PRICE COMPETITION IN THE JAPANESE WOOL TEXTILE INDUSTRY

R. P. BYRON*

University of Western Australia

Although much work has been done on the long-term income and substitution effects on wool consumption, little information is available on the short-term price effects in any wool market. The aim of this paper is to introduce the latter topic for consideration using a model of the Japanese wool textile market.

I. *Introduction*

Most statistical studies of wool consumption direct attention to long-run consumer demand with income as its main determinant. The hypothesis advanced here is that short-run price effects on wool consumption have been much neglected in favour of long-term income and technological effects. The crucial substitution decision occurs at the manufacturers' level. In the short run, the manufacturers' price responsiveness will depend on whether he can pass on price changes, on the structure of his production costs, on the technical possibilities of substitution, and on the availability of substitutes. If the industry is not vertically integrated, then a separate market decision will be made at each stage of production, and these factors will be prominent in the decision. This hypothesis, and several other hypotheses about the nature of the consumer demand for wool and the import demand for raw wool, are tested here in relation to the Japanese wool textile industry.

Previous studies have tended to ignore the importance of price at the various levels of demand in the Japanese wool textile industry.[1] Despite the presence of some large vertically integrated firms, the large number of small independent firms, particularly at the weaving stage, ensures that separate marketing decisions are made at each stage of production in the industry. As the industry is not vertically integrated a separate statistical analysis can be performed at each level at which market transactions occur. In this way the responsiveness of processors to a change in the prices confronting them can be examined.

Raw wool is imported into Japan in clean or greasy form, converted into tops, spun into yarn, woven into fabrics, and after further processing becomes the consumer product. A model is advanced here to examine

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[1] E. L. Jenkins and R. Brunswick, *Wool in Japan*, B.A.E. Wool Economics Research Report No. 5, Canberra, 1963. The Economist Intelligence Unit, *The Japanese Wool Textile Industry*, London, 1960. E. M. Barlow, *The Japanese Wool Textile Industry, Some Facts and Impressions*, National Wool Export Corporation, Bradford, 1960.

the nature of short-run import demand, to test hypotheses about the short-run demand and supply relationships at the successive stages of the industry, and to investigate consumer behaviour. The results of the analysis confirm several well established economic theorems relating to the price elasticity of demand for imports and the price elasticity of derived demand.

II. *Wool Flow through the Textile Industry*

To build a model of the Japanese wool textile market which encompasses the submarkets where transactions occur between the import demand stage and the final consumer demand phase, a flow chart of the wool as it is processed must first be traced. The wool passes through the hands of importers, topmakers, spinners, weavers and secondary processors before it is marketed to the consumer.

Data on the quantity of raw wool imported into Japan is readily available. This is converted on a clean basis and aggregated on a quarterly basis. These imports, together with the change in importers' stocks, are the amount the importers supply to the topmakers; this is equated to the quantity topmakers' demand. The topmakers convert this wool into tops, and their production, together with any changes in their inventories of tops, is the amount the topmakers supply to the spinners, and is equal to the spinners' demand for tops. It takes approximately three months for the wool to be imported and processed before it reaches the spinners.

The spinners convert these tops into yarn. The quantity of yarn they produce, together with the change in the yarn stocks they hold, makes up the total quantity of yarn supplied. Some of this yarn is exported and this quantity is subtracted from the total supply to derive the quantity of domestic supply by the spinners. This is equated to the quantity demanded by the weavers. Again there is a lag of three months between the time the wool tops reach the spinners and the time the yarn reaches the weavers.

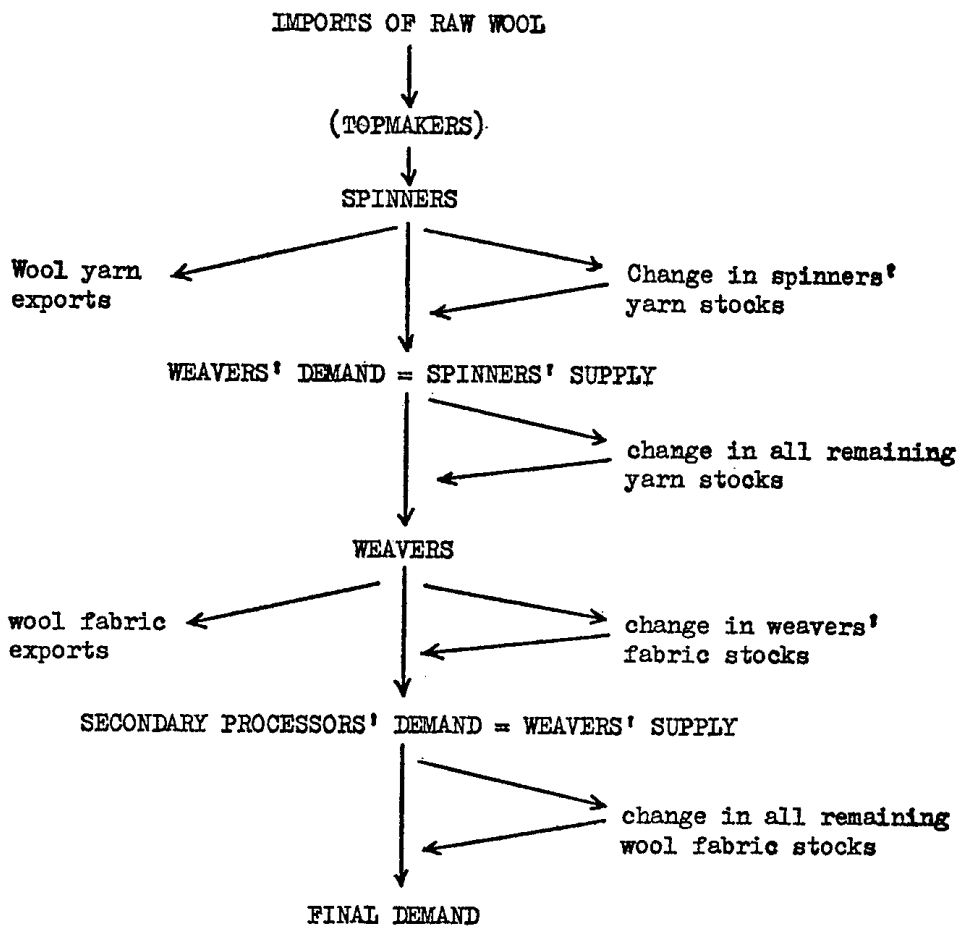
The weavers produce fabric and the quantity of woollen fabric supplied is calculated in the same manner as previously: changes in weavers' fabric stocks are added to their production of fabrics, and this amount is taken as the quantity they supply to the secondary processors. Again, this is equated to the quantity demanded by the secondary processors.

Insufficient information is available on both the prices facing and the operations of fabric wholesalers and retailers. This phase in the chain is ignored and the quantity of final demand by the consumer is estimated in terms of fabrics. In calculating the quantity of consumer demand, allowance is made for changes in secondary processors' stocks. However, no information is available on stocks of piece goods held by retailers or wholesalers, or on the quantity of these items exported. The estimate of the quantity of consumer demand in fabric terms is not necessarily inexact as the nearer a processor is to the final demand the less inventories he is likely to hold in relation to throughput. (Accelerator effects are weaker the nearer the consumer.) It might be argued that inventories move in sympathy with fluctuations in throughput. However, no useful data is available on the export of woollen piece goods, and its exclusion tends to cast doubt on the estimates of the level of final demand.

A flow chart underlying these calculations of quantity supplied and demanded is shown in Table 1. The market stages represented are: import demand of raw wool, spinners' supply and weavers' demand for wool yarn, weavers' supply and secondary processors' demand for woollen fabrics, and the final demand (in terms of fabrics). Continuity between the various stages of the model is achieved by the inclusion of a conversion factor relating the throughput of raw wool, that is, the quantity of unprocessed material which enters the production pipeline for the purpose of actual production, to the production of the processed output.

TABLE 1

Flow Chart of Wool Processing



The complete model, including the links between submarkets, is set out in Table 2. The variables concerned are in terms of their actual values, and the relationships specified are linear. The study is one of the effects of price on the consumption of wool at the various stages of production and consumption; as such, the relationships which prevail among the undeflated variables are of more interest than those which exist between the deflated variables. The time unit chosen is three

months. Quarterly data have special significance because of the seasonal nature of final consumption and an apparent three-month time lag in processing between import, yarn and fabric markets. As a three-month time period does not give the producer or consumer sufficient time to adjust his decision for changes in real values, this provides additional cause for the use of undeflated data. The time period covered is 1954 to 1963, making a total of 38 observations.

TABLE 2

The Model

Final Demand for Wool

(1) $Y_{1t} = f(Z_1, Z_{2t}, Z_{3t}, Z_{4t}, Z_{5t})$

where Y_{1t} = estimated final demand for woollen fabrics in t;
Z_1 = dummy variable for second quarter of year;
Z_{2t} = price of synthetic fibres in t;
Z_{3t} = personal savings (total bank deposits in t);
Z_{4t} = change in personal income in t;
Z_{5t} = price of woollen fabrics in t.

Quantity of Final Demand: Identity

$Y_{1t} = Y_{4t} - Z_{6t} - (Z_{7t} - Z_{7t-1})$

where Y_{4t} = production of woollen fabrics in t;
Z_{6t} = exports of woollen fabrics in t;
Z_{7t} = total stocks of woollen fabrics at end of t.

Secondary Processors' Demand for Wool Fabrics

(2) $Y_{2t} = f(Z_{2t}, Z_{5t}, Z_{8t})$

where Y_{2t} = secondary processors' demand for wool fabrics in t;
Z_{8t} = stocks of woollen fabrics held by secondary processors at end of $t - 1$.

Quantity of Secondary Processors' Demand: Identity

$Y_{2t} = Y_{3t}$

where Y_{3t} = weavers' supply of wool fabrics for domestic purposes in t.

Weavers' Supply of Wool Fabrics

(3) $Z_{3t} = f(Z_{9t}, Z_{10t})$

where Z_{9t} = total bank advances for all purposes to the textile industry in t;
Z_{10t} = weavers' equipment operable in t.

Quantity of Weavers' Supply of Wool Fabrics: Identity

$Y_{3t} = Y_{4t} - Z_{7t} - (Z_{11t} - Z_{11t-1})$

where Z_{11t} = weavers' stocks of wool fabrics at end of t.

Conversion of Yarn to Fabric

(4) $Y_{4t} = f(Z_{12t-1})$

where Z_{12t-1} = throughput of wool yarn in $t - 1$.

Throughput of Wool Yarn: Identity

$Z_{12t-1} = Y_{5t-1} - (Z_{13t-1} - Z_{13t-2})$

where Y_{5t-1} = weavers' demand for wool yarn in $t - 1$;
Z_{13t-1} = total stocks of wool yarn, other than held by spinners, at end of $t - 1$.

Weavers' Demand for Wool Yarn

(5) $Y_{6t-1} = f(Z_{2t-1}, Z_{5t-1}, Y_{5t-1})$

where Y_{6t-1} = price of wool yarn in $t - 1$.

Quantity of Weavers' Demand for Wool Yarn: Identity

$Y_{5t-1} = Y_{7t-1}$

where Y_{7t-1} = spinners' supply of wool yarn for domestic purposes in $t - 1$.

Spinners' Supply of Wool Yarn

(6) $Y_{7t-1} = f(Z_{9t-1}, Z_{14t-1}, Y_{6t-1})$

where $Z_{14t-1} =$ spinners' equipment operable in $t - 1$.

Quantity of Spinners' Supply of Wool Yarn: Identity

$$Y_{7t-1} = Y_{8t-1} - Z_{15t-1} - (Z_{16t-1} - Z_{16t-2})$$

where $Y_{8t-1} =$ production of wool yarn in $t - 1$;
$Z_{15t-1} =$ exports of wool yarn in $t - 1$;
$Z_{16t-1} =$ spinners' yarn stocks at end of $t - 1$.

Conversion of Raw Wool to Yarn

(7) $Y_{8t-1} = f(Z_{17t-2})$

where $Z_{17t-2} =$ throughput of raw wool in $t - 2$.

Throughput of Raw Wool: Identity

$$Z_{17t-2} = Y_{9t-2} - (Z_{18t-2} - Z_{18t-3})$$

where $Y_{9t-2} =$ total raw wool imports in $t - 2$, converted to clean basis;
$Z_{18t-2} =$ total raw wool stocks held in Japan at end of $t - 2$.

Import Demand for Raw Wool

(8) $Y_{9t-2} = f(Z_{9t-2}, Z_{18t-2}, Z_{19t-2}, Z_{20t-3}, Z_{21t-3})$

where $Z_{19} =$ dummy variable for seasonality in third quarter of year;
$Z_{20t-3} =$ Japan's total holdings of gold and foreign exchange reserves at end of $t - 3$;
$Z_{21t-3} =$ world wool price in $t - 3$.

III. *The Model*

In the economic sense the final demand for the finished product is the primary relationship and the other demands of the various processors are derived demands. As mentioned, it is difficult to calculate the precise quantity of the consumer demand for woollen goods in the short run. In this model woollen goods are treated as semi-durables; they are considered as illiquid assets. If the "balance sheet" approach is accepted, then the consumer attempts to maintain a certain ratio between liquid and illiquid wealth.[2] The major part of consumer demand is a replacement demand due to depreciation of consumer stocks; this bears a direct relation to consumer holdings of liquid wealth. In addition, the consumer makes additions to stocks. These additions are hypothesized as a function of the change in consumer income. Consumer income is a flow variable which is converted into other flows and stocks. If additional income is converted into other flows and stocks in a constant ratio, then net additions to consumer stocks of woollen goods are, in part, a function of change in income.

The equations of the model are listed in Table 2.[3] Equation 1 specifies consumer demand as a function of personal savings (wealth), changes in income, the price of fabrics, the price of synthetic fibres (synthetic fabric price data being unsuitable due to discontinuities in the series), and a dummy variable for seasonality. The synthetic fibres now in competition with wool did not exist prior to 1959, and the synthetic price variable tends to take on an all-or nothing character (with some

[2] K. E. Boulding, *A Reconstruction of Economics*, Science Editions Inc., New York, 1962, Ch. 8.

[3] Data series and their sources for the variables involved are presented in R. P. Byron, "Price Competition in the Japanese Wool Textile Industry", unpublished M.Ec. thesis, University of Western Australia, Perth, 1965.

price variation after 1959). The price variable therefore cannot be used to derive a cross elasticity of demand; it merely accounts for a change in the structure of the market, and allows for price changes after 1959. The implicit assumption of this equation is that competition at this stage takes the form of price competition. Because of a lack of data on advertising expenditures and fashion effects, it is not possible to formulate and test an alternative hypothesis.

Immediately preceding the final demand is the secondary processors' demand for fabrics, specified as equation 2 in the model. No time lag is specified between the two, although one must certainly exist. This is because the quantity of consumer demand is only a rough estimate based on adjusted domestic fabric production figures. The secondary processors' demand for wool fabrics is a derived demand. The demand for an input generally depends on its price, on the price of competing inputs, and on the price of the output.[4] The price of the output represents the conditions of demand in the succeeding market and consequently there is no need to include a shift variable for the level of demand. Because data is not available on the prices of the secondary processors' output, a surrogate variable—the secondary processors' stocks of fabrics—is included in its place. Output price data usually reflects the demand situation for the secondary processors' products; however, the fluctuations in their inventory holdings also reflect fluctuations in this demand, as well as its general level. The quantity of fabrics demanded by the secondary processors is specified in equation 2 as a function of the price of wool fabrics, the price of synthetic fibres, and the stocks of fabrics held by the secondary processors.

The fabric submarket is composed of the secondary processors' demand for fabrics, already mentioned, the weavers' supply of fabrics, and an identity equating the quantity demanded to the quantity supplied. The weavers' supply of fabrics is equation 3 in the model.

The quantity of fabrics supplied by the weavers is hypothesized as a function of the number of weaving looms operable, and the bank loans extended to the industry. (Bank loans appear to be a crucial factor in the operation of the Japanese textile industry where many of the smaller operators are on a financial tightrope.[5] It may possibly be argued that the level of bank loans to the industry is as much a function of the activity there as a cause of it. This hypothesis, however, is not considered here.) No data is available on cost conditions specific to the textile industry so this variable is excluded from the analysis. In fact, an original hypothesis that weavers' supply also depends on fabric price was rejected as the price response was found to be not significantly different from zero. The alternative hypothesis accepted is that the quantity of fabrics supplied is a function of bank loans and equipment operable (equation 3).

The weavers supply fabrics and demand yarn. The quantity of yarn they demand for throughput purposes is transformed into fabric production. As mentioned, this transformation takes three months, and is included in the model as a transformation equation relating the yarn market to the fabric market (equation 4).

[4] J. M. Henderson and R. E. Quandt, *Microeconomic Theory: A Mathematical Approach*, McGraw-Hill, New York, 1958, pp. 42-48.

[5] E. M. Barlow, *op. cit.*, p. 48.

The quantity of yarn demanded by the weavers is specified using the price of wool fabrics, the price of synthetic yarn and the price of wool yarn. In this market, unlike the fabric market, the price of wool yarn is specified as the dependent variable where single equation techniques are used. Unlike the fabric market, where prices appear to have a seasonal stability, yarn prices fluctuate violently. In addition, there would seem to be a case for including the quantity demanded as a predetermined variable, since a small part of the actual orders is placed in advance. This weavers' yarn demand function is equation 5 in the model.

The spinners' supply equation is specified in the same manner as previously for weavers' supply. The quantity of wool yarn supplied is hypothesized in equation 6 as a function of the price of wool yarn, the level of bank loans extended to the industry, and the number of spindles the Government permits to be operable. As with the fabric supply equation, cost data specific to the textile industry is not available for inclusion. The hypothesized supply equation proved inadequate as equipment operable does not contribute to an explanation of the variation in supply. The alternative function hypothesized and accepted is that yarn supply is a function of yarn price and bank loans extended to the textile industry.

The topmakers' supply and demand equations are excluded from the model for want of data. As the quantity supplied by the topmakers cannot be calculated exactly, neither can the quantity demanded by the spinners. Hence, a spinners' demand equation is not included in the model. A transformation equation involving a time lag of three months is used to skip this section of the market and to relate raw wool throughput to yarn production (equation 7).

In specifying a demand function for raw wool from all sources the negligible level of domestic production is ignored. This demand function is an import demand equation. Governmental decisions play a large part in determining Japan's imports of all raw materials, including wool. Short-run changes in this decision are based on Japan's ability to pay for imports, that is, her gold and foreign exchange holdings. From time to time during the period considered it was necessary to reduce the level of imports, and emphasis was placed on direct controls. In 1961 Japan removed import controls and the more recent tendency has been to rely on indirect monetary action rather than on import controls.

As the price of Japan's various imports tend to allocate the available purchasing power between the various end uses, the world price of wool is included as an explanatory variable in the import demand equation. A further consideration the Government takes into account is the quantity of raw wool stocks held in Japan, and the amount of raw wool which will be needed to prevent the domestic market from becoming under-supplied. In addition, there is a seasonality in Japanase raw wool imports, consisting of a regular drop in the third quarter of the year. This is allowed for by using a dummy variable.

In the import demand function (equation 8) it is assumed that the Japanese Government's decision on the desired level of imports takes one quarter to implement. Thus the world price of wool, gold and foreign exchange holdings and raw material stocks are lagged variables. Bank loans, the means by which the policy is implemented, and a dummy

variable for seasonality are current exogenous variables in relation to the quantity of raw wool imported. The hypothesis advanced is that import demand is causally dependent on the specified variables and a single equation technique is used. If the price effect is not assumed to be lagged, the hypothesis might be advanced that the level of Japanese imports of raw wool and the world wool price are mutually interdependent variables. This would involve specifying a model of the world wool market, an exercise beyond the scope of this study.

TABLE 3

The Results [a]

	Equation	d	R^2
(1)	*Final Demand for Wool*		
	$Y_{1t} = 79{,}755 - \underset{(289)^{**}}{2{,}084Z_{1t}} + \underset{(6\cdot07)}{4\cdot77Z_{2t}} + \underset{(0\cdot058)^{**}}{0\cdot322Z_{3t}}$		
	$+ \underset{(0\cdot244)}{0\cdot435Z_{4t}} - \underset{(9\cdot95)^{**}}{32\cdot34Z_{5t}}$	2·05*	0·91
(2)	*Secondary Processors' Demand for Wool Fabrics*		
	$Y_{2t} = 59{,}178 + \underset{(7\cdot55)^{**}}{21\cdot75Z_{2t}} - \underset{(19\cdot66)}{21\cdot97Z_{5t}} + \underset{(0\cdot22)^{**}}{0\cdot784Z_{8t}}$	0·63	0·84
(3)	*Weavers' Supply of Wool Fabrics*		
	$Y_{3t} = -38{,}515 + \underset{(0\cdot01)^{**}}{0\cdot04Z_{9t}} + \underset{(50\cdot63)^{**}}{237\cdot36Z_{10t}}$	0·87	0·93
(4)	*Conversion of Yarn to Fabric*		
	$Y_{4t} = \underset{(0\cdot45)^{**}}{1\cdot22Z_{12t-1}}$		0·82
(5)	*Weavers' Demand for Wool Yarn*		
	$Y_{6t-1} = 475 - \underset{(0\cdot08)}{0\cdot12Z_{2t-1}} + \underset{(0\cdot21)^{*}}{0\cdot57Z_{5t-1}} - \underset{(0\cdot002)}{0\cdot003Y_{5t-1}}$	0·98	0·85
	ILS		
	$Y_{6t-1} = 537 - 0\cdot09Z_{2t-2} + 0\cdot34Z_{5t-1} - 0\cdot006Y_{5t-1}$		
(6)	*Spinners' Supply of Wool Yarn*		
	$Y_{7t-1} = 6{,}554 + \underset{(0\cdot01)^{**}}{0\cdot08Z_{9t-1}} + \underset{(10\cdot7)}{11\cdot61Y_{6t-1}}$	0·71	0·82
	TSLS		
	$Y_{7t-1} = 19{,}716 + 0\cdot06Z_{9t-1} + 3\cdot49Y_{6t-1}$		
(7)	*Conversion of Raw Wool to Yarn*		
	$Y_{8t-1} = \underset{(0\cdot03)^{**}}{0\cdot69Z_{17t-2}}$		0·81
(8)	*Import Demand for Raw Wool*		
	$Y_{9t-2} = 15{,}979 + \underset{(0\cdot02)^{**}}{0\cdot06Z_{9t-2}} + \underset{(0\cdot16)^{*}}{0\cdot40Z_{18t-2}} - \underset{(448)^{**}}{1{,}317Z_{19t-2}}$		
	$+ \underset{(7\cdot11)^{**}}{43\cdot73Z_{20t-3}} - \underset{(14\cdot50)^{**}}{45\cdot85Z_{21t-3}}$	1·28	0·90

[a] The Durbin-Watson statistic is included in column (d); an asterisk signifies it is significant, and a blank indicates it is indeterminate. The multiple correlation coefficient is in the final column. Where appropriate, the standard errors of the coefficients are included in brackets together with an asterisk indicating their significance according to the t test: (*) at the 5% level, and (**) at the 1% level. Two-stage least squares (TSLS) and indirect least squares (ILS) are used respectively to estimate yarn supply and demand respectively. Elsewhere single-equation least squares is used.

III. *Interpretation of the Results*

Estimated coefficients for the various equations of the model are listed in Table 3. Corresponding elasticities with respect to relevant variables are presented in Table 4.

The quantity of final demand (Y_1) considered in the present analysis is only an estimate of the true quantity of consumer demand. However, if this final demand equation is taken as the consumer demand equation then the results for equation 1 shown in Table 4 confirm other findings on the price elasticity of demand of the consumer demand for wool. Polasek and Ferguson[6] estimate the price elasticity of consumer demand for wool in the United States as —0·55. The present price (Z_5) elasticity estimate is —0·51. The demand elasticity with respect to savings (Z_3) indicates that wool consumption may, to a large extent, be a replacement demand which is not responsive to short-run changes in consumer wealth. The synthetics variable combines innovation as well as price effects of that fibre on wool, and its outcome is not considered here. Finally, the dummy variable (Z_1) correctly accounts for a drop in demand in the spring season when consumers are preparing their wardrobe for summer.

TABLE 4

Elasticities Calculated from the Fitted Model

Equation	Quantity	Elasticity with respect to: [a]
(1)	Final demand for wool (Y_{1t})	Z_{6t} : 0·34
		Z_{4t} : 0·02
		Z_{5t} : —0·51
(2)	Secondary processors' demand for fabrics (Y_{2t})	Z_{5t} : —0·34
		Z_{8t} : 0·32
(3)	Weavers' supply of wool fabrics (Y_{3t})	Z_{9t} : 0·38
		Z_{10t} : 1·17
(5)	Weavers' demand for wool yarn (Y_{5t})	Y_{6t} : —3·94
		—2·37 [b]
(6)	Spinners' supply of wool yarn (Y_{7t})	Z_{9t} : 0·74
		0·64 [c]
		Y_{6t} : 0·15
		0·05 [c]
(8)	Import demand for raw wool (Y_{9t})	Z_{9t} : 0·04
		Z_{18t} : 0·32
		Z_{20t-1} : 0·66
		Z_{21t-1} : —0·55

[a] Estimated at the mean values of the variables. Symbols are explained in Table 2.
[b] Based on ILS estimate.
[c] Based on TSLS estimate.

More interesting than the results of the final demand equation are the price elasticity estimates of the derived demand equations. These present no surprises in the light of several well-known theorems of derived demand, and given a knowledge of the cost structure of the

[6] M. Polasek and C. E. Ferguson, "The Elasticity of Import Demand for Raw Apparel Wool in the United States", *Econometrica* 30: 670-690, 1962.

various stages of the industry. The principles of derived demand are well established.

> Firstly, that if the demand for a product is inelastic, the derived demand for the input will tend to be inelastic. Secondly, the smaller the proportion spent on an input, the more inelastic the derived demand will tend to be. Thirdly, other things being equal, the derived demand will tend to be inelastic if its technical substitutability is low. And fourthly, the derived demand will tend to be inelastic if all the other inputs are in inelastic supply to the industry.[7]

The second principle above is especially relevant in view of estimates made by Fead of the proportion of semi-processed input to combined output costs at each stage of production for the Australian textile industry.[8] Fead's estimates of the proportion of the total cost at each stage of production occupied by the semi-processed input cost of that stage are as follows:

Topmakers	clean wool to top	76 per cent
Spinners	top to yarn	50 per cent
Weavers	yarn to fabric	76 per cent
Secondary processors	fabric to suit	37 per cent

Although her estimates are for the Australian wool textile industry, they are worth considering in the Japanese context. The only likely difference is that the labour component of costs in Japan might be expected to be lower, and the proportion of wool-input cost to total cost at a particular stage of production might be expected to be higher. On the basis of the second principle of derived demand stated previously, and the cost information presented above, the secondary processors' demand for fabrics might be expected to be price inelastic, and the weavers' demand for yarn to be price elastic.

The estimates made of the secondary processors' demand for fabrics (Y_2) indicate that this demand is price inelastic. The coefficient relating the demand for wool fabrics to the price of synthetics is not a true cross elasticity of demand coefficient. This is because the synthetic data includes the introduction of new products and thus violates one of the basic assumptions of econometric work, that of stable parameters. The positive relation between stocks and demand is due to the relatively low levels of stocks held and the continual necessity of replacement as activity increases. The supply function of the weavers proved to be an institutional equation in which bank loans and equipment operable account for much of the variation in supply.

The estimates of the weavers' demand for yarn (Y_5) indicate a high price elasticity of demand. This is understandable in view of the proportion of weavers' total costs occupied by the cost of wool yarn. Furthermore, the presence of good substitutes provides another reason why the relationship should be elastic. Again, though the cross elasticity of demand can be estimated indirectly, it has no real significance as it overlies a changing parameter.

Equipment operable does not contribute to the explanation of the variation in spinners' yarn supply (Y_7), and hence was dropped from

[7] P. A. Samuelson, *Economics*, McGraw-Hill, New York, 3rd edn., 1955, pp. 501-502.

[8] M. Fead, "Cost Components of Manufactured Wool Products", *Quarterly Review of Agricultural Economics* 14: 1-9, 1961.

the final specification. Considering the evasive measures taken by the Japanese spinners against Government restrictions on operable machine capacity, this is not surprising. The supply response is inelastic in the short run to both the amount of credit extended to the industry and the price of wool yarn.

The present price elasticity of import demand estimate of less than unity conforms to the general pattern of international trade elasticity estimates. Polasek and Ferguson, however, refer to a theorem in international trade theory which establishes that the import demand of a country is an excess demand function of domestic demand over domestic supply, and will often tend to be elastic.[9] A comparison of their estimates of the price elasticity of import demand for wool in the United States and the results of the present study confirms this. Polasek and Ferguson's estimates are price elastic (between —1·3 and —1·5) and the present study's estimate is —0·55, i.e. price inelastic. This may be due to the absence of a domestic supply function in Japan. Foreign exchange has an inelastic relationship with wool imports—perhaps indicating that wool is a necessity on the Japanese import budget, the necessity of the commodity being a further reason for the import price inelasticity. The dummy variable indicates a seasonal drop in the third quarter of the year (due to supply factors). The sign associated with the coefficient for raw materials is positive, which may be taken as indicating a "normal relation" between stocks and activity such that as activity increases the normal level of stocks rises.

IV. *Concluding Remarks*

The present study is only a preliminary exploration of what could prove a very fertile field. The model, as can be seen at a glance, is not a complete dynamic model. In its present form it cannot be used as the subject of a simulation exercise aimed at tracing the impact of a shock through the system. It is possibly inadequate in several respects, particularly in relation to exports, inventories, synthetics and speculation. However, it does shed new light on substitution in the textile industry.

Consumer demand estimates seem to indicate that woollen goods are regarded as a necessity in Japan, and that consumption at this final stage is not very responsive to price changes. The secondary processors' demand for fabrics is price inelastic, which confirms *a priori* theory in view of the production possibilities open to secondary processors. The weavers' demand for wool yarn is price elastic. This is no surprise considering the high proportion of their costs of producing fabric which is occupied by yarn input costs. Finally, the import demand function is price inelastic, as might be expected in a country with no domestic supply, and to which the commodity may be a necessity.

[9] Polasek and Ferguson, *op. cit.*