DETERMINANTS OF PRICES OF PAPER AND PAPERBOARD IN THE EUROPEAN UNION FROM 1969 TO 1992

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ABSTRACT

The price of paper and paperboard (newsprint, printing and writing, and other paper and paperboard) in the European Union was hypothesized to be a function of input costs, scale of production, and technical change. The price models were estimated with panel data over the period 1969-1992. Application of duality theory allowed recovery of the parameters of the production function. Conditional demand equations were also obtained showing how relative factor prices, volume of production, and technical change affect the utilization of the various inputs. Judging from the magnitude of partial elasticities, paper and paperboard prices were most responsive to the prices of pulp, labor, capital and energy, in that order. Technological change accounted for a decline in real prices of paper and paperboard from 1969 to 1992.

Keywords: Panel data, paper and paperboard industry, prices, production function.

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INTRODUCTION

Little happened to the real prices of paper and paperboard before the first oil embargo of 1973. Prices tended to remain constant, or decline regularly. For that reason, little attention was given to the process of price formation and to the role of prices in demand. However, the sudden rise in energy prices in the mid seventies was associated with a near doubling of the prices of paper and paperboard . This spurred several studies of the mechanism of price formation (Dagenais, 1976; Buongiorno & Gilless, 1980; Buongiorno *et al.*, 1983; Booth *et al.*, 1991).

Since the completion of these studies, more data have become available, and prices have been subject to wide fluctuations: After doubling from 1970 to 1975, they returned

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to their 1970 level by 1985, and then climbed again by 30% in the two following years. The general objective of this paper is to better understand the reasons for these changes. In particular, we want to assess the validity of the simple model of price formation of Buongiorno & Gilless (1980) as an explanation of price changes in the countries of the European Union. The theory is that prices of paper and paper board can be explained to a large extent by the prices of inputs: labor, energy, raw materials, and capital, by the volume of output, and by technical change. The paper is organized as follows. In the first part, we review the theoretical justification for the price model. The data are described in the next section. The estimation procedure and the statistical results are presented in the two next sections. Part six describes the decomposition analysis applied to determine how much of the price changes between 1975-1985 were due to the variables of the model. The conclusions summarize the main findings and suggest future research.

Theoretical Model

Buongiorno & Gilless (1980) assumed that production of paper and paperboard in various countries could be represented by a Cobb-Douglas function including labor, capital, energy and materials as inputs, and allowing for technical change and non-constant return to scale:

$$Q_{it} = \alpha_{0i} e^{\theta_t} \left(L_{it}^{\alpha_L} K_{it}^{\alpha_K} M_{it}^{\alpha_M} E_{it}^{\alpha_E} \right) \mu_{it}, \tag{1}$$

where Q_{it} is the output of a specific product in country i and year t. L_{it}, K_{it}, M_{it} and E_{it} are respectively labor, capital, materials and energy used in making this output. The elasticities α_L, α_K, α_M, and α_E and the rate of technological change θ are constant, while α_{0i} may vary from country to country but is constant over time. Therefore, the production function is the same in all countries, except for intercountry differences reflected by α_{0i} and for random differences $\mu_{it.}$.

Returns to scale of national production are measured by,

$$r = \alpha_L + \alpha_K + \alpha_M + \alpha_E, \tag{2}$$

where $r > 1$ implies increasing returns to scale. Instead, $r = 1$ or $r < 1$ imply constant or decreasing returns to scale, respectively.

Total industrial cost C is related directly to quantity and price of inputs:

$$C = W_L L + W_K K + W_M M + W_E E, \tag{3}$$

where $W_{L,}\ W_{K,}\ W_{M,}\ W_E$ are the prices of labor, capital, materials, and energy, respectively. Cost minimization, subject to the production technology described by (1) and to exogenous factor prices, leads to the marginal productivity conditions:

$$\frac{W_L L}{\alpha_L} = \frac{W_K K}{\alpha_K} = \frac{W_M M}{\alpha_M} = \frac{W_E E}{\alpha_E}. \tag{4}$$

The reduced form of (1) and (4) is:

$$C = \beta_0\, e^{-\theta t/r}\, Q^{1/r}\, W_L^{\alpha_L/r}\, W_K^{\alpha_K/r}\, W_M^{\alpha_M/r}\, W_E^{\alpha_E/r}, \tag{5}$$

where $\beta_0 = r\left(\alpha_0\ \alpha_L^{\alpha_L}\ \alpha_K^{\alpha_K}\ \alpha_M^{\alpha_M}\ \alpha_E^{\alpha_E}\right)^{-1/r}$, and $\nu = \mu^{-1/r}$.

This cost function is the dual of the production function (1) since it summarizes all the relevant aspects of technology. There exists a duality between cost and production functions in the sense that the parameters of the production function can be recovered completely from those of the cost function (Varian, 1992, p. 87). This property enables the parameters of the production function to be estimated from data of output and factor prices.

The average cost function can be derived from (5),

$$\overline{C} = \frac{C}{Q} = \beta_0\, e^{-\theta t/r}\, Q^{1/r-1}\, W_L^{\alpha_L/r}\, W_K^{\alpha_K/r}\, W_M^{\alpha_M/r}\, W_E^{\alpha_E/r}\ \nu, \tag{6}$$

and the marginal cost function,

$$MC = \frac{dC}{dQ} = \frac{\overline{C}}{r}. \tag{7}$$

The model assumes monopolistic competition in international markets of paper and paperboard. Profits tend to zero in the long-run and prices equal average costs. This, then, leads to the price equation:

$$\ln P = \beta_0' - \frac{\theta}{r}t + \left(\frac{1}{r} - 1\right)\ln Q + \frac{\alpha_L}{r}\ln W_L + \frac{\alpha_K}{r}\ln W_K + \frac{\alpha_M}{r}\ln W_M + \frac{\alpha_E}{r}\ln W_E + v'. \qquad (8)$$

A special case is purely competitive markets in which the price is equal to average and marginal cost, and therefore $r = 1$: the industry operates in the region of constant returns to scale, and the output price is independent of the level of output.

The Data

The price analysis was done for the four paper and paperboard groups defined in the FAO Yearbook of Forest Products. They are newsprint, printing and writing paper, other paper and paperboard, and their total. The countries were: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. National annual production, in thousand tons, was obtained from the Food and Agriculture Organization (1970–1992). Prices in U.S. dollars per ton were estimated as the quantity-weighted average of import and export units values.

Only woodpulp was considered as raw material since it is the most important input in paper and paperboard production. The statistical source for woodpulp prices was also the FAO "Yearbook of Forest Products". As for paper and paperboard, pulp prices were estimated as the weighted average of unit value of imports and exports. Price of mechanical pulp was the index of raw material price in the newsprint equation because newsprint is manufactured mainly with mechanical pulp and with a lesser amount of chemical pulp and recycled fiber. The equations of printing and writing paper, and other paper and paperboard include used chemical pulp prices because it is the main fiber in the production of these paper grades. Price of all woodpulp, considered as the sum of mechanical, chemical and semichemical pulp, was the raw material price index in the aggregate paper and paperboard price equation.

Wastepaper prices were not included for lack of data, although it is an important source of fiber in some countries. The cost of chemicals was also ignored: it is estimated to be less than 10% of total cost (Smook, 1990), and chemicals prices should be strongly related to the energy price already included in the models.

Average hourly earnings published by the International Labour Organization (1970–1994, series 341, paper and paper products) were used as indicator of wage rates, for all product groups.

The unit value of crude oil imports was used as a price index of energy on the basis that most of the countries studied depend highly on foreign oil and that oil is the most important form of energy in European Union countries. Unit values of imports were computed from the United Nations' "International Trade Statistics Yearbook".

Obtaining data for the price of capital is complicated by the diverse capital sources used by the paper and paperboard industry: loans, internally generated funds, and government credit. Empirically, the cost of capital is the most difficult to measure. Here, capital price elasticites were derived from return to scale, labor, materials and energy elasticities, as in Buongiorno & Gilless (1980).

After conversion to current U.S. dollars, all price data were deflated by the US implicit price deflator for GDP (base 1987) published by the World Bank.

ESTIMATION

Model (8) was estimated with a panel data set composed of 24 years (1969–1992) and 14 countries[1]. Given a pooled sample, the question arises as to the appropriate model for pooling. The model used here was the 'within' or fixed effects model, which is equivalent to the analysis of covariance model featuring dummy intercepts U_i for each country. The empirical version is as follows,

$$\ln P_{ijt} = \sum_{i=1}^{n} \alpha_{ij} U_i + T_j t + R_j \ln Q_{ijt} + A_j \ln W_{Lijt} + B_j \ln W_{Mijt} + C_j \ln W_{Eijt} + \varepsilon_{ijt}, \tag{9}$$

[1] Since the FAO database gives information for Belgium and Luxembourg together, they are treated as one country.

where the subscripts i, j, t refer to a particular country, product and year, respectively. P and Q indicate the price and quantity produced, and t a time trend measuring technical change. W_L, W_M and W_E are the wage rate, price of raw materials and price of energy.

The parameters were estimated by assuming constant variance and zero covariance of the error term across countries, but possible autocorrelation within each country:

$$\varepsilon_{ijt} = \rho_{ij}\varepsilon_{ijt-1} + u_{ijt}, \tag{10}$$

where ρ_{ij} is the autocorrelation within country i, for commodity j, and u_{ijt} has the classical properties.

Equation (9) was estimated first by ordinary least squares (OLS), with one dummy intercept for each country. Estimates of ρ_{ij} were obtained by estimating Equation (10) from the residuals of Equation (9). After obtaining separate estimates for ρ_{ij} for each country, all variables were transformed to correct the first order autocorrelation by Cochcrane-Orcutt transformation (Johnston, 1984, p. 323). The new transformed variables were used to estimate the coefficients by OLS, obtaining generalized least squares (GLS) estimators.

Equations (8) and (9) lead to:

$$r_j = \frac{1}{1+R_j}. \tag{11}$$

Given the assumption of monopolistic competition, we would expect the industry to operate at increasing returns to scale, i.e. $r > 1$, and so a negative relation between price and quantity ($R_j < 0$ and small in absolute value), or at constant returns, with $r = 1$ and $R_j = 0$.

Increases in productivity in sector j due to technological change would be reflected in lower costs, and thus lower product price translating in a negative sign for T_j, since, from Equations (8) and (9):

$$T_j = \frac{-\theta_j}{r_j}. \tag{12}$$

Technological innovations have occurred, but slowly in the pulp and paper industry. Therefore, T_j is expected to be small in absolute value.

Moreover, A_j, B_j, and C_j coefficients should be positive and sum up to less than unity, corresponding to the elasticities of labor, materials and energy in the production function:

$$\alpha_{Lj} = A_j r_j ,$$
$$\alpha_{Mj} = B_j r_j ,$$
$$\alpha_{Ej} = C_j r_j , \tag{13}$$

while the capital elasticity can be computed as a residual, from Equation (2):

$$\alpha_{Kj} = r_j - \alpha_{Lj} - \alpha_{Mj} - \alpha_{Ej} . \tag{14}$$

From the marginal productivity conditions (4) and the production function (1) we can also obtain the conditional demand for each input. These conditional demand equations indicate how the energy, labor, capital and materials used by the paper sector are affected by the volume of production, the price of each input, and technological change. For example, the conditional demand for energy is:

$$E = \gamma_0 W_E^{(\alpha_E/r)^{-1}} W_L^{\alpha_L/r} W_M^{\alpha_M/r} W_K^{\alpha_K/r} Q^{1/r} e^{-\theta t/r} , \tag{15}$$

where $\gamma_0 = (\alpha_0 u)^{-1/r}$.

This equation shows how the amount of energy used to produce the output Q depends on the price of energy, but also on the price of labor, capital and material which can be substituted for energy, degree of economy of scale and technological improvements. All constant are entirely defined by the parameters of the production function, and therefore by the empirical price equations.

EMPIRICAL MODELS

The results of estimating Equation (9) by GLS are in Table 1. The statistical results are generally good, the price equations explaining 99% of the total price variance. The fit appears to quite good within countries as well (Figures 1 and 2). The coefficients of the input prices have plausible

TABLE 1. PAPER AND PAPERBOARD PRICE EQUATION FOR EU COUNTRIES, 1969–1992.

	Coefficients of Independent Variables						
Products	t	Q_t	W_L	W_M	W_E	R^2	DW
Total paper and paperboard	−0.007***	0.01	0.30***	0.42***	0.02*	0.99	1.66
	(0.002)	(0.03)	(0.03)	(0.03)	(0.01)		
Newsprint	−0.01***	0.02***	0.49***	0.34***	0.10***	0.99	1.99
	(0.002)	(0.008)	(0.05)	(0.04)	(0.02)		
Printing and writing paper	−0.007***	0.005***	0.35***	0.38***	0.05***	0.99	2.00
	(0.002)	(0.001)	(0.04)	(0.04)	(0.02)		
Other paper and paperboard	−0.003*	−0.07*	0.28***	0.44***	0.01	0.99	2.01
	(0.002)	(0.04)	(0.04)	(0.04)	(0.02)		

Note: Standard deviations of the coefficients are in parentheses.
R^2 = Coefficient of determination.
DW= Durbin-Watson test for residual autocorrelation, after correction for serial correlation.
***, **, * indicates coefficients significantly different from zero at 1%, 5%, and 10% significance level.

signs and magnitudes and they are highly significant, except for the energy price in the equation for other paper and paperboard.

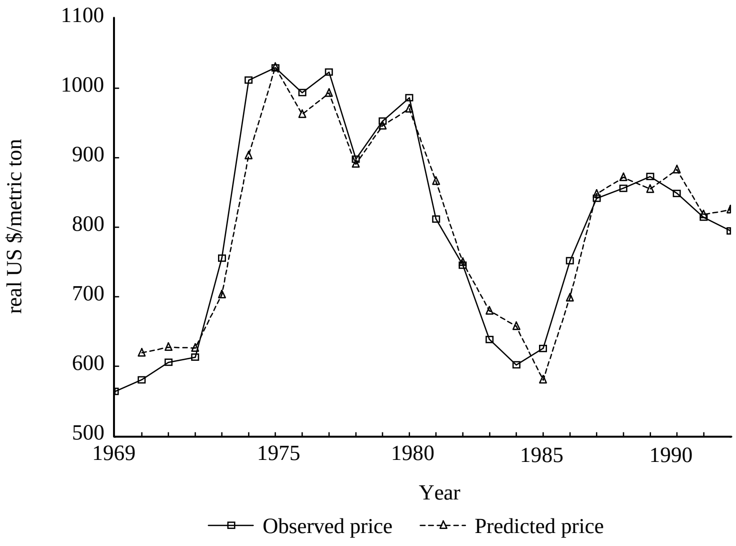

FIGURE 1: PREDICTED AND OBSERVED PAPER AND PAPERBOARD PRICES IN GERMANY.

In general, all energy coefficients are small, meaning a low influence on price evolution. There are two explanations for this. First, the price equations use the price of pulp as an input. Previous results suggest that the price of pulp is affected more by energy cost than the price of paper, conditional on that of pulp (Buongiorno & Gilless, 1980). Second, the net energy consumption of a modern integrated paper mill is low because it can produce energy as a by-product of pulp manufacturing. Here, the energy coefficient, conditional on the price of pulp, is highest for newsprint.

The time variable in the price model is used to capture technological change effects that decrease the amount of inputs needed per ton of paper and paperboard produced. The coefficients of *t* have all the expected signs and are significantly different from zero. They suggest that technical change led to decreases in prices for all product groups, at near 1% per year, except for other paper and paperboard, where the effect was less than 0.5% per year.

The coefficients of output, *Q*, in Table 1 are very small. The only exception is other paper and paperboard, where the equation predicts a price decrease of 7% for a production increase of 10%.

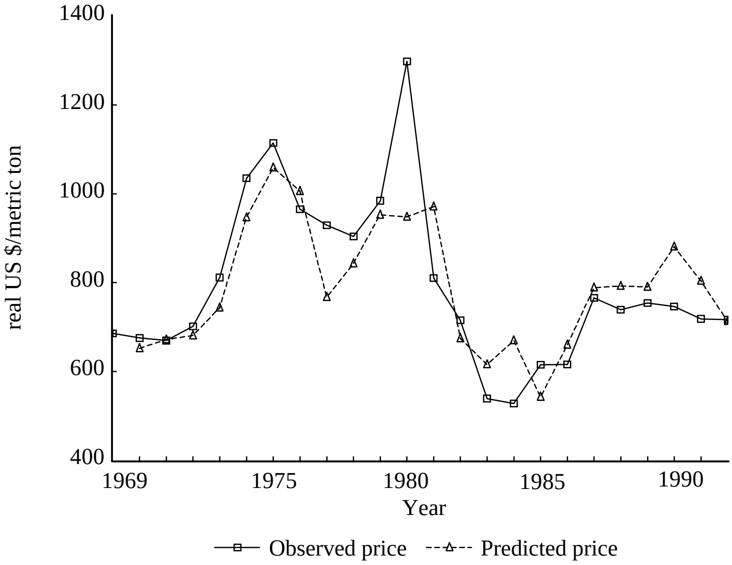

FIGURE 2: PREDICTED AND OBSERVED PAPER AND PAPERBOARD PRICES IN SPAIN.

Table 2. Estimated Returns to Scale (r), Input Elasticities and Rate of Technological Change (θ) in Paper Production in EU Countries, 1969–1992.

		Input Elasticities				
Products	r	α_K	α_L	α_M	α_E	θ
Total paper and paperboard	0.99	0.27	0.29	0.41	0.02	0.006
Newsprint	0.98	0.08	0.48	0.33	0.09	0.009
Printing and writing paper	0.99	0.23	0.34	0.37	0.05	0.006
Other paper and paperboard	1.07	0.30	0.29	0.47	0.01	0.003

The coefficients of the production function, computed from the statistics in Table 1 are in Table 2. The results show the marginal relative change in output due to a marginal change in energy, capital, labor, or materials input. Most products present almost constant returns to scale, coherent with competitive industries. However, the presence of increasing returns to scale for other paper and paperboard suggests monopolistic competition in this industry.

The partial elasticities of product price with respect to input price are the elasticities in Table 1, divided by the return to scale coefficient, r (see Equation 8). This indicates that newsprint price is most responsive to labor, materials, energy, and capital prices in that order. Prices of printing and writing paper, and total paper and paperboard appear to be most affected by relative changes in materials, labor, capital and energy costs, in that order. While for other paper and paperboard the order is materials, capital, labor, and energy. It should be noted that an increase in the cost of inputs would affect the price of paper and paperboard grades in two ways. First, it would increase directly the cost of manufacturing paper. Second, it would increase the cost of pulp and thus indirectly affect the price of paper.

Table 3 shows empirical conditional demand equations for inputs, based on Equation (16). The calculations, done for total paper and paperboard, show how the energy, labor, capital, and materials used by the paper industry are affected by the volume of production, the price of each in-

TABLE 3. CONDITIONAL DEMAND ELASTICITIES FOR LABOR, CAPITAL, RAW MATERIALS, AND ENERGY IN THE PAPER AND PAPERBOARD INDUSTRY OF EU COUNTRIES, 1969-1992.

	ELASTICITIES WITH RESPECT TO:					
	W_E	W_L	W_K	W_M	Q	t
Energy	*–0.97*	0.29	0.27	0.41	1.01	–0.007
Labor	0.02	*–0.70*	0.27	0.41	1.01	–0.007
Capital	0.02	0.29	*–0.72*	0.41	1.01	–0.007
Materials	0.02	0.29	0.27	*–0.58*	1.01	–0.007

put, and technological change. The results suggest that a 10% increase in energy prices would lead, other things being equal, to a 9.7% decline in demand for energy being substituted by an increase of 0.2% each in labor, capital, and materials. The relative increase in each input due to a given relative change in output would have to be almost equal to the relative change in output. Over the period of observation, technological improvements had reduced input requirements at a rate of 0.7% per year in the paper and paperboard sector.

DECOMPOSITION ANALYSIS

While the magnitude of elasticities in the price equations, and their statistical significance give useful information, they are generally not sufficient to tell the effect of a variable on prices. This effect depends on the magnitude of the elasticity, and the change in the variable itself. Decomposition analysis (Kako, 1980; Buongiorno & Lu, 1989) is meant to measure the full effect of a variable, over a specific period of observation.

Following Kako (1980), differentiation of the price equation (9) shows how changes of technology, volume of production, and input prices affect the price of paper and paperboard:

$$\frac{\Delta P}{P} \cong T + R\frac{\Delta Q}{Q} + A\frac{\Delta W_L}{W_L} + B\frac{\Delta W_M}{W_M} + C\frac{\Delta W_E}{W_E}, \qquad (16)$$

where, in practice, the relative change in a variable is measured by the average annual rate of change over a specific period.

TABLE 4. COMPONENTS OF THE ANNUAL RATE OF CHANGE OF PAPER AND PAPERBOARD PRICES IN GERMANY, FROM 1975 TO 1985.

Effects of	Total Paper and Paperboard	Newsprint	Printing and Writing Paper	Other Paper and Paperboard
Technological Change				
T	*–0.70*	*–1.00*	*–0.70*	*–0.30*
Production				
$\Delta Q/Q$	3.51	3.24	5.37	2.38
R	0.01	0.02	0.005	–0.07
$R\ (\Delta Q/Q)$	*0.035*	*0.064*	*0.026*	*–0.16*
Labor Price				
$\Delta W_L/W_L$	–2.25	–2.25	–2.25	–2.25
A	0.30	0.49	0.35	0.28
$A(\Delta W_L/W_L)$	*–0.67*	*–1.10*	*–0.78*	*–0.63*
Pulp Price				
$\Delta W_M/W_M$	–2.35	–1.62	–2.62	–2.62
B	0.42	0.34	0.38	0.44
$B\ (\Delta W_M/W_M)$	*–0.99*	*–0.55*	*–0.99*	*–1.15*
Energy Price				
$\Delta W_E/W_E$	3.00	3.00	3.00	3.00
C	0.02	0.10	0.05	0.01
$C\ (\Delta W_E/W_E)$	*0.06*	*0.30*	*0.15*	*0.03*
Predicted Price $\Delta P/P$	*–2.30*	*–2.29*	*–2.30*	*–2.22*
Observed Price $\Delta P/P$	–3.90	–1.50	–4.30	–4.00
t	–0.94	0.21	–0.73	–1.00

Note: Relative changes are annual percentages.

t: paired test of difference between two means, with 10 degrees of freedom.

The economic interpretation of (16) is that the rate of growth of paper prices can be decomposed into several parts, each one reflecting the effect of a particular variable, through the product of its own change, and its corresponding elasticity. Table 4 shows the effect of each variable on the price of paper and paperboard in Germany. The computations were made with the elasticities in Table 1 and the average rates of growth in production, input prices and paper and paperboard prices from 1975 to 1985, a period of substantial and regular decline in the price of paper and paperboard (Figure 1).

Table 4 shows that, from 1975 to 1985, technical change accounted for 0.7% per year of the decline in the real price of paper and paperboard, change in production had almost no effect, changes in labor and pulp prices accounted for 0. 7% and 1% per year, respectively, of the decline in price. The rise in energy price (3% per year) had a negligible effect on the price of paper and paperboard.

In general, the main components of the price change were labor price, pulp price, and technical change, while output had no effect, and energy affected mostly the price of newsprint and printing and writing paper. The bottom of Table 4 shows that the total predicted price change (the sum of all components) was not significantly different from the observed, over 1975 to 1985, although it was smaller in absolute value. Indeed, Table 4 does not contain all the price effects suggested by this paper: capital is missing. The method has given us an estimate of the price elasticity with respect to capital, but unless a measure of capital price is developed, the effect of change in capital price cannot be computed.

CONCLUSIONS

A simple Cobb-Douglas model accurately represented price changes from 1969 to 1992, for 14 EU countries. The results showed that paper and paperboard prices were most responsive to materials, labor, capital, and energy prices, in that order. Technological change accounted for a decline in real prices of paper and paperboard of nearly 1% per year during the period studied. The industry operated in the region of neutral, or slightly increasing returns to scale. These results are consistent with those obtained by Buongiorno & Gilless (1980) for OECD countries, from 1961 to 1976.

On the basis of the statistical results the proposed model seems plausible. However, some of the assumptions made could be relaxed in order to include a theory reflecting the oligopolistic nature of the paper and paperboard industry through price leadership or a combination of price leadership and target returns pricing (Rich, 1978; 1983). A mark-up pricing model has given plausible results for U.S. data, with an inventory-output ratio variable serving as signal for price change (Buongiorno & Lu, 1989). It is possible that a similar model could be implemented at international level, with capacity utilization substituted for the inventory-output ratio, because inventory data are not available internationally. Moreover, this analysis has determined how paper and paperboard prices are affected by pulp prices. Future research should deal with the determination of pulp prices also, to fully link the paper sector with timber markets.

Finally, it has been assumed in this study that the Cobb-Douglas production function is an adequate representation of production in the paper and paperboard industry. This has the advantage of generating estimates of price elasticities of capital as a residue, without data on price of capital. But, this comes at the cost of severe constraints regarding the value of the coefficients. It is also possible that the omission of the price of capital biases the value of the other coefficients. Therefore, while the form of the production function and of its dual cost function, could be made more general, the first step of future research should be to develop measures of capital cost that are suitable internationally for the pulp and paper industries.

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References

Booth, D.L., Kanetkar, V., Vertinsky, Y. & Whistler, D., 1991. An Empirical Model of Capacity Expansion and Pricing in an Oligopoly with Barometric Price Leadership: A Case Study of the Newsprint Industry in North America. *The Journal of Industrial Economics,* 39 (3), 255–276.

Buongiorno, J., Farimani, m. & Chuang, W.-J., 1983. Econometric Model of Price Formation in the United States Paper and PaperboardIndustry. *Wood and Fiber Science*, 15 (1), 28–39.

Buongiorno, J. & Gilless, J. K., 1980. Effects of Input Costs, Economies of Scale, and Technological on International Pulp and Paper Prices. *Forest Science,* 26 (2), 261–274.

Buongiorno, J.& Lu, H. C., 1989. Effects of Costs, Demand, and Labor Productivity on the Prices of Forest Products in the United States, 1958–1984. *Forest Science,* 35 (2), 349–363.

Dagenais, M.G. 1976. The Determination of Newsprint Prices. *Canadian Journal of Economics*, 9 (3), 442–461.

Food and Agriculture Organization of the United Nations, 1970–1992.*Yearbook of Forest Products* (Rome: FAO).

International Labor Organization, 1970–1994. *Yearbook of Labour Statistics* (Geneva: International Labor Organization).

Johnston, J., 1984. *Econometric Methods* (New-York: Mc Graw Hill).

Kako, T., 1980. An Application of the Decomposition Analysis of Derived Demand for Factor Inputs: The Case of Rice in Japan. *American Journal of Agricultural Economics*, 60 (4), 628–635.

Rich. S.U., 1978. Pricing Patterns in the Paper Industry. *Forest Products Journal*, 28 (4): 13.

Rich, S.U. 1983. Price Leadership in the Paper Industry. *Industrial Marketing Management*, 12, 101–104.

Smook, G. A., 1990. *Handbook for Pulp and Paper Technologist* (TAPPI).

United Nations, 1970–1994. *International Trade Statistics Yearbook*.

Varian, H,. 1992. *Microeconomic Analysis* (New-York: Norton).

World Bank, 1995. *World Tables*.