SOME COMPARATIVE STATICS EXERCISES WITH A SMALL SCALE MODEL OF THE ITALIAN FOREST SECTOR

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FOREWORD

The objective of the Forest Sector Project at IIASA is to study long-term development alternatives for the forest sector on a global basis. The emphasis in the Project is on issues of major relevance to industrial and governmental policy makers in different regions of the world who are responsible for forestry policy, forest industrial strategy, and related trade policies.

The key elements of structural change in the forest industry are related to a variety of issues concerning demand, supply, and international trade of wood products. Such issues include the development of the global economy and population, new wood products and substitution for wood products, future supply of roundwood and alternative fiber sources, technology development for forestry and industry, pollution regulations, cost competitiveness, tariffs and non-tariff trade barriers, etc. The aim of the Project is to analyze the consequences of future expectations and assumptions concerning such substantive issues.

The research program of the Project includes an aggregated analysis of long-term development of international trade in wood products, and thereby analysis of the development of wood resources, forest industrial production and demand in different world regions. The analysis is carried out by means of a model of the sector. The purpose of this article is to describe an Italian country component, suitable for analysis of the European forest sector. Given that similar components are created for other countries, a European model results by replacing export demand and import supply functions with explicit trade flow activities (for products that have components in common for all countries).

This work was carried out while the Author was in the Young Scientists Summer Program at IIASA in 1984.

Markku Kallio
Project Leader
Forest Sector Project

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1. INTRODUCTION

A simple model of the Italian forest sector is presented in this paper. The methodology used to set up the model is derived from the fund of knowledge and computing techniques developed at the IIASA Forest Sector Project.

The model we consider here is an attempt to study more closely the forest sector of a single country (in this case Italy), and to carry out some simulations that take into account the specific features of the Italian forest sector.

This is not always possible with large scale international trade models constrained to consider products and regions at a very aggregate level. The model assumes perfect competition as most of the general or partial equilibrium models do, and being non-dynamic can be used for comparative statics exercises only. Investment is not considered in this preliminary version, although it might be in the future.

For this reason the simulations carried out in section 5 are to be thought of as short-run exercises where the problem of investment in new production capacity is simply not considered.

Furthermore there are two reasons why we tend to consider the model as a preliminary one. The first reason concerns the data: they come from many different sources and further work should be done to make them consistent (e.g. the input technical coefficients) and more reliable.

The second reason is that the estimates of the parameters of the model, such as demand, supply, import and export elasticities, being very tentative, will require specific econometric work.

2. THE MODEL

We consider the following forest products:

1. Logs
2. Pulpwood
3. Sawnwood
4. Pulp for paper
5. Panels
6. Newsprint
7. Printing and writing paper
8. Packaging paper
9. Furniture

For each of these products we define demand, supply, export and import functions. As far as logs, pulpwood and pulp are concerned we do not consider a demand function, since consumption is defined in the model as *net consumption*, that is, the amount of a product consumed outside the forest sector. We assume that no logs, pulpwood or pulp are demanded other than by the above considered forest industries and therefore that their consumption is, by definition, equal to zero.

The requirements of logs, pulpwood and pulp, as well as of the other products that are inputs of any forest industry, are determined through technical coefficients as in input-output models.

Consumption, production, export and import are always in quantities (cubic meters or tons); prices in thousand lira per cum or ton.

2.1 The Consumption Function

The consumption function is defined for all products except logs, pulpwood and pulp for paper.

We consider the inverse of a demand function:

$$\pi_i = P_i(C_i) \qquad i=1,...6 \tag{1}$$

where

C_i = consumption of good i

π_i = price of good i

More specifically these functions are of the Cobb-Douglas type, that is:

$$\pi_i = \lambda_i C_i^{-\gamma_i} \tag{2}$$

with λ_i , γ_i , > 0 $i=1,...6$ and where $\frac{1}{\gamma_i}$ is the elasticity of consumption of good i with respect to its own price.

2.2 Production

The marginal cost of producing good i $Q_i(y_i)$ is an increasing function of the quantity produced y_i.

Again using a Cobb-Douglas specification we have:

$$Q_i = \alpha_i \, y_i^{\beta_i} \qquad i = 1, \ldots, 9 \tag{3}$$

with

$$\alpha_i \, , \, \beta_i > 0 \qquad i = 1, \ldots, 9$$

and where

Q_i = marginal cost of producing good i

y_i = quantity produced of good i.

We can also define a net production vector (that is the production to be consumed outside the Italian forest sector) as follows:

$$Y' = AY \tag{4}$$

where A is the 9 x 9 matrix of input coefficients and Y is the vector of the production quantities. More specifically the elements of the matrix A have these values:

$$A = \begin{bmatrix} 1 & 0 & 0.4 & -4.2 & -0.45 & -1.5 & -0.3 & -0.7 & 0 \\ 0 & 1 & -1.75 & 0 & -0.6 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & -0.46 \\ 0 & 0 & 0 & 1 & 0 & -0.2 & -0.6 & -0.12 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & -0.87 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -0.87 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Each forest industry has an upper limit to production given by 1980 production capacity; therefore we have:

$$Y_i \leq K_k \qquad i = 1, \ldots, 6 \tag{5}$$

where K_i is production capacity (see Table 6 below).

2.3 Imports and Exports

Imports are treated as the rest of the world's supply of forest products to Italy and they are therefore an increasing function of price. Exports are the rest of the world's demand of Italian forest products, thus a decreasing function of price.

Therefore we have:

$$M_i = M_i(m_i) \qquad i = 1, \ldots, 9 \tag{6}$$

$$E_i = E_i(e_i) \qquad i = 1, \ldots, 9 \tag{7}$$

where M_i and E_i are respectively import and export prices, whereas m_i

and e_i are import and export quantities (see Tables 7 and 8).

Once again using a Cobb-Douglas function, we obtain:

$$M_i = \delta_i \, m_i^{\mu_i} \qquad i = 1, \ldots, 9 \tag{8}$$

$$E_i = \psi_i \, e_i^{-\varepsilon_i} \qquad i = 1, \ldots, 9 \tag{9}$$

where $\delta_i, \mu_i, \psi_i, \varepsilon_i > 0, \; i = 1, \ldots, 9$

2.4 Final Remarks on the Consumption, Supply, Import and Export Functions

For each function it is possible to write (we consider here the consumption function only, but the same applies to supply, import and export functions as well):

$$\pi_{oi} = \lambda_i \, C_{oi}^{-\gamma_i} \qquad i = 1, \ldots, 6 \tag{2'}$$

where π_{oi} is the reference average price in 1980 and C_{oi} is the reference consumption in 1980.

Now dividing equation (2) by (2') we obtain:

$$\frac{\pi_i}{\pi_{oi}} = \frac{C_i^{-\gamma_i}}{C_{oi}^{-\gamma_i}} \qquad i = 1, \ldots, 6$$

or rearranging:

$$\pi_i = \frac{\pi_{oi}}{C_{oi}^{-\gamma_i}} C_i^{-\gamma_i} \qquad i = 1, \ldots, 6 \tag{10}$$

so that the reference set of elasticities of Table 3 and the reference values for 1980 are all we need to set up the model, since all other parameters disappear from equation (10).

For each product therefore we have consumption, supply, export and import functions as in Figure 1.

For each product consumption (which is in fact consumption outside the forest sector) must be equal to net production plus imports minus exports, that is in matrix notation:

$$C = AY + m - e \tag{11}$$

where

C = vector of net consumption

A = input-output matrix

m = vector of imports

e = vector of exports

Having defined all the functions we needed, we consider now the references values for 1980 and the other parameter values. Afterwards we will talk about the equilibrium solutions and how to calculate them.

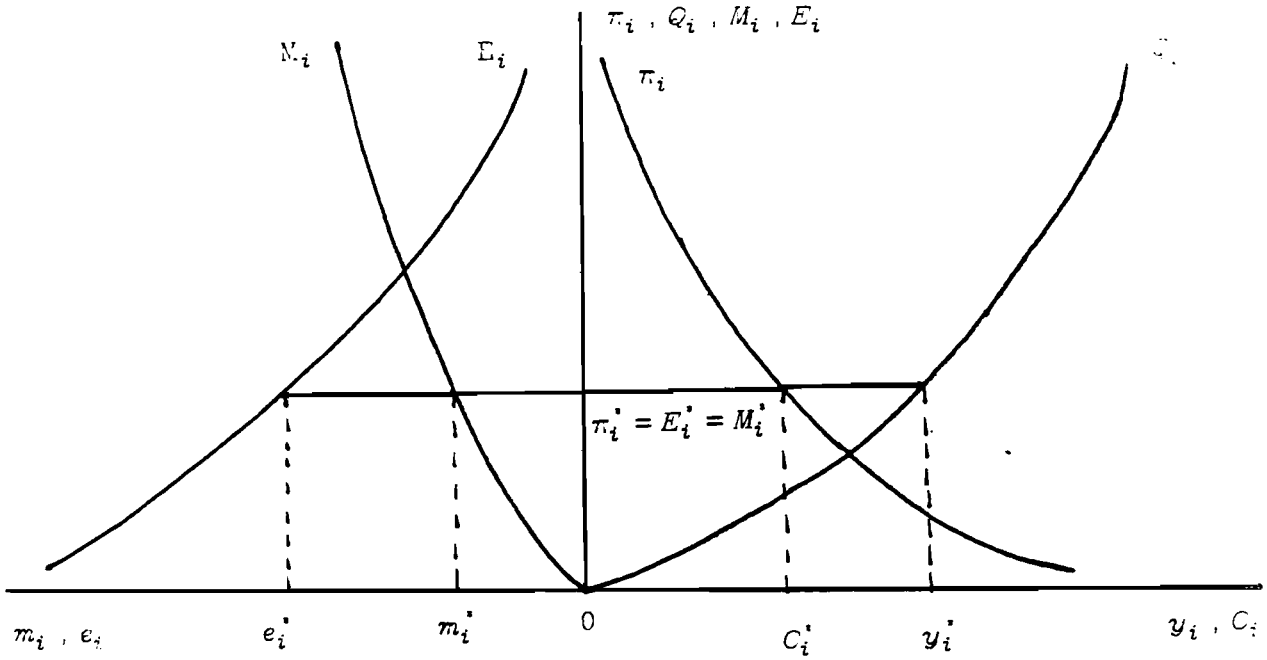

FIGURE 1. Consumption, supply, export and import functions. Variables with stars denote the reference values for 1980.

3. THE DATA

Pulpwood, logs, sawnwood and panels are always in cubic meters. Pulp, newsprint, printing paper, packaging paper and furniture are in tons (Tables 1 to 8).

TABLE 1. Average prices in 1980. Thousand lira per cubic meter or ton. (Source: FAO, ISTAT, CSIL)

Pulpwood	37.3 per cum
Logs	130.7 per cum
Sawnwood	215.3 per cum
Pulp for paper	463.0 per ton
Panels	330.3 per cum
Newsprint	483.4 per ton
Printing paper	1,078.5 per ton
Packaging paper	665.7 per ton
Furniture	3,249.0 per ton

TABLE 2. Consumption in 1980. Thousand of cubic meters or tons. (Source: FAO, ISTAT, CSIL)

Sawnwood	7,213.0
Panels	1,100.0
Newsprint	328.0
Printing paper	1,615.0
Packaging paper	2,970.0
Furniture	1,983.0

TABLE 3. Set of elasticities with respect to price.

	Demand	Supply	Import	Export
Pulpwood	–	0.90	1.30	–
Logs	–	0.90	1.30	–
Sawnwood	−0.60	0.90	1.10	−1.10
Pulp for paper	–	1.25	1.10	–
Panels	−0.60	1.25	0.90	−0.90
Newsprint	−0.60	1.25	0.90	−0.90
Printing paper	−0.60	1.25	0.70	−0.70
Packaging paper	−0.60	1.25	0.90	−0.90
Furniture	−0.60	1.25	0.50	−0.50

TABLE 4. Production in 1980. Thousand of cum or tons. (Source: FAO, ISTAT, CSIL)

Pulpwood	1,010
Logs	2,070
Sawnwood	2,636
Pulp	45
Panels	2,703
Newsprint	277
Printing paper	1,799
Packaging paper	2,526
Furniture	2,316

TABLE 5. Input coefficients expressed in units of tons or cum required to produce one ton or cum of forest products. (Sources: FAO, ISTAT, CSIL)

	Sawn.	Pulp	Panels	News.	Print	Pack.	Furn.
Pulpwood	−0.40	4.20	0.45	1.50	0.30	0.70	
Logs	1.75		0.60				
Sawnwood							0.46
Pulp				0.20	0.60	0.12	
Panels							0.87

TABLE 6. Production capacity in 1980. Thousand of cum or tons. (Source: CSIL)

Sawnwood	3,766
Pulp	67
Panels	3,337
Newsprint	319
Printing paper	2,307
Packaging paper	3,239
Furniture	3,217

TABLE 7. Imports in 1980. Thousand of cum or tons. (Source: ISTAT)

Pulpwood	2,077
Logs	4,229
Sawnwood	5,713
Pulp	1,394
Panels	696
Newsprint	64
Printing paper	166
Packaging paper	764
Furniture	63

TABLE 8. Exports in 1980. Thousand of cum or tons. (Source: ISTAT)

Pulpwood	–
Logs	–
Sawnwood	70
Pulp	–
Panels	284
Newsprint	13
Printing paper	350
Packaging paper	320
Furniture	353

4. THE SOLUTION PRINCIPLE AND THE EQUILIBRIUM CONDITIONS

We consider three types of agents: the producers, the consumers and the trade agents. Producers are profit maximizers; consumers and trade agencies purchase from producers at the lowest price. The equilibrium solutions (prices, quantities consumed, produced, imported and exported for each type of goods) can be found as solutions of the optimization problem corresponding to the maximization of consumers' and producers' surplus plus the surplus deriving from trade.

This problem can be stated as (see D. Dykstra, M. Kallio, 1984):

$$\max_{c_i, y_i, e_i, m_i} \left[\sum_{i=1}^{9} \int_0^{c_i} P_i(C_i)dc_i - \sum_{i=1}^{9} \int_0^{y_i} Q_i(y_i)dy_i \right. \tag{12}$$

$$\left. - \sum_{i=1}^{9} \int_0^{m_i} M_i(m_i)dm_i + \sum_{i=1}^{9} \int_0^{e_i} E_i(e_i)de_i \right]$$

s.t.

$$C_i - \sum_{j=1}^{9} a_{ij}\, y_j + e_i - m_i = 0 \qquad i = 1, \ldots, 9 \tag{13}$$

$$0 \le y_i \le K_i \qquad i = 1, \ldots, 9 \tag{14}$$

$$y_i, C_i, m_i, e_i \ge 0 \qquad i = 1, \ldots, 9 \tag{15}$$

where a_{ij} are the input coefficients of matrix A.

Function (12) that has to be maximized is the sum of consumers' and producers' surplus and the surplus deriving from trade.

Eq. (13) is simply eq. (11) in a different notation and it corresponds to the material balance.

Eq. (14) states that production has an upper limit given by production capacity K_i.

Eq. (15) requires the solutions to be non-negative.

Problem (12)-(15) is a nonlinear programming problem with mixed equality and inequality constraints. The necessary conditions that the optimal solutions must satisfy are (see Panik p. 296, 297):

$C_i^*, y_i^*, m_i^*, e_i^*$ satisfy (13),(14),(15) (i)

$$P_i(C_i^*) = \pi_i \tag{ii}$$

$$\pi_i - \sum_{\substack{j=1 \\ i \ne 1}}^{9} \pi_j\, a_{ij} - Q_i(y_i^*) - \mu_i \le 0 \tag{iii}$$

$$y_i^* \left[\pi_i - \sum_{\substack{j=1 \\ i \ne j}} \pi_j\, a_{ij} - Q_i(y_i^*) - \mu_i \right] = 0 \tag{iv}$$

$$\mu_i \ge 0 \tag{v}$$

$$\mu_i (K_i - y_i^*) = 0 \tag{vi}$$

$$\pi_i = M_i\ (m_i^*) \qquad \text{(vii)}$$

$$\pi_i = E_i(e_i^*) \qquad \text{(viii)}$$

where π_i is the Lagrange multiplier related to constraint (13) that gives the dual prices.

According to (ii) price π_i and consumption are obviously in balance.

Eq. (vii) and (viii) state the same for imports and exports. This reflects the competitive assumption that consumers and trade agents purchase at the lowest price from producers.

We show now that conditions (iii), (iv), (v), (vi) correspond to the necessary conditions for profit maximization by producers. In fact profit maximization by producers corresponds to the following problems:

$$\underset{y_i}{\text{Max}}\ y_i\ [\pi_i - \sum_{\substack{j=1 \\ i \neq j}}^{9} a_{ij}\ \pi_j] - \int_0^{y_i} Q_i(y_i)\, dy_i \qquad (16)$$

$$s.t.\quad 0 \leq y_i \leq K_i \qquad i = 1, \ldots, 9 \qquad (17)$$

Necessary conditions for problem (16)-(17) are:

$$\pi_i - \sum_{\substack{j=1 \\ i \neq j}}^{9} a_{ij}\ \pi_j - Q_i(y_i) - \mu_i \leq 0 \qquad i = 1, \ldots, 9 \qquad \text{(i')}$$

$$y_i \left[\pi_i - \sum_{\substack{j=1 \\ i \neq j}} a_{ij}\ \pi_j - Q_i(y_i) - \mu_i \right] = 0 \qquad i = 1, \ldots, 9 \qquad \text{(ii')}$$

$$y_i \geq 0 \qquad i = 1, \ldots, 9 \qquad \text{(iii')}$$

$$K_i - y_i \geq 0 \qquad i = 1, \ldots, 9 \qquad \text{(iv')}$$

$$\mu_i\ [K_i - y_i] = 0 \qquad i = 1, \ldots, 9 \qquad \text{(v')}$$

$$\mu_i \geq 0 \qquad i = 1, \ldots, 9 \qquad \text{(vi')}$$

Those are exactly the same as conditions (i), (ii), (iv), (v), (vi) of problem (12)–(15).

We have therefore shown that an optimal solution to problem (12)-) is an equilibrium solution of our model of production, consumption and foreign trade of forest products.

5. SOME COMPARATIVE STATICS EXERCISES WITH THE MODEL

In this section we simulate shifts in demand, supply, import and export functions and calculate the new equilibrium solutions produced by the model.

The quantitative results must not be taken as such but rather used to evaluate the capability of the model of producing solutions consistent with economic theory. In any case we have tried to elaborate scenarios that are not simply theoretical exercises, being related to specific features of the Italian forest sector. Again we recall that, in these exercises, consumption is in fact net consumption, that is the amount of a product demanded outside the forest sector.

5.1 Increased Domestic Supply of Pulpwood

The scarcity of domestic wood resources is a major problem for the Italian forest industries. A proposal often brought up is that of supporting a national program aimed at developing the industrial cultivation of poplar and other fast growing wood resources (such as copse wood), mainly for the pulp and panel industries.

Here we simulate a downward shift in the pulpwood domestic supply curve, such that producers are willing to supply 30% more pulpwood with respect to the 1980 quantity for the same price.

In Table 9 we report the percentage changes in the equilibrium solutions (omitting variables whose change is negligible with respect to 1980 values).

There is obviously an import substitution effect as far as pulpwood is concerned. Pulp production increases slightly whereas panel production, contrary to expectations, is not affected at all. The model therefore suggests that, as far as the panel industry is concerned, a greater availability of domestic wood resources wouldn't be a key factor in improving competitiveness. But this might simply be a result caused by the very high level of aggregation of what we here call panels, whereas it might still be an important factor if we consider more specific products (particleboards for instance).

TABLE 9. Increased pulpwood supply.

Pulpwood production	21.1%
Pulpwood imports	-9.3%
Pulpwood price	-7.2%
Pulp production	3.6%

5.2 Substitution of Panels for Sawnwood in the Building Industry

Sawnwood and panels are both important inputs of the construction industry. It is noteworthy though, that the use of wood based panels is lower in the Italian construction industry compared with other developed countries.

We have therefore imagined a scenario in which a strong substitution process of panels for sawnwood takes place. To do that we left the total amount of sawnwood and panel consumption at the 1980 level, but we shifted their demand curves in such a way that the share of panel increases from 15% to 25% of the total (panel + sawnwood) consumption.

Table 10 shows the results of this change on the forest sector as a whole.

We note that a relatively small change in the composition of final demand between panels and sawnwood has remarkable effects on the whole system. The effect is particularly strong on panel production that reaches the upper bound constraint given by production capacity in 1980. Imports of panels increase as well to satisfy the higher domestic demand, obviously less when the production capacity constraint is released.

The consequences for sawnwood are, not surprisingly, the opposite. Changes in equilibrium values are not limited to panel and sawnwood, but involve raw wood as well. It is noteworthy that the substitution process of panels for sawnwood leads to higher pulpwood production, imports and prices, whereas production, imports and price of logs decrease sensibly.

TABLE 10. Substitution process of panels for sawnwood.

	With capacity constraint	Without capacity constraint
Panel consumption	87.9%	98.6%
Panel production	24.3%	32.4%
Panel imports	32.7%	22.1%
Panel exports	-24.6%	-18.1%
Panel price	36.9%	24.8%
Sawnwood consumption	-14.8%	-15.0%
Sawnwood production	-19.7%	-21.5%
Sawnwood imports	-9.6%	-9.1%
Sawnwood exports	10.6%	10.0%
Sawnwood price	-8.8%	-8.3%
Pulpwood production	12.1%	14.8%
Pulpwood imports	17.6%	21.8%
Pulpwood price	13.3%	16.4%
Logs production	-6.6%	-6.0%
Logs import	-9.3%	-8.5%
Logs price	-7.2%	-6.6%

5.3 A Decrease in Transportation Costs

High transportation costs are a key problem for the Italian forest sector. The low efficiency of the Italian port and transportation system is, at least partially, responsible for the decreasing competitiveness of many forest industries.

Here we simulate the effects of a policy able to reduce transportation costs (and therefore import prices) of pulpwood, logs and sawnwood as much as 30%. This is carried out shifting downward the import function of these three products.

Table 11 shows the results of the change on the forest sector.

It is interesting to note here that while the domestic production of pulpwood and logs is reduced, the domestic production of sawnwood benefits from a decrease in transportation costs of sawnwood and logs. This is because there are two effects:

(i) a tendency towards a decrease in domestic production of sawnwood, because of the loss of competitiveness due to the lower price of sawnwood imports.

(ii) a gain in competitiveness due to the lower price of log imports, and therefore lower input costs.

Our model shows that this second effect is predominant, and therefore that domestic production of sawnwood increases.

It is interesting to note also that the only other industries benefiting from lower wood costs are the panel and pulp industries. The remaining industries are unaffected by this change in transportation costs.

TABLE 11. Decreased transportation costs.

Pulpwood production	-22.3%
Pulpwood imports	10.8%
Pulpwood price	-24.2%
Logs production	-18.9%
Logs import	17.8%
Logs price	-20.1%
Sawnwood consumption	14.4%
Sawnwood production	6.8%
Sawnwood imports	15.6%
Sawnwood price	-20.1%
Pulp production	11.1%
Panel consumption	2.5%
Panel production	2.8%
Panel imports	-3.6%
Panel exports	3.8%
Panel price	-4.1%

5.4 A Shift in the Furniture Demand Curve

The furniture industry had a rapid growth during the 1970s in Italy thanks to a strikingly high rate of growth of domestic demand and exports. An interesting question is: what are the effects of different rate of growth of domestic demand of furniture on the forest sector as a whole? Here we carry out a shift in the demand function such that at the same price of 1980, consumption is increased by 28% (corresponding to a shift of 5% a year for 5 years).

From Table 12 we see that the main influences are, besides furniture itself, on the panel industry which is closely interrelated with furniture production.

Panel consumption (outside the forest sector) obviously decreases to make up for the increased demand by the furniture industry. Import, domestic production and prices rise as a response to the higher production level of the furniture industry.

Through panels the effect of the increased demand for furniture reaches pulpwood. The consequences on sawnwood and logs are much less important, confirming the relevance of the substitution of panels for sawnwood that has taken place during the 1970s.

TABLE 12. An upward shift in the furniture demand function.

Furniture consumption	17.8%
Furniture production	14.4%
Furniture imports	6.9%
Furniture exports	−6.5%
Furniture price	14.2%
Panels consumption	−3.4%
Panels production	7.3%
Panel imports	5.4%
Panel exports	−4.9%
Panel price	6.0%
Sawnwood consumption	−
Sawnwood production	−
Sawnwood imports	1.6%
Sawnwood exports	−1.4%
Sawnwood price	1.5%
Pulpwood production	2.2%
Pulpwood imports	3.1%
Pulpwood price	2.4%
Logs production	1.4%
Logs imports	2.0%
Log price	1.5%

5.5 An Upward Shift of the Demand Functions for Paper Products

The same shift in the demand function for furniture has been applied to the demand functions for paper products: newsprint, printing and writing paper, packaging paper. In Table 13 we summarize the results. Since newsprint production reaches the upper bound given by the capacity constraint, we also give the values obtained releasing this constraint (they are not much different as it appears from Table 13 because the additional production capacity required to satisfy the increase in demand is very small).

We can see that there are strong effects on pulp and pulpwood imports, but also on pulp and pulpwood production.

The total value of imports of pulp and pulpwood increases by 27.6% and that of paper products consumption (newsprint, packaging and printing paper) rises by 34.9%, thus the elasticity of wood input imports with respect to domestic consumption of paper products is 0.8. These values give an idea of how much an increase in paper product consumption can worsen the national balance of trade.

TABLE 13. Upward shift in the demand functions for paper products.

	With capacity constraint	Without capacity constraint
Newsprint consumption	16.2%	16.9%
Newsprint production	15.2%	16.1%
Newsprint import	15.2%	14.3%
Newsprint export	−13.2%	−12.5%
Newsprint price	17.1%	16.0%
Printing paper consumption	17.9%	no change
Printing paper production	13.4%	no change
Printing paper import	9.7%	no change
Printing paper export	−8.9%	no change
Printing paper price	14.2%	no change
Packaging paper consumption	17.1%	no change
Packing paper production	14.4%	no change
Packaging paper import	13.8%	no change
Packaging paper export	−12.2%	no change
Packaging paper price	15.5%	no change
Pulpwood production	10.4%	9.7%
Pulpwood import	15.2%	14.1%
Pulpwood price	11.5%	no change
Pulp production	12.0%	no change
Pulp import	13.7%	no change
Pulp price	12.4%	no change

5.6 Increased Import Prices of Wood

In this scenario we simulate an upward shift of the import function of pulpwood, logs and sawnwood. Import prices are increased by 30%, whereas the imported quantity is the same as in 1980.

Table 14 shows the results of this exercise.

We can see that the wood price increase affects all the products, confirming the relevance of wood imports prices for the whole system. The higher import prices for pulpwood, sawnwood and logs reduce their imported quantities, while imports of final products and pulp increase. It is noteworthy that pulpwood and log production increase because of the higher competitiveness of domestic products, whereas sawnwood production decreases. This might be explained by the fact that, for the sawnwood industry, the higher price competitiveness is more than compensated for by the higher wood input costs (logs mainly imported).

TABLE 14. Increased import prices of wood.

Pulpwood production	19.9%	Newsprint consumption	2.5%
Pulpwood import	−7.8%	Newsprint production	1.9%
Pulpwood price	22.1%	Newsprint import	4.0%
Log production	16.1%	Newsprint export	−3.8%
Log import	−12.0%	Newsprint price	4.4%
Log price	17.8%	Printing paper consumption	3.3%
Sawnwood consumption	−9.1%	Printing paper production	2.4%
Sawnwood production	−1.9%	Printing paper import	2.0%
Sawnwood import	−10.6%	Printing paper export	−1.9%
Sawnwood export	−16.1%	Printing paper price	2.8%
Sawnwood price	17.4%	Packaging paper consumption	3.1%
Pulp production	−7.0%	Packaging paper production	2.3%
Pulp import	2.6%	Packaging paper import	3.0%
Pulp price	2.4%	Packaging paper export	−2.9%
Panel consumption	−2.4%	Packaging paper price	3.3%
Panel production	−1.6%	Furniture consumption	3.4%
Panel import	3.9%	Furniture production	0.9%
Panel export	−3.6%	Furniture import	1.0%
Panel price	3.0%	Furniture export	−1.0%
		Furniture price	0.5%

6. SOME FINAL REMARKS

The model we set up probably oversimplifies the real economics of the forest sector, but it has the advantage of being workable. It can be improved in many ways:

(i) considering more products (e.g. recycled paper, plywood, particleboards, etc);

(ii) modeling changes in production capacity introducing an investment function;

(iii) considering more carefully the problem of transportation costs;

(iv) paying more attention to elasticities and technical coefficients estimates.

We believe that with an effort in this direction the model can be used as a very helpful tool to evaluate policies and trends in the Italian forest sector.

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