset{(-3.5333)^a}{-3{,}733{,}554} + \underset{(1.2157)^d}{378.4704 \cdot P_{t-1}} + \underset{(2.3383)^b}{1{,}880.049 \cdot CP_t} + \underset{(4.9024)^a}{0.4539 \cdot IC_t} + \underset{(3.2779)^a}{204{,}857.5 \cdot ER_t} + \underset{(5.0751)^a}{0.5804 \cdot Y_{t-1}}$$

$R^2_{adjust} = 0.9808$ $\quad n = 21$ $\quad F = 205.1613^a$ $\quad DW = 2.6631^{IC}$

6) Using neperian logarithm in the above situation:

$$\ln Y_t = \underset{(-2.7039)^a}{-23.3572} + \underset{(0.4918)^{ns}}{0.0658 \cdot \ln P_{t-1}} + \underset{(1.7732)^b}{0.702 \cdot \ln CP_t} + \underset{(3.6302)^a}{1.5026 \cdot \ln IC_t} + \underset{(2.0558)^b}{0.4448 \cdot \ln ER_t} + \underset{(4.0049)^a}{0.6297 \cdot \ln Y_{t-1}}$$

$R^2_{adjust} = 0.9630$ $\quad n = 21$ $\quad F = 105.1907^a$ $\quad DW = 2.5816^{IC}$

REGRESSIONS CONSIDERING PRICE AND COST OF PRODUCTION DEFLATED BY THE US CONSUMER PRICE INDEX (1995 INDEX = 100)

7) Using price (P_t), cost of production (CP_t), productive capacity (IC_t), Exchange rate (ER_t) and lagged exports (Y_{t-1}):

$$Y_t = \underset{(-2.5643)^b}{-2{,}712{,}141} \underset{(-0.6594)^{ns}}{-186.9611 \cdot P_t} + \underset{(2.1106)^b}{1{,}064.642 \cdot CP_t} + \underset{(4.0188)^a}{0.4586 \cdot IC_t} + \underset{(2.4316)^b}{139{,}280.5 \cdot ER_t} + \underset{(4.0336)^a}{0.4659 \cdot Y_{t-1}}$$

$R^2_{adjust} = 0.982$ n = 21 $F = 218.9179^a$ $DW = 2.5018^{IC}$

8) Using lagged price (P_{t-1}), cost of production (CP_t), productive capacity (IC_t), Exchange rate (ER_t) and lagged exports (Y_{t-1}):

$$Y_t = \underset{(-4.2316)^a}{-3{,}449{,}197} + \underset{(1.0758)^d}{283.3566 \cdot P_{t-1}} + \underset{(2.5542)^b}{1{,}146.101 \cdot CP_t} + \underset{(5.2746)^a}{0.5064 \cdot IC_t} + \underset{(3.6461)^a}{177.800.7 \cdot ER_t} + \underset{(4.2147)^a}{0.4850 \cdot Y_{t-1}}$$

$R^2_{adjust} = 0.9828$ n = 21 $F = 229.3050^a$ $DW = 2.7644^{IC}$

9) Using neperian logarithms in the above situation:

$$\ln Y_t = \underset{(-3.1174)^a}{-27.0411} + \underset{(0.3972)^{ns}}{0.0494 \ln P_{t-1}} + \underset{(2.1381)^b}{0.6314 \cdot \ln CP_t} + \underset{(3.8422)^a}{1.8310 \cdot \ln IC_t} + \underset{(2.4302)^b}{0.4349 \cdot \ln ER_t} + \underset{(3.9469)^a}{0.5652 \cdot \ln Y_{t-1}}$$

$R^2_{adjust} = 0.9662$ n = 21 $F = 115.4162^a$ $DW = 2.7249^{IC}$

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[1] Market-oriented pulp is a name for pulp that is produced for sale on domestic or foreign markets.

[2] FAO has already prepared information for some countries about foreign production and trade of pulp for 2002. However, for other countries the last available information is from 2001. In order to work with consolidated data, this section only analyzes data until 2001, which will be subject to small changes in the future.

[3] CHERKASSKY, H. H. Perspectivas e oportunidades a nível mundial da Indústria de Produtos Florestais. In; 1º Encontro brasileiro de Economia Florestal. Curitiba 1998. Proceedings, v.2, p. 1-11.

[4] We considered pulp for paper. This data is available on http://www.fao.org.