WORKING PAPER

DEMAND FUNCTIONS FOR FOREST PRODUCTS

Sören Wibe

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WP-84-103

IIASA
International Institute
for Applied Systems Analysis

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INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
2361 Laxenburg, Austria

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 forest 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 in wood products. Such issues include the growth of the global economy and population, development of new wood products and of substitute for wood products, future supply of roundwood and alternative fiber sources, development of new technologies for forestry and industry, pollution regulations, cost competitiveness, tariffs and non-tariff trade barriers, etc. The aim of the Project is to analyze the consequence 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.

This article studies the long-term demand of forest products for the groups of products dealt with in the Project. The purpose of this work is to provide demand functions for our preliminary scenarios for most of the non-socialist countries or regions in our global model. For this purpose, a simple form of demand function is chosen where consumption is predicted by income per capita and population in the region, by the price of the forest product, and by a time trend which accounts for other factors such as technological change. The Project wishes to express sincere gratidude to Sören Wibe for this work which was tailored for our purposes and carried out almost exclusively in Sweden.

Markku Kallio
Leader
Forest Sector Project

CONTENTS

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Sören Wibe

1. INTRODUCTION

The global trade model (Dykstra and Kallio, 1984) which has been developed by the Forest Sector Project at IIASA deals with long-term forecasts of trade in forest products. Input to this model comprises, among other things, demand functions which relate the consumption of forest products to strategic variables such as price and income. The purpose of this paper is to provide estimates of such functions; those presented here can be used to forecast demand directly, but they can also be regarded as a starting point for deeper investigation into demand relations for forest products.

The paper focuses on the empirical values of income and price elasticities of demand, and on the substitution to or from forest products. In addition, the paper analyzes whether there are any systematic variations in the values of the elasticities between countries at different levels of per capita income.

2. THE MODEL

According to demand theory, the individual consumption of a product is determined by

(1) The price of the product.

(2) The prices of substitutes and complements.

(3) The income level.

(4) The preference pattern.

A simple model which takes into account of all these factors can formally be written:

$$CONSCAP = f(INCCAP, PRICE, TIME) \quad (1)$$

with

CONSCAP = consumption per capita

INCCAP = income per capita

TIME = yearly index

The time index is supposed to include the effects of (i) the change in trend of preference patterns, and (ii) the change in trend in the product price relative to the price of substitutes and complements. If, for instance, the prices of substitutes decreases (relative to the product price), this should lead to a decrease in demand over time and, hence, to a negative estimate of $\partial f / \partial TIME$.

Model (1) was chosen because, although very simple, it includes all the important effects. One objection to the model is that it is suitable only for ***consumer goods***, while most forest products are used as intermediates. The demand for intermediates can be derived from production functions and does not include income as an argument [as (1)). However, every production activity is in one way or other linked to consumption and model (1) can therefore be regarded as the ***reduced form*** of a system of demand functions. Certainly, income in a country may increase while the output of a specific industry remains unchanged, so there need not be any links between income and the consumption of intermediates in an industry. However, this can be judged only by statistical estimate. If we detect a strong correlation between income and the consumption of a product, then this allows us to talk of an "income-effect," regardless of whether this effect is direct (through consumption) or indirect (through intermediates). The whole question of consumer goods or intermediates then becomes a question of the detail of the explanatory variables.

Another objection to model (1) is the lack of a supply side. Quantities and prices are simultaneously, established on markets where both a supply curve and a demand curve interact. Theoretically, both curves should be estimated simultaneously but this is very seldom done* due to statistical identification problems.

Estimating only a demand function [like (1)] from equilibrium data on quantities and prices certainly creates some bias in the estimated parameter values. The important issue in empirical analysis is, however, not the ***existence*** of a bias, but the ***magnitude*** of it. In our case, we have strong reasons to believe that the bias is very small and that we are estimating a "true" demand curve. The prices that we use differ radically between countries due to, among other things, transport costs, custom duties, and nonequilibrium exchange rates. This implies that each country's supply curve is located at different levels. The distances between these levels are also greater than any possible supply effect on price because of the high long-run elasticity of supply. Should price increase by, say, 10% in a country, it would probably attract many sellers, at least in the longer run, since a price 10% above normal usually means at least a doubling of unit profits (*ceteris paribus*). These considerations lend us to assume that the long run supply curve is nearly horizontal and that the market at two different points of time and for two countries can be illustrated by Figure 1.

Owing to (i) high elasticity of supply and (ii) large difference in price between countries, data tend to be located on different parts of the demand function. Market equilibrium values can thus be used to produce a fairly safe

* To the authors knowledge there does not exist a simultaneous estimation of supply and demand applied to the forest sector. The author is, however, working on such a model for the OECD area.

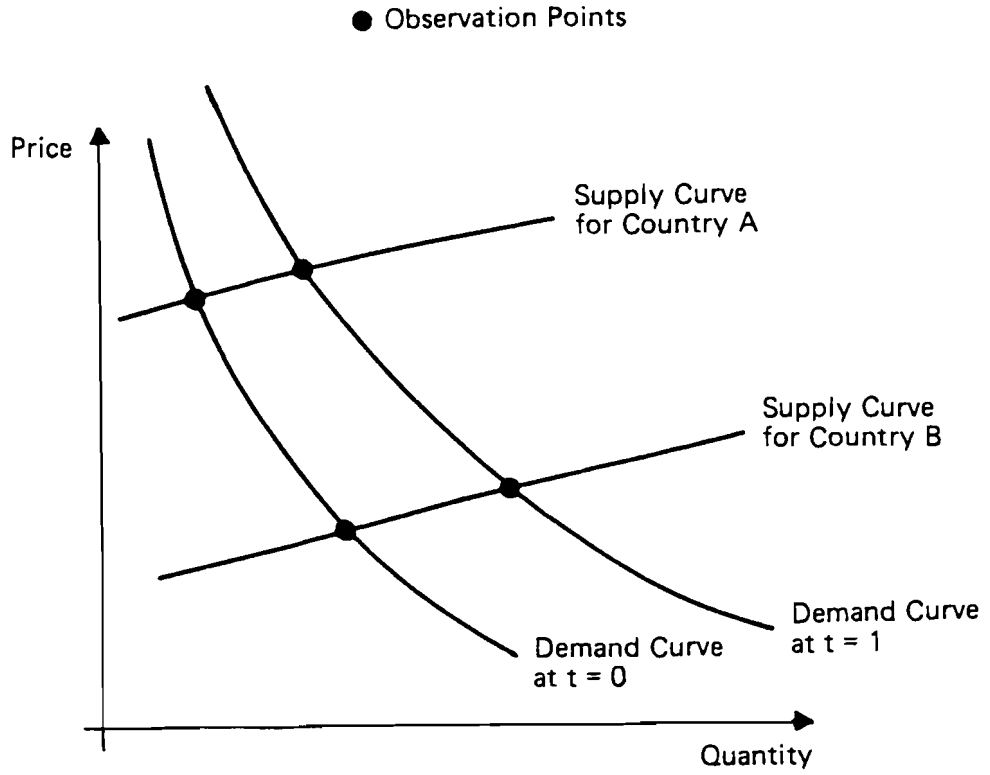

FIGURE 1. Illustration to text.

estimate of the demand relation.

The question of the form of model (1) was decided by the rule "the simplest possible." The form chosen was the log additive:

$$CONSCAP = Ae^{\alpha_1 TIME} (INCCAP)^{\alpha_2} (PRICE)^{\alpha_3} \quad (2)$$

where α_1 is the yearly rate of substitution, α_2 is the elasticity of income, and α_3 is the elasticity of price (A is a constant).

3. THE DATA BASE

The product classification for the trade model at IIASA is presented by Dykstra and Kallio (1984). Their extended model contains 13 different kinds of products, but the consumption of five (coniferous logs, nonconiferous logs, pulpwood, pulp, and recycled paper) are directly linked to the consumption of the rest. Thus, the model needs demand functions only for the following eight product groups:

Product Category	Abbreviation
Fuelwood	*F WOOD*
Coniferous sawnwood	*SAWN C*
Nonconiferous sawnwood	*SAWN NC*
Panels	*PAN*
Newsprint	*NEWPR*
Other printing and writing papers	*OTHER*
Household and sanitary papers	*HOUSE*
Packaging paper and boards	*PACK*

The time period chosen was 1970–1979 and about 80 of the most important paper consuming countries in the world were included. (A notable exception is China, which was excluded due to the lack of adequate data on national income.) For each country, year, and product category, data on production volume, import and export volumes and values were collected, all were taken from the FAO Yearbook of Forest Products 1979. Data on GNP (in 1975 US$) and population were taken from the UN Statistical Yearbook. Further information on the latter sources can be found in the Appendix. The arguments of the model were constructed in the following way:

$$CONSUMPTION = PRODUCTION - EXPORT + IMPORT \quad (\textit{All volumes})$$

This is "apparent consumption" since changes in inventories are included in *CONSUMPTION*. Furthermore we defined

$$CONSCAP = CONSUMPTION / POPULATION$$

$$INCCAP = GDP / POPULATION$$

$$PRICE = IMPORT\ VALUE / IMPORT\ VOLUME$$

$$TIME = YEAR - 1970$$

The only controversial definition is the price index. We have chosen an import-based price since the price of imports seems to be closest to the wholesale price in the countries. Åberg (1968) has also suggested the use of this price measure since imports are CIF and exports are FOB. However, Buongiorno (1978) has argued that unit values of imports might be misleading for countries which import little or nothing. Instead, he suggests the unit value of imports (CIF) for net importers and the unit value of exports (FOB) for net exporters. This hypothesis was supported by the strong correlation between unit prices and wholesales domestic price in France, Germany, Italy, Norway, and the US in 1963–1973. However, the correlation shown by Buongiorno relates to price movements in a country over time and contains no reference to the differences *between* countries. The latter differences are more important in cross-sectional studies and we think that they are better reflected by the unit import values. Awaiting further research in this area, we use here the import-based price measure.*

* Our choice of a price based on imports only is also a question of consistency. Export prices are systematically lower than import prices. Thus using import prices for some countries and export prices for others leads to a biased estimate.

The important values of the FAO Yearbook are given in nominal US dollars. A real price can thus be obtained if import values are divided by the GNP deflator for US for the period. For this study we estimated the demand relations using both the real and the nominal prices. As expected, the results were quite similar.*

4. ORGANIZATION OF THE DATA

The most important question when using a cross-section, time-series database is how to organize the data. Functions could be estimated using yearly cross-sectional data, country specific time-series data, or pooled cross-section time-series data. Since we are interested in the *TIME* trend, we did not consider the pure cross-section alternative. The choice between the remaining two was made with reference to the purpose of the study. As pointed out in the introduction, the purpose was to provide basic information for long-term forecasts of demand. The question was then which method would serve this purpose best. To analyze this, we conducted a special investigation on newsprint consumption in three countries (Sweden, UK, and US) for the period 1949–1979. (Data and data sources are presented in the Appendix.) Regressions were made for each country and for different periods on the equation:**

$$CONSCAP = A(INCCAP)^{\alpha} \tag{3}$$

which was put in a log-linear form. The estimates of α for different periods and countries are displayed in Table 1.

It is quite obvious, judging from the results in Table 1, that an estimate of the income elasticity for one decade is *not* a good predictor of the long-term value. The decade value varies heavily and could accordingly, if they were the basis for a forecast, lead to serious misjudgements. The addition of a *TIME* and a *PRICE* index may, of course, alter the results, but judging from the material we have, we concluded that country-specific demand functions based on time-series data for a 10-year period are not very reliable for long-term forecasts.

TABLE 1. Income elasticities for newsprint in Sweden, UK, and US for different periods, 1949–1979.

	Period			
Country	1949–1959	1960–1969	1970–1979	1949–1979
Sweden	1.17	1.41	–0.49	0.66
UK	4.31	0.33	–0.58	1.03
US	0.61	0.76	0.08	0.51

* If the rate of US inflation was (roughly) constant during the period, a transition from nominal to real price only changes the estimations of the "time-component" and not the impacts from price and income. See Appendix.

** Unfortunately, we did not have access to a *PRICE* measure for the whole period, so we worked only with the income as explanatory variable.

When pooling all the data, we obtained an income elasticity of 0.63. This is, of course, not wholly in accordance with actual development (e.g., for UK), but the result seemed more reliable than the pure time series. Accordingly, we chose the combined cross-section, time-series approach for our estimations.*

Essentially, the combined cross-section, time-series approach means that we regard the differences ***between*** countries as more fundamental than the differences ***within*** the countries over time, likely to be a realistic assumption. Probably, the huge difference in *INCCAP* between countries is the most decisive variable for explaining differences in, for example, paper consumption. Also, the big differences in prices exist ***between*** countries and the cross-section approach should, accordingly, lead to the best estimates of the price elasticities.

The approach taken here was to estimate ***one*** function (1) using the whole data base. However, by grouping countries, we were able to analyze whether income elasticities, price elasticities, and substitution rates varied systematically between groups of countries. This grouping was made on the basis of *INCCAP* only, since the natural assumption was that *INCCAP* was the vital factor determining similarities in consumption patterns between countries. The following grouping was made:

Estimation No. 1:	No grouping
Estimation No. 2:	< 300 1975 US$ *INCCAP* 300–600 1975 US$ *INCCAP* 600–1000 1975 US$ *INCCAP* 1000–2500 1975 US$ *INCCAP* 2500–5000 1975 US$ *INCCAP* > 5000
Estimation No.3:	< 600 1975 US$ *INCCAP* 600–2500 1975 US$ *INCCAP* > 2500 1975 US$ *INCCAP*

The grouping was accomplished with dummy variables, and the final equation had the (linear) form:

$$\ln(CONSCAP) = \ln A + \alpha_1 \ln(INCCAP) + \alpha_2 \ln(PRICE) + \alpha_3 TIME + \sum_j \beta_j^1 D_j \ln(INCCAP) + \sum_i \beta_i^2 D_i \ln(PRICE) + \sum_k \beta_k^3 D_k TIME \quad (4)$$

where $D_j = D_i = D_k$ (if $j = i = k$) are the dummy variables, taking the value 1 if the observation belongs to that group, and ***zero*** if it does not. For the first run, $j = k = i = 0$; i.e., no dummies are needed. For the second case, $j = i = k = 5$; and for the third case, $j = i = k = 2$. α_1 is the estimate of the income elasticity for the reference group, $\alpha_1 + \beta_1^1$ the income elasticity for group No. 1, etc. The reference group was the group with the highest *INCCAP* (see Appendix).

* When we repeated this analysis for *PULP* consumption, 1949–1979, the combined approach did not work as well (see Appendix).

5. RESULTS

Owing to space considerations, all the estimation results cannot be reprinted in this paper. All important results can be found in the Appendix, and a copy of the full computer printout can be obtained from the author. Our results indicate, however, that there were not that much variation with respect to income groups, and the more detailed grouping (6 groups) resulted in totally insignificant estimates. Consequently, we present here results from the "no grouping" and the "3 grouping" cases only.

5.1 The Elasticity of Income

The level of income was, as would be expected, the most important determinant of consumption. Table 2 shows the results obtained from the "no grouping" case (from estimations with real price).

The statistical significance, measured by the *t*-ratios, is very high, indicating that the estimates are significantly different from zero. We observe that the elasticity is negative for *F WOOD*. This result seems realistic since it is probable that less and less wood is used as fuel as the national income increases. We observe also that every positive elasticity is greater than one except for *SAWN NC*. However, the results for *SAWN NC* should be used with cautions. Since *NC* woods are consumed mostly in the southern hemisphere and in countries with low *INCCAP*, we would naturally obtain a low income elasticity in cross-sectional studies. The elasticity may be higher if countries with large amounts of *NC* forests only were considered.

The variation with respect to income can be obtained from Table 3. Here, we have accepted only those estimates with a *t*-ratio higher than 2.0 (*t*-ratios are given in the Appendix.)

TABLE 2. Income elasticity of demand for eight types of forest products.

Product group	Estimated income elasticity	*t*-ratio
F WOOD	−0.18	(2.0)
SAWN C	1.57	(27.3)
SAWN NC	0.88	(23.0)
PAN	1.37	(54.5)
NEWPR	1.23	(38.5)
OTHER	1.24	(44.4)
HOUSE	1.57	(27.9)
PACK	1.24	(33.5)

TABLE 3. The income elasticity for different income groups.

Product group	*INCCAP* 1975 US$			Elasticity in the "no grouping" case (Table 2)
	0–600	600–2500	2500–	
F WOOD	0*	1.29	0*	–0.18
SAWN C	1.20	1.92	1.57	1.57
SAWN NC	0.98	0.74	0.74	0.88
PAN	1.46	1.46	1.46	1.37
NEWPR	1.36	1.37	0.88	1.23
OTHER	1.34	1.45	1.34	1.24
HOUSE	0.86	1.08	1.22	1.57
PACK	1.12	1.36	1.12	1.24

* *t*-ratio below 2.

It seems obvious, judging from Table 3, that there is little or no variation in the elasticity of income between different income levels. However, for the differences that exist we have a clear and interesting pattern: the elasticity is highest for the middle group (except for *HOUSE*) with *INCCAP* between 600 and 2500 US$. This means that the log of consumption is related to the log of income by some sort of *logistic* relation. However, the significance of this result should not be overestimated; the general impression of Table 3 is that the differences in income elasticities are small.

5.2 The Price Elasticity

The estimates of the price elasticity in the "no grouping" case are displayed in Table 4.

TABLE 4. The price elasticity of demand.

Product group	Estimated price elasticity	*t*-ratio
F WOOD	–0.71	(–5.3)
SAWN C	–0.72	(–5.2)
SAWN NC	–0.90	(–9.7)
PAN	–0.37	(–6.4)
NEWPR	–1.15	(–9.0)
OTHER	–0.78	(–9.3)
HOUSE	–0.28	(–2.5)
PACK	–0.88	(–8.4)

All values have the same sign, and the estimates are all significant to a high level of confidence. The magnitude of the elasticities seems reasonable although somewhat higher than other estimates (Buongiorno 1978). The relatively high values can be explained by our choice of time period. The present study is the first to use data only from the 1970s, and it is quite possible that the price elasticity is higher now than in the 1960s due to increased competition from different substitutes. It is, for instance, quite possible that the high price elasticity for *NEWPR* is due to increased competition from electronic-based news media.

The differences with regard to *INCCAP* can be obtained from Table 5. Again we only accept estimates with a t-ratio higher than 2.0.

Table 5 reveals some interesting features. First of all, we note that the price elasticity is (close to) zero for three product groups in the highest income levels; *SAWN C*, *PAN*, and *HOUSE*. On the other hand we find a great sensitivity to prices in this income class for *NEWPR*, *PACK*, and *F WOOD*. Thus, we do not have the same pattern as for the elasticity of income. From Table 5 we draw the conclusion that the elasticity of price can both increase and decrease with income depending on the kind of product. Probably two factors are working:

(1) A "luxury effect" which makes people insensitive to price changes (this is probably the case for *HOUSE*).

(2) A "substitution effect" where the increased importance of substitutes increases the sensitivity to prices (this probably is the case for *NEWPR*).

TABLE 5. The price elasticity for different income groups.

Product group	*INCCAP* 1975 US$ 0–600	600–2500	2500–	Elasticity in the "no grouping" case (Table 4)
F WOOD	0*	−1.39	−1.39	−0.71
SAWN C	−1.46	0*	0*	−0.72
SAWN NC	−0.48	−1.19	−1.19	−0.90
PAN	−0.48	−0.36	0*	−0.37
NEWPR	−0.58	(0.67)	−2.65	−1.15
OTHER	−1.14	−0.42	−0.42	−0.78
HOUSE	−0.72	−0.23	0*	−0.28
PACK	−1.29	−0.32	−1.29	−0.88

* low t-ratio.

5.3 Rate of Substitution

The rates of substitution to or from forest products are measured by the *TIME* effect. The estimates here were all very close to zero with low t-ratios, suggesting that the pure substitution effect is small. Despite low t-ratios we have reprinted the "no grouping" results in Table 6 in order to show the general character of the estimates.

Accepting a t-ratio > 2 as a criterion, we are left with a (negative) rate of substitution only for *SAWN C*. However it should be noted that all values except for that category (and *OTHER*, which is practically zero) are positive. This suggests that there is a small increase in demand for forest products at constant price and income levels. At least, Table 6 tells us that there is no general drift *away* from forest products in present consumption patterns.

TABLE 6. Rate of substitution (% per year) as estimated for the "no grouping" case.

Product group	Rate of substitution	t-ratio
F WOOD	1.2	(0.4)
SAWN C	−5.8	(−2.4)
SAWN NC	0.5	(0.3)
PAN	1.8	(1.7)
NEWPR	2.2	(1.5)
OTHER	−0.08	(−0.1)
HOUSE	4.0	(1.7)
PACK	2.7	(1.6)

6. SUMMARY

This paper has analyzes the demand for forest products in a long-term perspective. The most important empirical results can be summarized briefly as follows:

- ***Per capita income*** is the most important variable that determines consumption per capita. The elasticity of income is generally above 1 and centers around 1.3 for paper products, and is highest for medium income countries [between 600 and 2500 US$ (1975) per capita] but the differences in this respect are, on the whole, very small.
- ***Real price*** is, next to income, the most strategic variable for demand. The price elasticity centers around −0.7, but notable exceptions are *NEWPR* (−1.15), *PAN* (−0.37) and *HOUSE* (−0.28). The elasticities determined in this study are slightly higher (in absolute terms) than those of similar studies probably due to the selection of time period. Essentially, our higher price elasticities indicate that competition from close substitutes has increased during the 1970s.

  Furthermore, our result indicate that price sensitivity can both increase or decrease with income level depending on the type of product. For example, the elasticity of price increases (with income) for *NEWPR*, but decreases for *PAN* and *HOUSE*.
- ***The rate of substitution*** is generally insignificantly different from zero. However, the sign is usually positive, indicating a substitution to forest products at constant price and income. The magnitude is of the order of 1−3% per year.

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APPENDIX

A1. THE DATA BASE

A1.1. National income data

The national income data are displayed in Table A1. Each row contains 11 variables. The first is the country code (see below). The second figure is GNP per capita for 1970 (in 1975 US$); the third refers to 1971, etc., up to 1979. If the figure equals zero we have no information and the observation was deleted from the estimations.

Sources:

- The main is the *UN Statistical Yearbook 1981*. From Table 33 we obtained GNP per capita for 1975 (Tables 49, 19, 26 for Hungary, Bulgaria, Poland, and USSR).
- Real growth of GNP per capita 1971–1979 was obtained from Table 25 and for 1970–1971 from *UN Statistical Yearbook 1978*.
- GNP index for countries 020 (1979), 028 (1979), 040 (1979), 220 (1978–1979), 250 (1978–1979), 168 (1977–1979), and 131 (1978–1979), were calculated from *International Marketing Data and Statistics 1982*.
- GNP index for countries 062 (1977–79), 091 (1977–79), 102 (1978–79), 124 (1976), and 143 (1978–79), were calculated from publications of the Swedish Export Board.

The country codes are given in Table A2.

TABLE A1. National income data.

251 514 504 529 504 524 494 499 459 454 405
117 408 443 455 513 548 583 653 705 775 816
184 127 129 121 122 120 130 138 142 151 0
174 1311 1405 1530 1702 1686 1561 1623 0 0 0
168 451 456 487 553 537 507 522 512 527 537
159 427 465 475 486 529 534 561 593 0 0
157 661 668 668 683 741 734 741 763 683 0
143 452 462 477 477 488 519 566 581 602 628
137 0 0 0 0 0 729 729 780 795 816
136 359 0 346 287 315 312 324 309 299 0
131 539 0 687 750 789 781 843 890 929 984
252 5872 6000 6319 6894 7021 6383 6574 6702 6957 0
124 2417 0 4151 4887 5833 5255 6253 6516 6359 6937
123 409 413 421 424 421 393 397 389 389 0
118 15824 0 15824 14635 12969 11898 12612 12374 12017 12493
112 541 0 541 491 473 455 501 0 0 0
109 1250 1250 1420 1420 1463 1420 1306 1235 0 0
107 0 0 0 0 0 576 622 628 657 0
103 944 968 907 1067 1079 1226 0 0 0 0
102 1120 1183 1404 1514 1577 1577 1735 1656 1325 1293
250 173 180 176 186 192 168 153 146 133 129
032 383 391 387 395 407 407 419 0 0 0
078 6254 6390 6594 6866 6934 6798 7206 7410 7682 8022
081 535 563 521 530 544 465 428 428 0 0
226 260 258 251 242 235 222 215 213 198 0
223 704 757 784 793 837 891 944 962 971 0
220 2165 2238 2263 2311 2287 2433 2603 2798 2944 3139
219 0 0 0 0 0 316 370 398 417 392
217 276 0 292 273 276 268 260 268 287 0
209 403 0 467 410 601 707 742 0 0 0
197 239 232 232 234 236 223 221 216 223 0
194 4263 4709 5536 6236 6045 6363 7127 7254 7699 0
084 1863 1978 2139 2277 2185 2300 2415 2461 2622 2691
089 520 531 555 572 590 584 607 637 648 660
091 589 582 569 563 595 647 660 673 679 692
038 249 246 249 255 285 277 285 294 307 377
171 322 329 333 352 359 374 389 408 419 434
191 0 0 0 0 0 352 370 380 433 422
093 134 140 140 144 149 149 158 159 164 167
095 380 387 387 390 376 358 376 394 404 419
096 1450 1450 1595 1813 1813 1813 2139 2321 2502 2665
097 1360 1452 1544 1636 1746 1838 1875 2022 2114 2150
173 1334 1434 1573 1713 1872 1992 2111 2191 2250 2171
228 1523 1599 1637 1771 1828 1904 1980 2075 2152 2171
054 6893 7042 7342 7642 7567 7492 8091 8166 8241 8541
055 0 0 362 380 398 362 387 398 0 0
056 574 613 666 728 751 766 797 812 804 820
058 482 488 482 580 598 610 647 659 677 683
059 283 287 294 319 327 363 385 407 436 457
060 402 411 420 425 442 447 456 474 474 456
062 95 97 99 100 100 97 97 99 101 104

066 982 1030 1078 1186 1198 1198 1174 1222 0 0
067 4939 5057 5410 5704 5880 5880 5880 5880 5998 6409
068 5456 5649 6034 6291 6419 6419 6740 6932 7125 7382
039 158 158 144 134 150 172 165 0 0 0
040 548 577 567 538 558 485 495 529 548 538
044 486 503 525 542 559 565 576 588 622 638
047 1064 1021 979 936 894 851 808 800 0 0
048 850 870 920 970 1000 1000 1020 1090 1120 1150
050 1389 1541 1649 1671 1345 1085 1335 1573 1703 1834
002 0 0 0 180 186 200 202 196 206 194
009 1274 1318 1376 1419 1477 1448 1405 1448 1390 1491
010 6348 6417 6693 6969 6900 6900 7038 6969 7176 7245
011 4216 4417 4668 4868 5119 5019 5320 5521 5621 5872
016 0 0 95 104 103 113 112 118 120 123
015 5454 5711 5968 6289 6545 6417 6738 6802 6994 7187
023 0 0 0 719 764 749 726 734 764 0
019 434 449 460 480 495 505 525 530 530 530
020 303 0 404 468 463 532 532 553 686 803
021 807 912 959 1064 1134 1169 1239 1262 1298 1344
027 1199 1267 1351 1452 1571 1689 1807 1925 2044 2128
028 96 98 98 95 96 96 98 102 106 109
029 114 0 107 112 110 109 117 124 128 129
033 6060 6348 6709 7070 7214 7214 7503 7647 7863 8008
110 3844 3978 4202 4515 4425 4470 4649 4872 5051 5275
106 3165 3199 3302 3474 3612 3440 3612 3681 3750 3922
105 3080 3268 3606 3643 3756 3756 3756 3681 3831 3944
104 2286 2338 2441 2518 2569 2569 2569 2697 2826 2852
101 173 180 194 209 220 225 234 250 261 268
100 141 141 138 140 137 147 147 156 163 151
099 4735 5320 5554 5904 5904 5846 6080 6431 6723 6606
150 5459 5641 5763 6005 6187 6066 6309 6430 6551 6673
149 121 115 119 116 121 120 122 124 124 125
138 1183 1183 1235 1314 1314 1301 1288 1340 1393
134 881 907 986 1026 1131 1315 1539 1723 1867 1999
114 233 238 243 248 248 243 241 255 262 262
229 3767 3809 3933 4223 4181 4140 4306 4347 4513 4554
203 2385 2444 2650 2827 2945 2945 3004 3063 3122 3122
202 1334 1362 1348 1362 1433 1419 1405 1362 1348 1362
200 1730 1905 2131 2332 2432 2507 2657 2833 3058 3284
195 396 385 396 362 366 381 400 392 332 358
177 2816 2930 3074 2988 2944 2873 2959 3045 3189 3160
170 914 934 924 934 984 994 984 954 924 934
169 473 479 502 524 553 570 593 650 701 752
166 1098 1158 1194 1230 1230 1194 1158 1170 1206 1266
165 180 180 182 186 186 190 192 200 203 211
162 5817 6101 6385 6526 6881 7094 7449 7662 8016 8371
222 533 580 680 672 719 773 804 819 858 904
216 292 306 310 334 338 348 369 386 414 428
212 466 496 556 511 624 752 790 744 782 797
211 8387 8726 8811 8980 9065 8472 8472 8641 8641 8896
210 7823 7823 7999 8263 8614 8790 8878 8702 8702 9054
236 2118 2118 2118 2187 2233 2302 2417 2509 2509 2463
234 1184 1159 1134 1171 1210 1260 1310 1323 1399 1512
231 6626 6769 7054 7339 7268 7125 7481 7766 8051 8194
215 154 156 160 159 159 162 167 172 180 183

TABLE A2. Country code.

002 Afghanistan	009 Argentina	010 Australia
011 Austria		
015 Belgium–Luxembourg	016 Bangladesh	019 Bolivia
020 Botswana	021 Brazil	023 Belize
027 Bulgaria	028 Burma	029 Burundi
032 Cameroon	033 Canada	038 Sri Lanka
039 Chad	040 Chile	044 Colombia
047 Cook Islands	048 Costa Rica	050 Cyprus
054 Denmark	055 Dominica	056 Dominican Republic
058 Ecuador	059 Egypt	060 El Salvador
062 Ethiopia		
066 Fiji	067 Finland	068 France
078 Germany (FRG)	081 Ghana	084 Greece
089 Guatemala	090 Guinea	
093 Haiti	095 Honduras	096 Hong Kong
097 Hungary		
099 Iceland	100 India	101 Indonesia
102 Iran	103 Iraq	104 Ireland
105 Israel	106 Italy	107 Ivory Coast
109 Jamaica	112 Jordan	
114 Kenya	117 Korea Rep.	118 Kuwait
123 Liberia		
131 Malaysia	136 Mauritania	137 Mauritius
138 Mexico	143 Morocco	
149 Nepal	150 Netherlands	157 Nicaragua
159 Nigeria	162 Norway	
165 Pakistan	166 Panama	168 Papua New Guinea
169 Paraguay	170 Peru	171 Philippines
173 Poland	174 Portugal	177 Puerto Rico
184 Rwanda		
191 St. Vincent	194 Saudi Arabia	195 Senegal
197 Sierra Leone	200 Singapore	202 South Africa
203 Spain	209 Swaziland	210 Sweden
211 Switzerland	212 Syria	
215 Tanzania	216 Thailand	217 Togo
220 Trinidad and Tobago	222 Tunisia	
225 United Arab Emirates	226 Uganda	228 USSR
229 UK	231 USA	234 Uruguay
236 Venezuela		
250 Zaire	251 Zambia	
252 Luxembourg		

A1.2 Population Data

Population data are presented in Table A3. Each row contains 11 variables, the first is the country code, the second is population for 1970 (in mill.), and the third is population for 1971, etc.

The common *source* for the population data is *UN Demographic Yearbook 1975*, Table 5.

TABLE A3. Population data.

020	0.58	0.58	0.63	0.65	0.66	0.69	0.69	0.71	0.73	0.79
029	3.62	3.69	3.74	3.80	3.86	3.93	4.03	4.14	4.26	4.38
039	3.64	3.72	3.79	3.86	3.95	4.03	4.12	4.21	4.31	4.42
059	33.33	34.08	34.84	35.62	36.42	37.23	37.87	38.74	39.64	40.98
062	24.63	25.25	25.89	26.19	26.78	27.47	28.19	28.98	29.71	30.42
081	8.61	8.86	9.09	9.39	9.61	9.87	10.31	10.63	10.97	11.32
107	5.31	5.58	5.86	6.15	6.43	6.71	6.97	7.23	7.61	7.92
114	11.23	11.67	12.07	12.48	12.91	13.40	13.85	14.34	14.86	15.32
123	1.34	1.38	1.42	1.47	1.52	1.57	1.63	1.68	1.74	1.80
124	1.99	2.10	2.19	2.24	2.33	2.43	2.51	2.63	2.75	2.86
136	1.25	1.28	1.31	1.35	1.38	1.42	1.46	1.50	1.54	1.59
137	0.83	0.85	0.85	0.86	0.87	0.88	0.89	0.91	0.92	0.94
143	15.31	15.38	15.70	16.31	16.80	17.31	17.83	18.36	18.91	19.47
159	56.35	58.07	59.85	61.71	63.65	65.66	67.76	69.94	72.22	74.60
184	3.68	3.79	3.90	4.01	4.12	4.20	4.29	4.37	4.51	4.65
195	4.27	4.41	4.55	4.70	4.84	4.98	5.12	5.25	5.38	5.52
197	2.69	2.76	2.83	2.90	2.97	3.05	3.11	3.21	3.29	3.38
202	22.47	23.02	23.67	24.30	24.92	25.47	26.13	26.94	27.70	28.48
209	0.42	0.44	0.45	0.46	0.48	0.49	0.50	0.51	0.54	0.54
217	1.96	2.01	2.07	2.12	2.17	2.23	2.29	2.35	2.41	2.47
222	5.13	5.23	5.33	5.44	5.64	5.61	5.74	5.88	6.08	6.20
226	9.81	10.13	10.46	10.81	11.17	11.55	11.94	12.35	12.78	13.22
032	6.78	6.92	7.06	7.21	7.37	7.53	7.70	7.91	8.06	8.25
215	13.27	13.63	14.00	14.37	14.76	15.31	16.41	16.92	17.44	17.98
250	21.69	22.30	22.91	23.56	24.22	24.90	25.57	26.31	27.08	27.94
251	4.25	4.39	4.53	4.68	4.83	4.98	5.14	5.30	5.47	5.65
023	0.12	0.12	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.16
033	21.32	21.59	21.82	22.07	22.40	22.73	23.02	23.28	23.50	23.69
048	1.73	1.80	1.84	1.87	1.92	1.97	2.02	2.07	2.13	2.19
055	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08
056	4.06	4.18	4.30	4.43	4.56	4.70	4.84	4.98	5.12	5.28
060	3.53	3.65	3.67	3.77	3.89	4.01	4.12	4.26	4.35	4.66
089	5.27	5.42	5.58	5.74	5.91	6.08	6.26	6.44	6.62	7.05
093	4.24	4.31	4.37	4.44	4.51	4.58	4.67	4.75	4.83	4.92
095	2.64	2.72	2.81	2.90	2.99	3.09	3.20	3.32	3.44	3.56
109	1.87	1.90	1.93	1.97	2.01	2.04	2.07	2.10	2.13	2.16
138	50.69	52.45	54.27	56.16	58.12	60.15	62.33	64.59	66.94	69.38
157	1.83	1.89	1.95	2.01	2.08	2.16	2.23	2.31	2.41	2.64
166	1.43	1.48	1.52	1.57	1.62	1.67	1.72	1.77	1.83	1.88
177	2.72	2.78	2.87	2.95	3.03	3.12	3.21	3.32	3.36	3.41

191 0.09 0.09 0.10 0.10 0.09 0.09 0.09 0.10 0.10 0.10
220 1.03 1.03 1.05 1.06 1.07 1.08 1.10 1.12 1.13 1.13
231 203.81 206.22 208.23 209.86 211.39 213.56 215.15 216.88 218.72 220.58
009 23.75 24.07 24.39 24.72 25.05 25.38 25.72 26.06 26.39 26.73
019 4.93 5.06 5.19 5.33 5.47 5.63 5.79 5.95 5.14 5.43
021 92.52 95.17 97.85 100.56 103.35 106.23 109.18 112.24 115.40 118.65
040 9.37 9.55 9.72 9.90 10.08 10.25 10.45 10.66 10.86 10.92
044 20.53 21.09 21.67 22.34 22.98 23.64 24.33 25.05 25.64 26.36
058 5.96 6.17 6.38 6.60 6.83 7.06 7.31 7.56 7.81 8.15
091 0.71 0.72 0.74 0.76 0.77 0.78 0.79 0.81 0.82 0.87
169 2.30 2.36 2.43 2.50 2.57 2.65 2.72 2.80 2.89 2.97
170 13.45 13.83 14.22 14.63 15.04 15.47 15.91 16.36 16.82 17.29
234 2.89 2.92 2.96 2.99 2.77 2.81 2.83 2.85 2.86 2.88
236 10.28 10.61 10.94 11.28 11.63 11.99 12.36 12.74 13.12 13.52
002 14.87 15.22 15.57 15.92 16.29 16.67 17.05 14.74 15.11 15.49
016 68.12 69.77 72.39 74.37 77.03 78.96 80.82 82.72 84.66 86.64
028 27.03 27.64 28.26 28.89 29.52 30.17 30.83 31.51 32.21 32.91
050 0.60 0.61 0.61 0.62 0.63 0.62 0.61 0.61 0.62 0.62
096 3.96 4.05 4.12 4.21 4.32 4.40 4.44 4.51 4.61 4.90
100 539.08 551.23 563.53 575.89 588.30 600.76 613.27 625.82 638.39 650.98
101 119.47 122.53 125.64 128.80 132.00 135.23 138.49 141.78 145.10 148.47
102 28.66 29.61 30.41 31.23 32.04 32.87 33.66 34.57 36.46 36.94
103 9.44 9.75 10.07 10.41 10.77 11.12 11.51 12.03 12.33 12.77
105 2.97 3.07 3.15 3.28 3.38 3.46 3.53 3.61 3.69 3.78

110 103.40 105.70 107.19 108.71 110.16 111.57 112.77 113.86 114.90 115.87
112 2.30 2.38 2.46 2.54 2.62 2.70 2.78 2.89 2.98 3.09
117 32.24 32.88 33.51 34.10 34.69 35.28 35.86 36.44 37.02 37.60
118 0.74 0.79 0.84 0.89 0.94 1.00 1.06 1.13 1.20 1.27
131 10.39 10.70 11.00 11.31 11.65 11.90 12.30 12.60 12.96 13.30
149 11.42 11.56 11.81 12.06 12.32 12.59 12.86 13.14 13.42 13.71
165 60.61 62.43 64.30 66.23 68.21 70.26 72.37 74.87 76.77 79.84
171 36.85 37.90 38.99 40.12 41.30 42.07 43.75 45.03 46.35 47.72
194 6.20 6.38 6.57 6.76 6.97 7.18 7.40 7.63 7.87 8.11
200 2.07 2.11 2.15 2.19 2.22 2.25 2.28 2.31 2.33 2.36
038 12.52 12.61 12.86 13.09 13.29 13.50 13.72 13.94 14.18 14.74
212 6.26 6.46 6.68 6.89 7.12 7.35 7.60 7.84 8.09 8.33
216 36.37 37.49 38.59 39.69 40.78 41.87 42.96 44.04 45.10 46.14
223 34.85 36.22 37.15 38.09 39.07 40.35 41.09 42.13 43.21 44.31
011 7.43 7.46 7.50 7.53 7.53 7.52 7.51 7.52 7.51 7.51
015 9.66 9.67 9.71 9.74 9.77 9.80 9.82 9.83 9.84 9.85
027 8.49 8.54 8.58 8.62 8.68 8.72 8.76 8.80 8.81 8.95
054 4.93 4.96 4.99 5.02 5.05 5.06 5.07 5.09 5.10 5.12
067 4.61 4.62 4.64 4.67 4.69 4.71 4.73 4.74 4.75 4.76
068 50.77 51.25 51.70 52.13 52.49 52.70 52.89 53.08 53.28 53.48
078 60.71 61.29 61.67 61.97 62.04 61.83 61.51 61.40 61.31 61.34
084 8.79 8.83 8.89 8.93 8.96 9.05 9.17 9.28 9.36 9.44
097 10.34 10.37 10.40 10.43 10.48 10.54 10.60 10.65 10.68 10.70
099 0.20 0.21 0.21 0.21 0.22 0.22 0.22 0.22 0.22 0.23
104 2.94 2.98 3.02 3.07 3.12 3.18 3.23 3.27 3.31 3.36
106 53.66 54.01 54.41 54.91 55.41 55.83 56.17 56.46 56.71 56.91
252 0.34 0.34 0.35 0.35 0.36 0.36 0.36 0.36 0.36 0.36

134 0.33 0.33 0.32 0.32 0.32 0.33 0.33 0.33 0.34 0.35
150 13.03 13.19 13.33 13.44 13.54 13.65 13.77 13.85 13.94 14.03
162 3.88 3.90 3.93 3.96 3.99 4.01 4.03 4.04 4.06 4.07
173 32.53 32.80 33.07 33.36 33.69 34.02 34.36 34.70 35.01 35.23
174 9.04 8.99 8.97 8.98 9.10 9.43 9.66 9.73 9.80 9.87
203 33.78 34.13 34.49 34.86 35.22 35.60 35.97 36.35 36.78 37.18
210 8.04 8.10 8.12 8.14 8.16 8.19 8.22 8.26 8.28 8.29
211 6.19 6.23 6.39 6.43 6.44 6.41 6.35 6.33 6.34 6.33
229 55.42 55.61 55.79 55.91 55.93 55.89 55.89 55.85 55.84 55.88
010 12.51 12.94 13.18 13.38 13.60 13.77 13.92 14.07 14.25 14.42
047 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.02
066 0.52 0.53 0.54 0.55 0.56 0.57 0.58 0.60 0.61 0.61
168 2.49 2.52 2.58 2.56 2.65 2.76 2.83 2.91 2.99 3.08
219 0.09 0.09 0.09 0.09 0.09 0.10 0.09 0.09 0.09 0.10
228 242.76 245.08 247.46 249.75 252.06 254.39 256.67 258.93 261.26 264.11

A1.3 Production and Consumption of Forest Products

Since all data have been reprinted from *FAO Yearbook of Forest Products 1979*, there is no need for another presentation here.

A2. SPECIAL INVESTIGATION 1949–1979

A2.1 The Data Base

Data for the period 1970–1979 was the same as for the large data base. Apparent consumptions of pulp and newsprint were taken from *FAO Yearbook for Forest Products* (different years). Population statistics were obtained from the *UN Statistical Yearbook*. The data used are presented in Table A4.

TABLE A4. Data used for special investigation 1949–1979.

	Year	1948	1953	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
SWEDEN	Newsprint cons.per capita	17.9	16.9	23.5	23.2	24.0	23.5	28.2	26.1	20.13	9.1	23.3	26.6	32.3	33.6	36.6	36.3	39.0
	Pulp cons. per capita	164.1	147.2	219.8	211.4	242.7	233.5	231.4	270.13	28.3	322.0	323.9	373.5	433.1	374.1	412.6	490.3	492.6
	GNP per capita	3725	4272	4669	4818	4918	4968	5167	5415	5714	5884	6108	6536	6720	6782	6966	7211	7517
U.K.	Newsprint cons.per capita	8.22	14.25	17.5	19.5	20.2	20.5	21.42	5.4	24.9	24.4	24.4	26.5	25.3	25.5	24.1	25.7	28.0
	Pulp cons. per capita	20.68	34.50	47.1	46.2	44.8	44.0	48.05	7.4	54.6	51.2	54.7	60.9	59.8	58.9	55.5	61.0	61.3
	GNP per capita	2366	2625	2798	2856	2885	2885	2972	3088	3148	3148	3243	3405	3470	3502	3567	3697	3729
U.S.	Newsprint cons.per capita	32.3	34.1	35.1	37.8	36.8	33.6	36.03	6.6	36.3	36.3	36.0	38.2	39.2	42.6	41.5	41.9	43.7
	Pulp cons. per capita	92.2	110.7	122.2	128.6	122.9	121.4	132.81	33.4	137.1	144.1	151.7	1600.1	167.4	177.7	174.5	192.4	200.7
	GNP per capita	4064	4797	4892	4892	4892	4750	49885	238	5288	5288	5450	5612	5882	6152	6314	6584	6692

These data were used for OLS regressions on newsprint consumption, the results of which are presented in Table 1 in the paper. In addition, a similar test was made for pulp, the results of which are displayed in Table A5.

TABLE A5. Income elasticities for pulp in Sweden, UK, and US for different periods, 1949–1979 (see Table 1).

	Period			
Country	1949–1959	1960–1969	1970–1979	1949–1979
Sweden	1.44	1.64	0.98	1.73
UK	3.76	0.62	-1.34	0.50
US	1.69	1.44	0.78	1.18

The income elasticity with the pooled data base was 2.29.

A3. REGRESSION RESULTS

Adjusted R^2, overall F-value, and number of observations in the different regressions are shown in Table A6. All results refer to the real price case.

TABLE A6. Adjusted R^2, F-value, and number of observations.

Product group and income grouping	No. of income groups	Adjusted R^2	F-value	N
F WOOD	1	0.09	13	347
	3	0.21	11	347
	6	0.37	12	347
OTHER	1	0.72	738	858
	3	0.75	282	858
	6	0.77	154	858
HOUSE	1	0.68	278	391
	3	0.71	105	391
	6	0.76	70	391
PACK	1	0.68	429	599
	3	0.72	169	599
	6	0.75	99	599
PAN	1	0.80	1056	782
	3	0.80	358	782
	6	0.81	187	782
NEWPR	1	0.67	526	784
	3	0.69	197	784
	6	0.70	101	784
SAWN C	1	0.54	252	635
	3	0.57	95	635
	6	0.57	48	635
SAWN NC	1	0.47	177	588
	3	0.49	64	588
	6	0.51	35	588

Parameter estimates are given in Tables A7–A9. Observe that the t-ratio given for the coefficient not belonging to the highest income class refers to the significance of the ***difference from the highest class' value*** and not the difference from zero.

TABLE A7. Estimates of income elasticity for different income groups (t-ratio in parenthesis).

F WOOD

		−0.18 (2.0)			
0.06 (−0.8)		1.29 (6.3)		0.28 (1.33)	
−0.83 (0.7)	−1.58 (−1.2)	−2.0 (−2.3)	0.24 (7.3)	−0.8 (2.0)	−1.16 (−3.7)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN C

		1.57 (27.3)			
1.20 (−2.4)		1.92 (2.6)		1.57 (10.1)	
0.77 (−1.6)	0.76 (−2.4)	1.47 (1.31)	1.38 (0.9)	1.39 (4.7)	1.19 (4.2)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN NC

		0.88 (23.0)			
0.98 (2.3)		0.84 (1.4)		0.74 (8.3)	
1.52 (3.9)	0.66 (−0.5)	0.75 (0.1)	0.85 (1.2)	0.75 (0.1)	0.73 (4.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PAN

		1.37 (54.5)			
1.42 (−0.7)		1.48 (0.5)		1.46 (24.5)	
1.19 (−2.6)	1.34 (−1.6)	1.42 (−0.4)	1.31 (−2.6)	1.36 (−1.5)	1.45 (13.8)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

NEWPR

1.23 (38.5)					
1.36 (6.5)		1.37 (5.8)		0.88 (10.8)	
0.94 (2.5)	0.92 (2.7)	0.94 (2.3)	1.08 (3.9)	0.62 (−0.2)	0.64 (5.0)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

HOUSE

1.57 (27.9)					
0.86 (−4.5)		1.08 (−3.3)		1.22 (8.8)	
−0.49 (−4.8)	−0.40 (−7.1)	0.20 (−1.5)	−0.09 (−6.6)	0.32 (−0.8)	0.36 (1.5)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

OTHER

1.24 (44.4)					
1.29 (−1.1)		1.45 (2.7)		1.34 (21.7)	
0.52 (−4.4)	0.62 (−4.1)	0.88 (−0.3)	0.88 (−0.3)	0.96 (0.9)	0.90 (8.7)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PACK

1.24 (33.5)					
0.99 (−1.8)		1.36 (4.4)		1.12 (13.3)	
0.13 (−2.7)	−0.07 (−5.5)	0.65 (2.0)	0.53 (0.6)	0.65 (2.0)	0.47 (3.4)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

TABLE A8. Estimates of price elasticity for different income groups (t-ratio in parenthesis).

F WOOD

		−0.71 (−5.3)			
0.13 (5.8)		−1.79 (−1.2)		−1.39 (−7.1)	
−0.9 (2.5)	−1.75 (1.0)	−2.39 (−0.4)	0.57 (8.7)	−1.01 (3.3)	−2.20 (−9.0)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN C

		−0.72 (−5.2)			
−1.46 (−2.5)		0.35 (2.30)		−0.54 (−1.62)	
−1.27 (−1.17)	−1.63 (−2.1)	0.39 (2.0)	−0.04 (0.9)	−0.11 (0.6)	−0.57 (−1.3)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN NC

		−0.90 (−9.7)			
−0.48 (3.0)		−0.99 (0.9)		−1.19 (−6.6)	
0.52 (5.1)	−1.17 (0.4)	−1.12 (0.5)	−1.03 (0.8)	−1.17 (0.3)	−1.29 (−5.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PAN

		−0.37 (−6.4)			
−0.48 (−2.0)		−0.36 (−1.2)		−0.18 (−1.5)	
−0.75 (−4.1)	−0.29 (−2.3)	−0.06 (−1.2)	−0.60 (−3.8)	−0.24 (−1.8)	0.21 (1.15)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

NEWPR

		−1.15 (−9.0)			
−0.58 (7.2)		0.67 (5.63)		−2.65 (−10.9)	
−0.47 (5.8)	−0.67 (5.1)	−0.86 (3.4)	−0.56 (4.5)	−2.44 (0.1)	−2.51 (−4.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

HOUSE

		−0.28 (−2.5)			
−0.72 (−3.3)		−0.23 (−2.1)		0.40 (1.5)	
0.97 (1.01)	−1.16 (−3.9)	0.23 (−0.3)	−1.16 (−3.8)	0.53 (0.36)	0.35 (1.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

OTHER

		−0.78 (−9.03)			
−1.14 (−3.0)		−0.46 (−0.2)		−0.42 (−2.1)	
−0.83 (−1.89)	−1.25 (−3.3)	−0.34 (−0.2)	−0.54 (−0.9)	0.17 (0.9)	−0.27 (−1.2)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PACK

		−0.88 (−8.4)			
−1.39 (−0.3)		−0.32 (3.5)		−1.29 (−5.7)	
−0.79 (2.1)	−1.03 (−1.4)	0.14 (4.6)	−0.80 (2.1)	−0.26 (2.5)	−1.49 (−5.6)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

TABLE A9. Estimates of substitution rate (%) for different income groups (*t*-ratio in parenthesis).

F WOOD

1.2 (0.4)					
12.1 (1.03)		4.3 (0.4)		1.6 (0.4)	
2.0 (−0.3)	14.9 (0.7)	8.8 (0.2)	2.7 (−0.3)	1.5 (−0.5)	5.3 (1.2)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN C

−5.8 (−2.4)					
−11.6 (−1.2)		−2.9 (0.3)		−4.3 (−1.1)	
−9.2 (−1.0)	−12.4 (−1.6)	1.2 (0.1)	−2.1 (−0.4)	−13.2 (−1.7)	0.5 (0.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

SAWN NC

0.5 (0.3)					
1.4 (−0.4)		−2.5 (−1.4)		2.7 (1.06)	
−2.4 (1.0)	1.1 (0.4)	1.9 (−0.2)	−2.5 (−1.2)	2.7 (0.1)	3.1 (0.9)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PAN

1.8 (1.7)					
3.2 (0.1)		0 (−1.1)		3.0 (1.5)	
0.8 (0.2)	6.2 (1.7)	−0.5 (−0.2)	1.2 (0.3)	6.1 (1.5)	0.2 (0.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

NEWPR

2.2 (1.5)					
1.3 (−2.8)		−1.2 (−3.4)		11.4 (4.0)	
−2.9 (−2.2)	6.5 (−0.1)	−0.3 (−1.4)	−1.7 (−1.8)	14.8 (1.3)	7.1 (1.9)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

HOUSE

4.0 (1.7)					
3.5 (0.80)		9.6 (2.0)		−1.3 (−0.4)	
−3.5 (−0.5)	19.3 (2.7)	−13.9 (−1.9)	20.5 (3.3)	−2.3 (−0.4)	0.5 (0.1)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

OTHER

−0.08 (−0.07)					
−0.9 (−0.8)		−0.8 (−0.7)		−1.3 (0.6)	
−1.1 (0.3)	5.2 (0.83)	−3.8 (−0.4)	2.1 (1.1)	0.51 (1.6)	−2.1 (−0.8)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

PACK

2.7 (1.6)					
7.1 (1.5)		0.4 (−0.2)		1.2 (0.4)	
−2.0 (−0.8)	18.0 (3.2)	−0.52 (−1.36)	8.3 (1.4)	1.2 (−0.1)	1.9 (0.6)
0–300	300-600	600–1000	1000–2500	2500–5000	5000–

Income per capita (1975 US$)

A4. COMPARISON OF ESTIMATES WITH REAL AND NOMINAL PRICES

The estimates of income and price elasticities (with no grouping) resulting from estimations based on a nominal price are shown in Table A10. Comparison with Tables 3 and 5 in the paper reveals that the differences are insignificant.

TABLE A10. Estimates of income and price elasticities based on a nominal price.

Product group	Income elasticity	Price elasticity
F WOOD	−0.18	−0.70
SAWN C	1.57	−0.71
SAWN NC	0.88	−0.88
PAN	1.37	−0.37
NEWPR	1.23	−1.08
OTHER	1.24	−0.77
HOUSE	1.57	−0.28
PACK	1.24	−0.86

The rates of substitution are not directly comparable since the "nominal-price run" also includes inflation in the "*TIME* effect." However, the average rate of inflation in US during 1970–79 was 7.65% per year. This should *decrease* demand according to the price elasticities in Table A10. Taking the net of this effect and the *TIME* effect in the "nominal-price run," we obtain a rate of substitution which can be compared to the "real-price case." This is shown in Table A11.