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Waiting Time: A Factor in Export Demand for Manufactures

Margaret L. Greene

INTERNATIONAL FINANCE SECTION
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I. INCLUSION OF WAITING TIME IN THE THEORY OF DEMAND

To a great extent, manufacturers of durable goods — goods which account for a large and growing proportion of the value of the world's exports — meet current demand out of future production. As a result, there may often be a significant delay between the placing of an order and the shipping of the product. This delay, or "waiting time," will be costly if the purchaser does not perfectly anticipate his own needs and therefore cannot arrange for delivery at the ideal time. If, for example, the purchaser cannot get delivery as rapidly as he desires, he pays not only the quoted price but also the imputed cost of waiting. Waiting time has two important implications for the study of international trade. First, the length of time to delivery constitutes an additional factor which, together with such considerations as price, quality, and terms of credit, determines the competitiveness of a country's products in world markets. Second, the length of delivery time represents the minimum amount of time that must elapse before there is an observable response in the level of a country's export shipments to a change in the exchange rate or in any of the other determinants of export demand.

The role of length of delivery time in export demand was first examined in an empirical study by Steuer *et al.* (1966), who found waiting times to be highly significant variables and relative prices not significant in the explanation of foreign new orders for British machine tools. Their paper sparked subsequent research. Bispham (1970, pp. 45–49) included a measure of order backlog in equations explaining export new orders for the aggregate of British engineering industries. His estimates suggested that, as measured by the beta coefficients, relative delivery dates typically account for three times as much of the variation in export orders as do relative prices, although both effects are considerably less important than the level of total world demand. In a later report, Artus (1971) confirmed that British export orders for machine tools and for all machinery were favorably influenced by long waiting times in a competing country, Germany. He also noted that long waiting times in the exporting country had an unfavorable influence for the British and American machinery industries as well as for the American machine-tool industry. Gregory (1971) concluded that American buyers consider domestic (but not foreign) terms of delivery when choosing between domestic and foreign suppliers and suggested that a 50 per cent increase in waiting time is equivalent to an 8 per cent increase in actual price.

These studies are useful in that they present preliminary findings to suggest that waiting time, a long-forgotten factor in empirical studies, may indeed be an important determinant of export demand. Unfortunately, their authors failed to draw upon general price theory to obtain an understanding of precisely how terms of delivery affect demand. As a result, their estimation procedures suffer from misspecification, and the theoretical underpinning for subsequent work is never laid out.

The procedures used in these earlier studies were based on largely empirical rather than theoretical considerations. Steuer *et al.* (1966) admitted that it would be desirable to relate orders for machine tools theoretically to the explanatory factors they included in their estimating equations, but they felt that it was not feasible to do so. Instead, they examined a wide range of possible relationships, using single-equation, least-squares regressions (p. 394). These relations included either the ratio of two countries' waiting times — the formulation presumed to be the more appropriate — or countries' waiting times as separate arguments — an approach designed to accommodate waiting-time estimates for more than two countries. Neither of these approaches proved to be entirely satisfactory statistically. Although their regression estimates improved when waiting times were entered separately, Steuer *et al.* suspected that at least one of the waiting-time arguments was not capturing the effects of fluctuations in delivery times but, rather, was standing in as a measure of world demand (pp. 397–398). Artus (1971) found that, when waiting-time estimates were entered separately, multicollinearity between these estimates was frequently so serious that it was difficult to isolate statistically the independent importance of any one of them (p. 27).

Nevertheless, a theoretical approach for introducing waiting time into empirical export-demand equations can easily be derived and has been suggested by the variety of analyses that treat time as an economic good.[1] Becker (1965), in his general treatment of the allocation of time, analyzes a case that closely anticipates the approach used in this study. Initially, he assumes that no time is required to purchase a particular market good.

[1] Apart from Becker's (1965) work, described below, Stigler (1961) stressed that the search for the lowest price is expensive in terms of both time and money; Mincer (1963) explicitly included in the demand function the buyer's opportunity cost of time spent consuming a product; and Contini (1968) concluded that in labor negotiations the bargainer who is more anxious to reach agreement may have to settle for a relatively less advantageous solution.

Then he posits a price ceiling on that good (below the market price) and a production subsidy sufficient to maintain the same level of output. Because of the cut in price, more is demanded than is supplied, and the good must be rationed. If the good is distributed on a first-come first-served basis, a queue of prospective customers will develop and grow until the expected cost of joining the line is so high as to discourage the excess demand. In other words, the total cost of the commodity remains unchanged, but indirect time costs are substituted for direct goods costs.

In this study, I first explore the theoretical relationship between demand for a product and alternative terms of delivery. I demonstrate that the relevant consideration for a potential purchaser is the difference — not the ratio — in waiting times offered by competing suppliers, given quoted prices. Since a demand equation that includes the difference in waiting time cannot be transformed into one that is a function of waiting-time ratios, it is not surprising that the separate waiting-time arguments in the Steuer *et al.* equations provided the better results.

My second objective is to extend the work of earlier authors by analyzing the role of waiting time for a wider range of industries and a larger number of countries than have been covered before. The industry groups to be studied are iron and steel, fabricated metal products, and various sectors of the mechanical and electrical engineering groups. The countries to be included are those for which data could be obtained. Waiting-time estimates were calculated for Canada, Germany, Japan, the Netherlands, Norway, the United Kingdom, and the United States. Export-demand equations were estimated for at least one industry in each of these countries (except Canada). Although this group of seven countries does not contain all important suppliers for each of the several industries studied in this paper, these countries — with two members of the European Economic Community, two members of the European Free Trade Area, two countries of North America, and the major industrial nation of the Far East — are probably representative.

The method of calculating waiting times and the procedures used to introduce the waiting-time difference into an empirical export-demand function are discussed in Chapter II. Although it is important to appreciate the limitations of the statistical techniques employed, the reader interested primarily in the results of these experiments might wish to proceed quickly over the technical discussion of this chapter and turn to Chapter III.

Even though the emphasis of this study is waiting time, one should not lose sight of the other nonprice factors that may enter into the demand function for a particular commodity, some of which may be of greater importance. When British companies were asked to give reasons for any changes in their export position during the period 1960–65, better marketing, improved design, and a change in product mix were the most frequently given reasons for improvement. The greatest hindrance to exports, in the opinion of most companies, was presented by tariffs and quotas. Too long delivery dates were considered to be as important as uncompetitive prices only by companies that exported more than half their total output (National Economic Development Council, 1965).

However, delivery dates have been shown to be of crucial importance from time to time. When Cooper *et al.* (1970, p. 100) asked British pottery firms wishing to increase foreign sales what actions they were taking to encourage export orders, the largest group of respondents indicated they were giving export orders priority (see Table 1). The now infamous contract that Rolls Royce had to accept to fill a £1 billion order for their RB211 aircraft engines from Lockheed serves as another example. Lockheed was so concerned that the engines be delivered on time that, as a condition of the contract, it drew up detailed production schedules and required U.S. auditors to determine that the schedules were being kept. The penalties imposed for late delivery were so severe that when, in fact, Rolls Royce was unable to meet the technical requirements by the stated date, it was forced into receivership.

TABLE 1

ACTION TO INCREASE PROPORTION OF EXPORTS TO TOTAL SALES: POTTERY INDUSTRY, UNITED KINGDOM

Action	*Frequency of Response*
Giving priority to export customers	8
Doing all we can already	6
Arranging mix of products to suit export markets	2
Looking for new markets	2
Increasing selling effort overseas	1
Adding production capacity	1

SOURCE: Cooper *et al.* (1970, p. 100).

The Theoretical Model

There have been several attempts to analyze from the supply side the effects of waiting time and other factors on a country's competitive position (see, for example, Ball *et al.*, 1966; Adams *et al.*, 1969; Henry, 1970; and Artus, 1971). The so-called "pressure-of-demand hypothesis" supposes that all forms of nonprice competition are less favorable for a country when, other things being equal, the level of domestic demand is especially high. This hypothesis implies that producers give preference to the domestic market, which is assumed to be the more profitable, and allow delivery terms for export orders to lengthen while they meet the demand at home. The approach taken here is, by contrast, from the demand side.

The principal effect of a delay in delivery is to force the purchaser to wait before he can enjoy the service flow from the commodity in question. The seriousness of this delay will depend on how well the individual purchaser anticipates his needs and in what manner he discounts the value of the product's services in future periods. If the buyer perfectly anticipates his future requirements and the ability of his supplier to meet commitments, he can avoid the inconvenience of waiting simply by placing his order at the appropriate time. But if he does not have the benefit of perfect foresight and he has a positive rate of discount — if he values the good's services in the current period more highly than those in subsequent periods — then the buyer may have to be compensated for any postponement of the service flow. It is the trade-off between waiting time and price that is the focus of this paper.

To derive the role of waiting time in the demand function, I need simply assume maximizing behavior. That is, I assume a purchaser is willing to pay as much as the present value for any given product and that the rate at which he is willing to substitute between two alternatives is therefore the ratio of present values. Consider, for example, two machines identical in every way except that the first can be delivered in period t while the second cannot be delivered until period T, $T > t$. Other terms of sale are the same in both cases. The purchaser, considering these two alternatives, must add to the price of the second machine the present value of its foregone use during the period when the first machine would be available, then subtract the present value of the use of the second machine after the first has worn out. If R_n is the money value of the return from the machine in the nth period, α is the appropriate rate of discount (assumed, for convenience, to be uniform for each period), and k is the life of the machine, a purchaser willing to pay the present value (PV) for each machine would have to contrast

$$PV_1 = \sum_{n=t}^{t+k} R_n A^n, \qquad \text{and} \qquad PV_2 = \sum_{n=T}^{T+k} R_n A^n, \tag{1.1}$$

where $A = 1/(1 + \alpha)$.

The purchaser would be indifferent between the two machines if the difference in quoted prices were equivalent to the difference in present values. In the more specific case where the return to the machine is assumed to be constant over its life and equal to $\bar{R}$, and where the rate of discount is positive (i.e., $A < 1$), it can be shown that the machine with the earlier delivery can command a higher price. For, under these more stringent assumptions, the condition for indifference can be reduced to

$$PV_1 - PV_2 = \bar{R}A^t(1 - A^{k+1}) \sum_{n=0}^{T-t-1} A^n > 0 .$$

In most cases, of course, goods traded internationally are not identical in all respects other than length of time to delivery. If we allow for quality differences and unique design specifications, it is no longer possible to determine which of the machines will command the higher price. But the rate of substitution between two machines is easily determined. If, as before, it is assumed for the sake of simplicity that the return to each machine is constant over its life and equal to $\bar{R}_1$ and $\bar{R}_2$, respectively, and, further, that consumers weigh the relative merits of the two machines independently of their time preferences, the rate of substitution (s), equal to the ratio of present values, can be shown (Greene, 1972, pp. 17–19) to reduce to

$$\begin{aligned} s = PV_2/PV_1 &= (\bar{R}_2 A^T \textstyle\sum_{n=0}^{k} A^n)/(\bar{R}_1 A^t \sum_{n=0}^{k} A^n) \\ &= (\bar{R}_2/\bar{R}_1)A^{T-t} . \end{aligned} \tag{1.2}$$

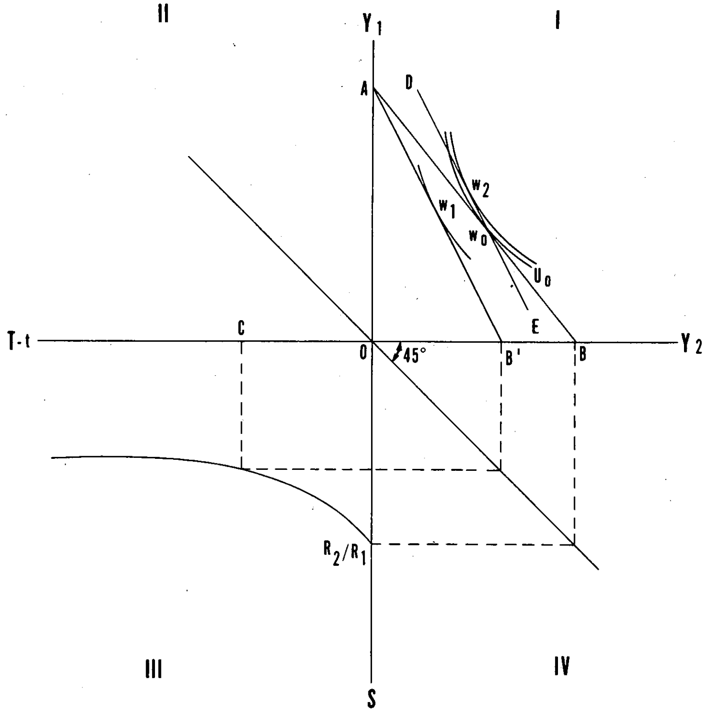
Notice that this ratio of present values involves the difference in waiting times, not the ratio of waiting times.[2] This ratio indicates that, when delivery terms are identical, the marginal rate of substitution reflects only the relative returns of the two machines. But when delivery time for the second machine is longer than for the first, these relative returns are discounted by the *additional* amount of time the consumer must wait to acquire machine 2.

Waiting times can readily be included in the traditional graphical treatment of the theory of demand. The rate at which individuals are willing to substitute between competitive products with different delivery dates, given by equation (1.2), is a downward-sloping function of the variable $T - t$, as shown in quadrant III of Figure 1. When the terms of delivery are identical for both products, $s = \bar{R}_2/\bar{R}_1$ (or 1, if the two goods are perfect substitutes). Quadrant I contains the usual budget

[2] In the event that the machines are perfect substitutes — that is, that $\bar{R}_1 = \bar{R}_2$ — the marginal rate of substitution reduces further to $s = A^{T-t}$.

FIGURE 1

THE EFFECT OF WAITING-TIME DIFFERENCES ON CONSUMER EQUILIBRIUM



constraint scaled in such a fashion that, for convenience, the distance OB equals the distance $\bar{R}_2/\bar{R}_1$ (or unity). The ratio of quoted prices facing the purchaser is equal to the slope of the line AB. Clearly, if the terms of delivery are identical for both products, the quoted prices will fully reflect the relative costs of the two items, and the buyer will be in equilibrium when his marginal rate of substitution — the slope of his indifference curve — is equal to the ratio of quoted prices (see point w_0).

If, however, machine 2 will be delivered later — that is, $T - t$ is equivalent to a distance such as OC — the effective relative cost of the two machines is not the ratio of quoted prices (the slope of AB) but rather the slope of AB'. The total cost of machine 2 includes not only the monetary outlay but also the delay in the use of the machine. Therefore, the relative cost of machine 2 is higher than that indicated simply by relative quoted prices. The consumer will not be in equilibrium until his marginal rate of substitution is equal to the slope of AB'. In addition, the value of the additional time lost represents a cut in the consumer's real income; the greater his rate of discount, the greater the income loss. In equilibrium, he will consume less of the service flow of machine 2 partly because of the loss of income (compare w_1 with w_0). But even if he were compensated for this income loss (that is, if the new budget constraint were DE), he would prefer to substitute some of the service flow of machine 1 for that of machine 2 (that is, the consumer would move from equilibrium at point w_0 to equilibrium at point w_2).

For simplicity of exposition, it has been assumed that the current period is the optimal time of delivery. If one accounts for the possibility that the optimal delivery time is, instead, some future date, the arguments become more complicated because the purchaser must compare whatever return he would obtain prior to the optimal delivery date against storage, financing, and other costs or inconveniences of too early delivery. Nevertheless, the marginal rate of substitution remains a function of the difference in the two goods' waiting times (see Greene, 1972, pp. 26–27). Moreover, it can always be assumed that, in any data on new orders used in an empirical study such as this, the orders recorded are wanted at least by the date promised, since a prospective buyer could have delayed his order so as to bring delivery more in line with his desired date of receipt.[3]

[3] If optimal delivery is later than the current period but prior to the quoted delivery date for either of the two substitute goods, the marginal rate of substitution is multiplied by a complicated ratio that is greater than unity.

II. INCLUSION OF WAITING TIME IN EXPORT DEMAND: THE EMPIRICAL SPECIFICATION AND ESTIMATING PROCEDURE

As shown in Chapter I, a demand function that takes account of length of time to delivery is similar to that conventionally assumed except that the price term is discounted by the difference in waiting times. Just as demand functions are frequently approximated, empirically, by a constant-elasticity demand function, so, too, the relationship shown in Figure 1 to describe the demand function for commodity χ_2 can be approximated by

$$\chi_2 = cY^{\varepsilon_0}[P/A^{T-t}]^{\varepsilon_1}, \tag{2.1}$$

where Y represents the consumer's income; P, the price of machine 2 relative to that of machine 1; A^{T-t}, the discounted value of the difference in waiting times; and ε_0 and ε_1, the income and relative-price elasticities respectively. This approach is fundamentally different from that adopted by Steuer *et al.* (1966) and Bispham (1970), who included the ratio of waiting times in the principal formulations of their experiments (Greene, 1972, pp. 22, 27–28).

The statistical procedures used to estimate demand equations of this type are similar to those used to estimate demand functions generally. The one difference, of course, is that a new independent variable has been introduced, the difference in waiting times. In this chapter, I describe how the waiting-time data were derived and review other data used. I then describe the actual empirical specification for the export-demand equations and attempt to determine if inclusion of a waiting-time differential would be expected, a priori, to introduce any bias into the estimation.

The Waiting-Time Estimates

Waiting times were calculated from data on new orders, unfilled orders, and shipments by way of a procedure first suggested by Steuer *et al.* (1966, pp. 389–390) and subsequently used by Artus (1971) and Nobay (1970). The procedure is to calculate the amount of time it takes for the first item ordered in a given month to be delivered on the basis of three assumptions: (1) that every recorded shipment appears also as an order on producers' order books;[1] (2) that items are ordered and shipped throughout a month;[2] and (3) that orders keep their place in the order queue, that is, orders are processed on a first-in first-out basis.

On the basis of these assumptions, a measure of waiting time can be calculated using any benchmark value of unfilled orders and time-series data on net new orders and shipments. The first item ordered in period t will not be delivered until all the items on order at the end of period $t - 1$ have been processed. Waiting time, therefore, will equal the number of months it takes for shipments, beginning at time t, to cover completely unfilled orders on the books at the end of period $t - 1$ as well as the first item ordered in period t.[3] Waiting times are always positive, and a value less than 1.0 indicates that shipment occurred within a month after the order was received.

This concept of waiting time (which differs from both the traditional measure of order backlog — the ratio of unfilled orders to deliveries — and that derived from a distributed-lag relationship between deliveries and new orders)[4] is based on assumptions which, to be sure, are not particularly realistic. Orders and shipments are not necessarily evenly spaced: purchasers often order several items at one time, with the result that orders

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[1] Items sold from producers' inventories would be treated as being ordered and delivered simultaneously.

[2] My estimates of waiting time were based on monthly data wherever possible. However, when only quarterly data were available, I had to assume, as did Steuer *et al.* (1966), that items were ordered and shipped at equal intervals throughout each quarter.

[3] Mathematically, the waiting-time estimate (W_t), derived from data on the level of unfilled orders at some initial period (U) and time-series data on shipments (S_t) and net new orders (N_t), can be described as $W_t = (n - t) + (1/S_{n+1})$, where n is that value satisfying the condition $U + \sum_{i=1}^{t} N_{i-1} - \sum_{i=1}^{n} S_i = 0$. In most cases, the basic data are not independent series and, by calculating the estimates in this fashion, I use all the information contained in these three series.

For example, if unfilled orders at the end of December 1959 were 100 and shipments in the first three months of 1960 were, respectively, 45, 46, and 30, waiting time for the first item ordered in January 1960 would be $2\frac{1}{3}$ months.

[4] The ratio of unfilled orders to deliveries is satisfactory only if the rate of delivery does not change much; the procedure used here, by contrast, takes into account subsequent fluctuations in shipments. The distributed-lag model, unlike the Steuer *et al.* method, allows for the fact that work may be in process simultaneously on orders received in different periods, and that orders booked in a particular period may therefore be delivered before some previously placed orders. However, in all other respects the distributed-lag procedure requires the same assumptions as this one and is much more cumbersome to use when estimates for many industries are required, as in this study.

and subsequent shipments may be bunched up. In addition, orders do not always keep their place in the queue: purchasers who do not wish to take delivery at the earliest possible date may give up their place in the queue, while rush orders may jump their place in the queue and be handled more rapidly than the waiting-time estimates would suggest. But even if some orders are processed at rates different from the waiting-time estimate, under most circumstances there is little reason to expect a systematic bias to result from this method of calculation. The most serious problems occur when there are unusually large or unusually long-term contracts, or when there are sizable modifications and cancellations of orders previously placed. In any of these cases, there might be a distortion in the waiting-time series for several periods (Greene, 1972, pp. 32–33), causing serially correlated errors that may introduce additional problems in the subsequent estimation of export-demand equations.

As for the actual calculation of waiting times, the net new-order and shipment data are from monthly or quarterly series, whichever were available, before seasonal adjustment and for the period I 1960 through II 1970.[5] (Where the most recent data were not yet available, a somewhat shorter period had to be used.) The benchmark value of unfilled orders is end-1959. In some cases, data on unfilled orders were not available for any period, and an initial value of waiting time had to be assumed. In these instances, a variety of calculations were made, based on alternative assumed initial values. The series chosen was the one that best satisfied criteria established to ensure a "well-behaved" series throughout the estimation period,[6] and, in this respect, these are partly arbitrary.

Waiting-time estimates were obtained for several durable-goods industries and industry groups in seven countries (in one case, also the European Community). Coverage varies for each country according to the availability of data. Within each country, the different industrial sectors represent various degrees of aggregation. The industries for which estimates could be obtained represent from 12 to 42 per cent, individually, of these countries' exports in 1965, the midpoint of the period covered in this study: Canada, 12.1; Germany, 42.1; Japan, 18.1; the Netherlands, 18.9; Norway, 15.8; the United Kingdom, 35.4; and the United States,

[5] Sources for all data are given under Data Sources at the end of this paper. Problems of comparability, coverage, and availability are described in Greene (1972, Appendix I).

[6] See Greene (1972, pp. 34–36) for the criteria used to choose the best series in these instances.

29.2.[7] As a group, these country-industries accounted for more than 29 per cent of the included countries' total exports in that year, and almost 68 per cent of all OECD trade in iron and steel products, fabricated metal products, nonelectrical machinery, and electrical machinery. Moreover, in some cases estimates could be derived separately for orders placed by domestic and foreign customers. A summary of all waiting-time estimates calculated is displayed in Table 2.

As can readily be seen by the total estimates obtained for British industries and industry groups, summarized for illustrative purposes in Table 3, the average length of time to delivery varies among industries. For most industries, the estimated values appear reasonable, both in isolation and in comparison with estimates for other industries of a similar degree of aggregation. To facilitate comparison of the estimated waiting times for each of the broadly defined industry groups in all seven countries, I ranked the groups in each country, assigning the industry group with the shortest average length of delivery a rank of 1 (see Table 4). When the rank sum for each group is standardized (by way of a procedure described in Greene, 1972, p. 51), the estimates look all the more plausible. The lowest ranks, and therefore the shortest average waiting times, are for the iron and steel and fabricated-metal-product industries. By contrast, the shipbuilding industry, known to be characterized by exceptionally long terms of delivery, has the highest rank, representative of the longest waiting times. When this same procedure is applied to a more detailed classification of industries for the countries for which individual industry waiting times were calculated, the interindustry differences in waiting times also conform to expectations. By far the shortest waiting times are obtained for industries producing items that are relatively standardized, that can be produced in large batches, and that take a relatively short time to manufacture—domestic appliances, construction machinery, iron and steel products, and insulated wire and cable. Similarly, the longest waiting times are in heavy industry, where the products are large and complex to build and production frequently must await individual customers' specifications — shipbuilding, rolling mills, engines and turbines, and generating, transmission, and distribution equipment.

The summary statistics presented in Table 3 for British industries and industry groups also suggest a fair amount of fluctuation over the sample

[7] The data on unfilled orders, shipments, and net new orders used for the estimation of waiting times are classified by industry. Data on exports, however, are classified by commodity. For the purpose of this study, these two methods of classification had to be reconciled (Greene, 1972, pp. 187–189).

TABLE 2

SUMMARY OF WAITING-TIME ESTIMATES CALCULATED BY INDUSTRY AND BY COUNTRY[a]

Industry or Industry Group	*Canada*	*EEC*	*Germany*	*Japan*	*Netherlands*	*Norway*	*U.K.*	*U.S.*
Iron and steel	T	X-H	T			X-H	X-H	T
Fabricated metal products	T		X-H		X-H	T	X-H	T
Mechanical engineering	T		X-H	T	X-H	T	X-H	T
Engines and turbines			X-H	T			X-H	T
Metalworking equipment			X-H	T			X-H	T
Machine tools			X-H	T			X-H[b]	X-H
Rolling-mill equipment			X-H				X-H	
Construction, mining, and mechanical handling equipment			X-H	T			X-H	T
Construction machinery			X-H	T			X-H	
Mining machinery			X-H	T			X-H	
Mechanical handling equipment			X-H				X-H	
Chemical plant and apparatus			X-H	T			X-H	
Industrial equipment	T		X-H	T			X-H	
Textile machinery			X-H	T			X-H	
General industrial equipment			X-H				X-H	T
Pumps and valves			X-H	T			X-H	
Electrical engineering	T		X-H		X-H	T	X-H	T
Generating, transmission, and distribution equipment	T			T			X-H	T
Insulated wire and cable	T			T			X-H	
Domestic appliances	T						X-H	T
Shipbuilding				T	X-H		T	

[a] Estimated waiting-time series are published in Greene (1972, pp. 196–328).
[b] Estimates based on both quarterly and monthly data.
NOTE: T represents estimates calculated for total country industry only. X-H represents estimates also calculated for export and home markets separately.

TABLE 3

WAITING-TIME ESTIMATES IN MONTHS BY INDUSTRY, UNITED KINGDOM
(time series based on quarterly data I 1960–II 1970, unless otherwise indicated)

Industry or Industry Group	*% Share of Britain's Exports, 1965*	*Summary Statistics of Waiting-Time Estimates (in months)*			
		Minimum	*Maximum*	*Mean*	*V (in %)*[a]
Iron and steel[b]	5.7%	3.16	5.39	3.90	13.52%
Fabricated metal products	2.5	12.47	18.37	15.02	11.51
Mechanical engineering	19.7	6.38	8.96	7.65	8.79
Engines and turbines	4.0	16.18	21.49	19.05	7.76
Metalworking equipment	1.3	6.65	10.95	8.60	15.81
Machine tools[c]	1.1	6.14	9.82	7.50	16.45
Rolling-mill equipment	0.2	9.43	21.45	15.68	16.84
Construction, mining, and mechanical handling equipment	2.1	2.48	6.99	5.33	17.33
Construction machinery	1.2 (Construction machinery and Mining machinery together)	1.84	3.81	2.92	15.99
Mining machinery		2.46	7.45	4.43	28.94
Mechanical handling equipment	0.9	2.28	11.08	8.63	21.30
Chemical plant and apparatus[d]	n.a.	8.97	15.99	12.75	14.23
Industrial equipment	7.8	5.55	7.88	6.75	8.58
Textile machinery	1.8	5.96	8.99	7.82	10.98
General industrial equipment	2.8	5.26	7.50	6.30	8.88
Pumps and valves	1.1	5.19	7.73	6.41	10.87
Electrical engineering	7.0	4.49	9.82	7.33	17.99
Generating, transmission, and distribution equipment	2.6	7.18	16.25	12.04	17.72
Insulated wire and cable	0.7	2.35	4.00	3.06	15.71
Domestic appliances	0.7	0.75	1.52	1.12	16.55
Shipbuilding[e]	0.5	15.23	30.89	23.69	15.57
Tankers		11.00	39.55	22.57	28.04
Other ships		11.32	29.31	21.20	21.29
Total share of Britain's exports	35.4				

[a] The coefficient of variation, equal to the standard deviation divided by the mean, multiplied by 100.
[b] Based on monthly data, January 1960–July 1970.
[c] Estimate based on quarterly data. Summary statistics for waiting-time estimates based on monthly data (which exclude welding equipment) for period January 1960–June 1969 are as follows: Minimum, 6.88; Maximum, 11.38; Mean, 8.76; *V*, 16.51.
[d] Based on quarterly data only through IV 1969.
[e] Based on quarterly data I 1961–IV 1970. Tankers are measured by number of ships; other ships (as well as the total) are measured according to gross tonnage.

TABLE 4

RANKING OF AVERAGE WAITING TIME BY INDUSTRY GROUP

Industry Group	*Country*							*Sum of Ranks*	*Standardized Sum of Ranks*[a]
	Canada	*Germany*	*Japan*	*Netherlands*	*Norway*	*U.K.*	*U.S.*		
Iron and steel	1	2[b]	—	—	2	1	1	7	1
Fabricated metal products	2	1	—	3	1	4	2	13	2
Mechanical engineering	4	3	1	1	4	3	3	19	3
Electrical engineering	3	4	—	2	3	2	4	18	4
Shipbuilding	—	—	2	4	—	5	—	11	5
Highest rank	4	4	2	4	4	5	4		

[a] Standardized for number of industry groups in each exporting country (see Greene, 1972, p. 51, for explanation of standardizing procedure).

[b] For Germany, the waiting-time estimate for steel and hot rolling-mill products was used.

NOTE: — = No waiting-time estimate calculated.

period for each estimate. Although some estimates vary according to developments peculiar to the specific industry, most estimates display a noticeable cyclical pattern, as might be expected. Terms of delivery were generally extended for many industries during the booms of 1960–62 and 1968–70 on the Continent, during the expansion of 1964–66 in the United Kingdom, and after 1964 in the United States. Similarly, waiting times in Japan shortened considerably early in the 1965–68 slowdown there (see Figure 2, where, as an example, waiting times for the machine-tool industry in these countries are presented).

Despite these general cyclical patterns, variation in the waiting-time estimates remains clearly distinct from variation in conventional measures of economic activity (Greene, 1972, pp. 54–57 and 88–89). In fact, upon careful inspection of these estimates, it becomes clear that any relationship between waiting-time and output fluctuations is quite complex. Peaks in delivery-time estimates frequently lead peaks in the deviation of actual output from its trend value. In addition, the precise timing of fluctuations in waiting times and output varies among industries, as would be expected in view of the different responses of each industry to cyclical swings. Therefore, the variation "explained" by a difference in waiting times would be expected to be different from that "explained" by the various "pressure" variables used to test the importance of pressure of domestic demand on export demand.

In country-industries for which it was possible to derive separate estimates for orders placed by domestic and by foreign customers, the estimated export waiting times frequently differ substantially from domestic estimates. Even though the ranking may be rather similar, as is the case for British industry (see Table 5), the differences in average waiting times for the two markets are often quite large and the differences throughout the full period are usually significant (Greene, 1972, pp. 77–79). These differences may reflect differences in commodity composition for domestic and foreign orders or differences in the way producers process orders in the two markets.[8] Whatever the explanation, I used export waiting times in the regression equations wherever these separate estimates could be calculated.

In the actual regression equations for a given industry, these estimates were used to calculate the differences in waiting times between competing

[8] See Greene (1972, pp. 77–79) for an analysis, based on the estimated waiting times for export and domestic markets, of two frequently assumed hypotheses: (1) that export waiting times are consistently longer than those for domestic customers, and (2) that the variation of export delivery dates reflects changes in the level of domestic demand.

FIGURE 2

ESTIMATES OF WAITING TIME FOR THE MACHINE-TOOL INDUSTRY

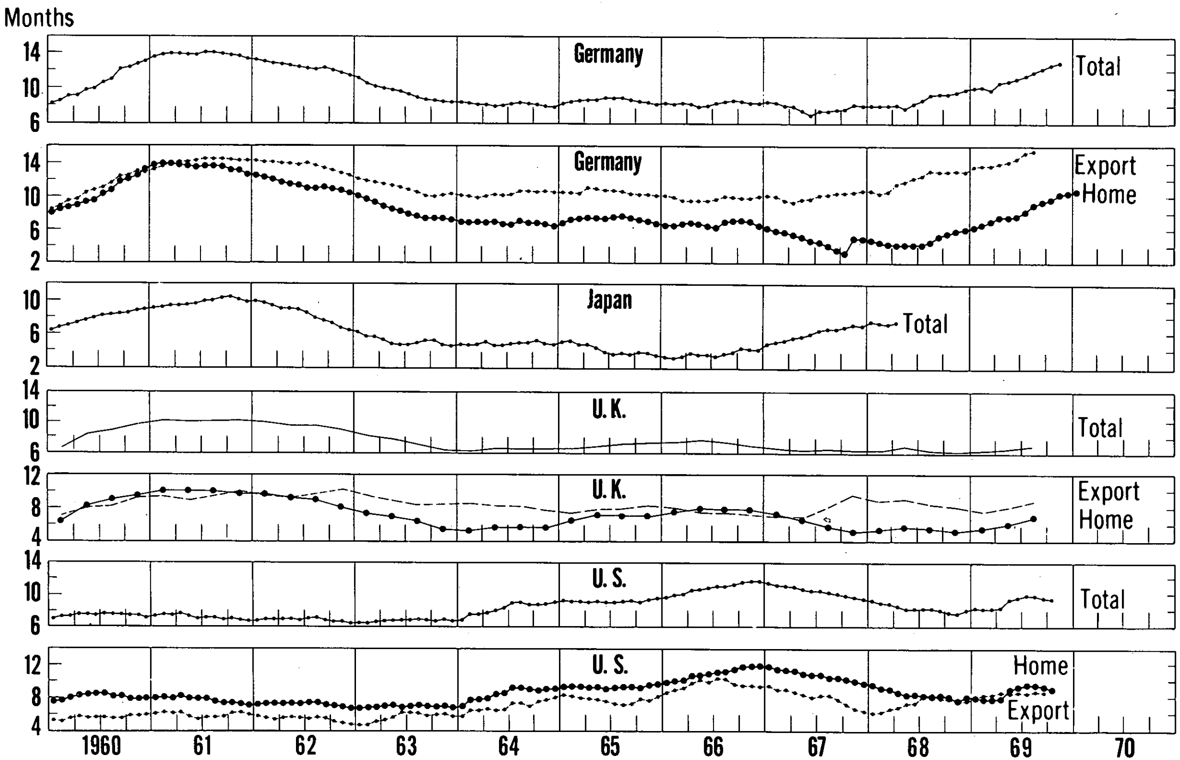


TABLE 5

EXPORT AND HOME WAITING-TIME ESTIMATES IN MONTHS BY INDUSTRY, UNITED KINGDOM
(time series based on quarterly data for I 1960–II 1970, unless otherwise indicated)

Industry	*Mean*		*V (in %)*[a]		*Rank of Average Estimate*	
	Export	*Home*	*Export*	*Home*	*Export*	*Home*
Iron and steel[b]	4.37	3.83	15.57	13.76	3	4
Fabricated metal products	15.03	15.08	13.50	12.66	18	19
Mechanical engineering	7.71	7.62	8.05	9.93	10	13
Engines and turbines	12.18	23.38	15.62	10.62	16	20
Metalworking equipment	10.31	7.82	11.37	23.52	15	14
Machine tools[c]	8.43	7.18	10.47	22.18	12	12
Rolling-mill equipment	20.05	13.25	15.90	20.92	20	18
Construction, mining, and mechanical handling equipment	4.01	5.93	14.43	20.07	4	6
Construction machinery	2.95	3.06	17.78	18.01	2	3
Mining machinery	5.64	4.54	24.11	31.60	6	5
Mechanical handling equipment	7.36	9.02	17.14	24.34	9	15
Chemical plant and apparatus[d]	15.57	10.60	24.25	12.70	19	16
Industrial equipment	7.81	6.15	9.80	9.30	11	7
Textile machinery	8.77	6.62	13.19	13.25	13	9
General industrial equipment	5.77	6.38	8.71	10.89	7	8
Pumps and valves	5.98	6.72	10.90	11.89	8	10
Electrical engineering	9.15	6.82	11.40	21.65	14	11
Generating, transmission, and distribution equipment	13.10	11.63	11.14	22.03	17	17
Insulated wire and cable	4.93	2.76	25.22	14.76	5	2
Domestic appliances	1.52	0.70	25.68	26.10	1	1
					$r_r = .73$	

[a] The coefficient of variation, equal to the standard deviation divided by the mean, multiplied by 100.
[b] Based on monthly data, January 1960–July 1970.
[c] Estimate based on quarterly data. Summary statistics for waiting-time estimates based on monthly data, which exclude welding equipment, are as follows: For Export, Mean, 9.90; *V*, 9.58. For Home, Mean, 8.36; *V*, 21.76.
[d] Based on quarterly data through IV 1969 only.
NOTE: r_r represents Kendall's rank coefficient.

export countries. Since, in every case, it is a comparison of waiting times that is important, great care was taken to use comparable levels of industrial aggregation within each equation.[9] For example, I included in the analysis of the machine-tool industry only those countries for which data for that industry were available—Germany, Japan, the United Kingdom, and the United States (see Table 2)—and used only the data specific to that industry. By contrast, Steuer *et al.* (1966) and Artus (1971) used estimates based on the entire nonelectrical machinery industry in Germany as a proxy for machine-tool waiting times; apparently, Steuer *et al.* also used estimates for the entire metalworking-equipment industry in the United States. Such comparisons are not only inappropriate but also potentially misleading. Since the more highly aggregated waiting-time estimates vary as the relative importance in total output of each of the component industries varies (Greene, 1972, pp. 62–64), such differences contain variable measurement errors that can only lead to a downward bias in the regression coefficient for the waiting-time argument.[10] In this study, the waiting-time differences are entered as an independent variable and are therefore assumed to be exogenous even though export orders, overall demand, waiting times, and prices are simultaneously determined.[11] Moreover, waiting-time differences were contemporaneous in all cases.[12]

Price, Demand, and Orders Data

As for the other independent variables, export price indices, as distinct from unit-value indices, were used wherever possible. When an export price index was not available, I took the advice of Kravis and Lipsey (1971, Chap. 8), who concluded that, despite their inadequacies, wholesale price indices are more reliable indicators of relative price movements for exported goods than export unit values. For only one country, the United

[9] Also, I was careful to classify similarly for each industry the basic data from which waiting times were estimated for each country (Greene, 1972, Appendix I).

[10] Such a bias may still occur if, as described earlier, either of the waiting-time estimates contains serially correlated errors resulting from inadequacies in the new-order or shipment data or in the procedure for estimating waiting times.

[11] Since the waiting-time estimate is a function of past orders and future shipments rather than of current orders, any simultaneous-equation bias affecting the waiting-time coefficient may be less severe than would otherwise be the case.

[12] In effect, I assumed either that potential customers' expectations about the time they must wait for delivery are correct or that potential customers are quoted correct waiting times by manufacturers who are aware of their order positions.

Kingdom, were neither export prices nor wholesale prices available in sufficient detail to be used in this study; in this instance, I calculated indices of export unit value from available export value and volume data. These calculated indices for each industry were led by the number of months suggested by the waiting-time estimate, so that the index measured prices at the time the orders were placed rather than at the time the commodity was exported. Indices of all types have been converted to the base year 1965, the midpoint of the period under review.

Although an income variable is suggested by equation (2.1), I generally used as the scalar variable a measure of the level of demand for the specific commodity in question. This measure was obtained by summing orders — both domestic and foreign — placed with manufacturers in countries where data were available (all data converted to U.S. dollar value). Total orders are thereby assumed to be pre-determined, but the allocation of these orders is assumed to be affected by the competitive conditions facing customers. A similar assumption is frequently employed in studies of export demand (Leamer and Stern, 1970, Chap. 7) and is invoked by Steuer *et al.* (1966, p. 388). But, in this case, the buyer, having decided to make the purchase, is seen as choosing between a supplier in his home market or in any possible export market. By using this variant of the "export share" formulation, I hope to impound the income effects and to isolate the terms-of-trade effect of differences in waiting times.

I estimated each equation in current- and constant-value form, so as to judge the reliability of the estimated relative-price elasticities. As price deflators, I used the same price indices that were included as explanatory variables, despite the inadequacy of this approach. In order to have also a scalar variable for the constant-value form that would not reflect the many errors that may be contained in a deflated total-orders variable, I used, in addition, an alternative measure — a weighted average of the industrial-production indices for each export country's major foreign markets.[13]

Clearly, the interpretations attached to the coefficients of the orders-demand and alternative production variable are different. Whereas the coefficient to the variable based on total orders represents the share elasticity, that for the production measure, a proxy for the real value of income abroad, more nearly approximates the income elasticity. The two coefficients would therefore be different if, for example, a particular

[13] Initially, to account for possible substitution among commodities of different industries or industry groups, equations with this scalar variable also contained as an independent variable the relative price of the specific commodity in question.

country enjoyed an increasing share of the market for a particular commodity but world expenditure for this commodity did not increase any more rapidly than world income.

The Empirical Specification

The dependent variable, export demand, is in every case measured by net foreign orders received by manufacturers in the exporting country. An export-demand equation was estimated for industries in the countries in which separate export-order data were available. For each country-industry, three forms of regression equations were estimated. These types of equations can be designated as Model A for the current-value equations,

$$\text{A: } lnXO_{ijt} = b_0 + b_1 lnD_{oit} + b_2(W_{ij} - W_{ik})_t + b_3 ln(P_{ij}/P_{ik})_t + e_t\,, \qquad (2.2)$$

and as Model B for the constant-value equations,

$$\text{B: } lnKXO_{ijt} = b_0 + b_1 lnKD_{oit} + b_2(W_{ij} - W_{ik})_t + b_3 ln(P_{ij}/P_{ik})_t + e_t\,, \qquad (2.3)$$

and

$$\text{B: } lnKXO_{ijt} = b_0 + b_1 lnD_{pjt} + b_2(W_{ij} - W_{ik})_t + b_3 ln(P_{ij}/P_{ik})_t + b_4 ln(P_i/\overline{P})_t + e_t\,, \qquad (2.4)$$

where XO_{ijt} = export orders placed with manufacturers of industry i in country j at time t, in current U.S. dollars

KXO_{ijt} = export orders in 1965 U.S. dollars

D_{oit} = sum of all orders (domestic and foreign) placed with manufacturers of industry i in all countries at time t, in current U.S. dollars

KD_{oit} = sum of all orders in 1965 U.S. dollars

D_{pjt} = income in country j's foreign markets, as measured by indices of industrial production (1965 = 100) at time t

W_{ijt} = waiting time for industry i in country j, the exporting country

W_{ikt} = waiting time for industry i in country k, the competitor country (or a weighted average of all competitors)

P_{ijt} = price index for industry i in country j

P_{ikt} = price index for industry i in country k

$P_i/\bar{P}$ = relative price of commodity i. $P_i/\bar{P} = \sum_{j=1}^{n} w_j(P_i/\bar{P})_j$, where $\bar{P}_j$ is the overall wholesale price index for each of n countries and where the weights (w_j) represent each country's share of 1965 exports.

The three basic equations were estimated with quarterly data for a period beginning I 1960. The kth country represented either one of the exporting country's competitors (in which case, the equation contained a "pairwise comparison") or the weighted average of all other countries (a "weighted comparison"). The length of the sample period, which was determined by the length of the waiting-time series, varied. The number of observations was always at least 25 and, in some cases, as many as 38. Whenever any of the independent variables was not statistically significant at the 0.05 level, I excluded the variable making the smallest contribution and re-estimated the equation until all variables or all variables but the difference in waiting times were significant. If, at that point, the Durbin–Watson statistic fell outside the acceptable range, I re-estimated the equation using the so-called "first-order Cochrane–Orcutt" transformation (Johnston, 1963, p. 194; Goldberger, 1964, pp. 235–238). In some cases, a simple autoregressive scheme obviously did not pertain. In those instances, I re-estimated the basic equations in stock-adjustment form (that is, with the lagged value of the dependent variable), a model probably relevant to a wide range of industries where demand for replacement, repairs, and parts is included in the data and is partially determined by previous levels of demand.

The three estimating models are derived from the log-linear form of the assumed demand function

$$ln\chi_2 = lnc + \varepsilon_0 lnY - \varepsilon_1 lnA(T - t) + \varepsilon_1 lnP \,. \tag{2.5}$$

On the basis of this theoretical relationship, the waiting-time and price variables can be entered either as separate arguments or as a single, collected term. But, empirically, they must be introduced separately if one is to avoid inserting an arbitrary value for the discount factor, the parameter to be estimated. As will be discussed later, it may be difficult to assess the value of the waiting-time coefficient, inasmuch as it serves as an estimate of the product of two parameters, $-\varepsilon_1 ln(A)$. Nevertheless, the sign of this coefficient is unambiguous. If the rate of discount for consumption between any two consecutive periods is positive, $ln(A)$ will be negative. Since the price elasticity is, by definition, also negative, the entire expression would be less than zero. The null and alternative hypotheses to be tested, therefore, are $H_o: b_2 \geq 0$ and $H_a: b_2 < 0$. In addition, it was presumed that b_1 is greater than 0, b_4 is less than 0, and b_3, which measures the offer-curve elasticity in Model A or the relative-price elasticity in Model B, is also less than zero.

In estimating these equations, every effort was made to address the statistical problems encountered in previous studies. By introducing one waiting-time argument, I avoided sample-period multicollinearity between the two separate waiting-time estimates and also reduced the possibility that one of the waiting-time estimates might serve as a more precise measure of demand for the country-industry in question than the demand variable itself.[14] As a further precaution in this regard, I used a demand variable (based on either orders or output in major export markets) that, I felt, would more adequately capture fluctuations in demand for the commodity in question than what had been used before,[15] and did not consider an equation successful unless this variable was significant. Even then, if the residuals of the equation suggested that there were still recognizable demand fluctuations remaining to be explained, I tried to impound these fluctuations using any one of the following variables: quarterly dummies (QI, QII, etc.) with the usual definitions; a cyclical variable (CYC), the deviation from semilog trend of the industrial-production indices of each exporter's major foreign markets; and a speculative variable (Z), the ratio of the three-month forward premium on the exporter's currency to the premia of other major currencies.[16]

Even with these improvements, my estimating equations may be subject to certain specification deficiencies. Measurement errors may yet be contained in the waiting-time estimates for a given industry because of remaining discrepancies in the industrial classification among countries, differences in the composition of output in various countries even in a properly defined industrial category, or serially correlated errors in one of the waiting-time estimates. Sample-period multicollinearity can be en-

[14] Even if there were reason to expect a positive relationship between one of the waiting-time estimates and export orders, there is no a priori reason to anticipate a systematic relationship between the difference in any two waiting times and export orders.

[15] Steuer *et al.* (1966) used a demand proxy based on import and export data.

[16] Deviation from interest parity might have been a more sophisticated measure, but the ratio used here did vary in accordance with exchange-market pressures.

countered at any time and, if serious enough, could render my estimates of the discount factor too imprecise to be meaningful. And, of course, simultaneous-equation bias may distort results whenever single-equation least-squares is used to estimate demand functions. In effect, I assume for the purposes of estimation that waiting times, relative prices, and total demand are independent of each other; if, in fact, there are systematic interrelationships among any of these variables, multicollinearity may result. The effect of multicollinearity is to provide inefficient estimates; the effect of either measurement error or simultaneous-equation bias is to bias the estimate of b_2 toward zero. If there is an error in the conclusions of this study, therefore, it is more likely to be an understatement of the significance of waiting times in export demand than an overestimate of their importance.

III. INCLUSION OF WAITING TIME IN EXPORT DEMAND: THE STATISTICAL RESULTS

The export-demand equations described in the previous chapter can be viewed from two levels of abstraction. At the simplest level, it has been assumed that, on average, buyers have a positive rate of discount between current and future consumption and that they maximize their utility. On the basis of these assumptions, consumers faced with two sources of supply for the same commodity were shown to prefer to place their orders with the supplier providing the shorter waiting time, *ceteris paribus*. In other words, in an explanation of export new orders, the estimated coefficient for the waiting-time differential, $\hat{b}_2$, would be negative. If two additional assumptions are imposed — (1) that the rate of discount between any two consecutive periods is a constant and (2) that the demand relationship is adequately described by a Cobb-Douglas function — it is possible to interpret the magnitude of the coefficient $\hat{b}_2$. In this chapter, the empirical results are summarized with a view, first, to testing the hypothesis concerning the sign of the waiting-time coefficient and, second, to estimating the rate of discount.

Sign of the Waiting-Time Coefficient

To derive the sign as well as the value of the waiting-time coefficient, I estimated a set of Model A (current value) and of Model B (constant value) equations for each industry in countries where data on export orders were available. Each set consisted of equations comparing the exporting country to each of the other countries for which a waiting-time estimate for that particular industry was available, as well as an equation comparing the exporting country to a weighted average of all these other countries. For illustrative purposes, all successful comparisons obtained for the machine-tool industry are presented in Table 6.[1] These results, like

[1] For the United Kingdom, only equations based on data from the quarterly survey of all engineering industries are shown. Another source of data for the British machine-tool industry was available monthly for most of the period through September 1968 (Greene, 1972, p. 180). These were the data used by Steuer *et al.* (1966). In general, the forms of the best equations provided by the two sets of data were similar. However, of the successful equations, the monthly data provided a better fit and a larger value of $|\hat{b}_2|$ over a sample period that was somewhat shorter (Greene, 1972, p. 372).

TABLE 6

EXPORT DEMAND FOR MACHINE TOOLS

		Equation									Summary Statistics			
E:C[a]	Model	Constant	lnD_o	$lnKD_o$	lnD_p	$(W_{ij} - W_{ik})$	$ln(P_{ij}/P_{ik})$	Z	CYC	λ[b]	R^2	DW	SEE	df
G:J	A	−1.304 (−1.62)	+.732 (4.90)*			−.076 (−2.60)*		+3.474 (1.82)			.565	2.06′	.094	29
G:J	B	−1.184 (−1.33)		+.636 (3.68)*		−.084 (−2.84)*		+3.688 (1.92)			.500	2.04′	.095	29
G:U.S.	B	9.168 (1.82)		+.549 (1.84)*		−.044 (−1.89)*	−2.729 (−2.48)*#	+4.419 (2.14)*		+.416 (4.69)*	.863	2.37	.102	32
J:W[c]	A	29.638 (4.16)*	+1.271 (2.68)*			−.122 (−2.32)*	−8.081 (−7.07)*		$+8.700_{-1}$ (1.98)		.867	2.39	.373	28
J:U.K.	A	8.351 (1.27)	+2.097 (4.43)*			−.193 (−3.06)*	−4.630 (−4.44)*				.781	1.72	.491	30
J:U.S.	A	22.075 (3.70)*	+2.0[d]			−.109 (−4.18)*	−7.467 (−5.76)*		−9.967 (−2.26)*		.711	1.81	.403	30
J:W[c]	B	18.654 (1.04)			+2.050 (2.12)*	−.132 (−3.72)*	-4.945_{-1} (−2.42)*#		$+14.363_{-1}$ (3.41)*		.933	2.17′	.329	27
J:G	B	12.768 (1.02)			+2.354 (3.14)*	−.133 (−3.12)*	-4.259_{-2} (−3.33)*		$+21.531_{-2}$ (5.28)*		.944	2.46′	.301	26
J:U.K.	B	−19.342 (−10.60)*			+4.418 (10.67)*	−.114 (−2.46)*			$+6.798_{-1}$ (1.94)		.873	2.32	.356	29
J:U.S.	B	−17.930 (−7.91)*			+4.141 (8.21)*	−.075 (−2.67)*					.875	2.15	.361	31
U.K.:G	A	4.500 (2.26)*	+.526 (4.90)*			−.063 (−3.36)*	-1.009_{-2} (−2.71)*#		−6.446 (−3.29)*		.566	1.82	.161	32

U.K.:G	B	1.552 (2.06)*			+.391 (2.35)*	−.055 (−2.87)*				.273	2.38	.170	36
U.K.:J	B	2.869 (2.03)*			+.904 (2.72)*	−.059 (−2.66)*	−.735 (−1.68)			.154	2.24	.157	30
U.S.:W[e]	A	−3.740 (−.87)	+1.119 (1.83)*			−.107 (−2.05)*			+.461 (3.68)*	.325	1.67	.181	29
U.S.:J	A	7.423 (3.35)*	+.817 (2.93)*			−.040 (−2.12)*	−2.826 (−3.67)*[f]			.325	1.76′	.155	29
U.S.:U.K.	A	−2.152 (.63)	+.906 (2.02)*			−.118 (−2.22)*			+.434 (3.91)*	.296	1.91	.186	34
U.S.:W[e]	B	−.927 (.96)		+.928 (2.38)*		−.085 (−2.95)*		+7.354 (1.90)		.311	1.87‴	.160	28
U.S.:G	B	−2.906 (−.76)		+.977 (1.79)*		−.093 (−2.29)*			+.363 (5.32)*	.499	1.96	.194	34
U.S.:J	B	8.127 (3.22)*		+.841 (3.02)*		−.038 (−2.29)*	−3.095 (−4.26)*			.497	1.78′	.152	29
U.S.:U.K.	B	−5.934 (−1.62)		+1.477 (2.70)*		−.158 (−3.17)*			+.396 (5.29)*	.555	2.02	.183	34

* Statistically greater than (less than, or different from) zero at the 0.05 level of significance.
\# Not statistically different from −1.0 at the 0.05 level of significance.
′ All variables have been transformed to take account of first-order autocorrelation in the residuals.
‴ All variables have been transformed to take account of second-order autocorrelation in the residuals.
[a] To designate which waiting time is being referred to in this table, E (Exporter) is shown to the left of the colon and C (Competitor) to the right, where country codes used are as follows: G = Germany, J = Japan, U.K. = United Kingdom, U.S. = United States. W designates a weighted comparison.
[b] λ represents the rate of adjustment, the proportion of the total amount of adjustment that is accomplished during the current quarter. When a stock-adjustment equation is reported, the parameters indicated here are the estimated long-run coefficients.
[c] For these equations, W is a weighted average of U.S., U.K., and G.
[d] Elasticity constrained to a value similar to those obtained for other pairwise comparisons in order to avoid strong multicollinearity between waiting-time differential and demand.
[e] For these equations, W is a weighted average of J, U.K., and G.
[f] Not statistically different from −2.0 at the 0.05 level of significance.
NOTE: The numbers which appear in parentheses under each coefficient are *t*-statistics.

those obtained for all industries, provided significant relationships that almost always contained significant and "right signed" demand variables. The waiting-time coefficient was almost always negative and, in a number of pairwise comparisons, was statistically significant. Of all the coefficients, the price elasticities were the least reliable. Even when a significantly negative coefficient was obtained, the estimates from the two models were frequently inconsistent (compare, for example, Models A and B pairwise equations for British exports of machine tools). Nevertheless, my results for British machine tools were similar to those obtained by Steuer *et al.* (1966) for this industry. German competitive terms were significant here, as they were in those earlier results, but neither the American nor the weighted variables proved successful in either study. The results for other exporting countries were at least as successful as those for the United Kingdom.

In all, 477 equations were estimated to describe foreign demand for 20 industries or industry groups in 7 countries (or regions).[2] The results of these experiments were, on the whole, quite satisfactory and indicate that the importance of waiting time is not limited to the machine-tool industry. Of all the equations attempted, only 36 failed to provide a significant relationship, as measured by the F-statistic for the equation as a whole at the 0.05 level. Only 42 equations were rejected because they failed to meet the second criterion for success — a significantly positive demand variable[3] (see Table 7). A somewhat greater proportion of Model B equations had to be rejected for either of these two reasons than was the case for Model A. However, on the basis of these criteria, Model B proved to be more successful than might have been supposed in view of the additional difficulties inherent in estimating a constant-value equation. For both models, a greater proportion of weighted than pairwise equations did not meet the first two criteria for success. But a comparison between these two types of equations is difficult to draw because the sample period for the weighted comparisons is frequently more limited.[4]

[2] Export-demand equations were not estimated for the shipbuilding industry primarily because "export" orders received by British shipbuilders probably do not adequately measure demand by nonresidents for British ships (Greene, 1972, p. 180). Had equations for this industry been estimated, the sample periods would have been much shorter than for most equations reported here, in view of the very long estimated delivery times.

[3] Note that a one-tailed significance test was used, since the null hypothesis to be tested was that the demand coefficient, b_1, is less than or equal to zero.

[4] The number of observations for the equation had to be determined by the number of observations available for the waiting-time estimate of the country-industry that was estimated to have the longest length of delivery time (or for which the available order

TABLE 7

SUMMARY OF RESULTS

	Total	Model A W	Model A P	Model B W	Model B P
1. Number of equations attempted	477	51	180	54	192
2. Number rejected because equation not significant	36	3	9	4	20
3. Number rejected because "demand" not significant	42	7	12	9	14
4. Line 1 − lines 2 and 3	399	41	159	41	158
5. Number rejected because waiting-time differential not significant	207	20	95	20	72
6. Number of successful equations (line 4 − line 5)	192	21	64	21[a]	86[b]

[a] Of which 3 were for the iron and steel industry, an industry for which no Model A equation could be estimated.
[b] Of which 9 were for the iron and steel industry.
NOTE: W = weighted, P = pairwise.

Of the remaining 399 equations that met the first two criteria for success, more than half contained a coefficient for the waiting-time differential that was significantly negative.[5] In this respect, the Model B equations provided modestly better results. In fact, the highest rate of success among the otherwise acceptable equations was for the Model B pairwise comparisons, where it was possible to accept the alternative hypothesis that b_2 is less than zero in 54 per cent of the otherwise acceptable equations (or 45 per cent of all equations tried). The extent to which the waiting-time coefficient is significantly negative is all the more impressive in view of the possibility that the waiting-time coefficients might be biased toward zero. The results of the unsuccessful equations may give some indication that there was, in fact, a downward bias to the waiting-time coefficients. The proportion of waiting-time coefficients that were correctly "signed" in

and shipment data used to estimate waiting time were the shortest). The sample period for pairwise comparisons was longer when the estimated waiting times for the two country-industries being considered were relatively short.

[5] Again, a one-tailed test was used to test the null hypothesis that the waiting-time coefficient, b_2, is equal to or greater than zero.

these equations was 70 percent, significantly higher than would be expected if, in fact, waiting time has no consistent effect on export orders.[6]

Of the potential estimation problems, the most serious one actually encountered was multicollinearity. At times, it was impossible to retain all three variables — demand, the waiting-time differential, and relative prices — significantly in the equation. However, there was no consistent pattern of relationships between any of these variables, and a collinear relationship that appeared for a short period was not necessarily maintained for a slightly longer period. It seems possible to conclude, therefore, that the collinearity that did emerge in these experiments reflected not so much a consistent error in specification but historical, and perhaps coincidental, trends within these variables. In any case, any equation which, because of multicollinearity or any other reason, did not have both significant demand and waiting-time coefficients was rejected as "unsuccessful."

A closer look at the equations which provided significantly negative waiting-time coefficients reveals that Models A and B yielded broadly similar results. The theoretically more attractive Model B provided a somewhat larger number of satisfactory estimates of the waiting-time coefficient for most countries (see Table 8). The United Kingdom was the only country for which Model B provided less than half the acceptable equations. And this was the one country for which it was necessary to use calculated export unit values rather than an export or a wholesale price index as the price deflator for most equations.

The demand variable in the "best" Model B equations was more frequently the weighted average of the industrial-production indices in major export markets, or D_p, a variable that apparently reflected develop-

TABLE 8

NUMBER OF SUCCESSFUL EQUATIONS OBTAINED FROM EACH MODEL[a]

	Germany	*Japan*	*Netherlands*	*U.K.*	*U.S.*	*All Countries*
Model A	25	12	6	39	3	85
Model B	35	14	8	34	4	95
Total	60	26	14	73	7	180

[a] Does not include the 12 successful equations for the iron and steel industry, since only Model B was estimated for this industry.

[6] If there was such a bias, it appears to have been widespread and no more serious when estimates of waiting time based on an assumed initial value were used.

ments in the exporting countries' major markets more than did the sum of all orders, or KD_o. This variable was by far the superior demand variable for the Japanese equations (see Table 9). Considerations in local export markets were probably quantitatively more important than "world demand," because Japan did not emerge as a major competitor in world markets in most products considered in this study until somewhat late in the sample period. For Japan, as well as for the other countries, however, the constant-dollar value of orders would have provided a satisfactory equation in many instances even if the equation fit, as measured by the standard error, had not been quite so good.

TABLE 9

DEMAND VARIABLES IN "BEST" MODEL B EQUATIONS[a]

	Germany	*Japan*	*Netherlands*	*U.K.*	*U.S.*	*All Countries*
KD_o	13	2	2	17	4	38
D_p	22	12	6	17	0	57
Total	35	14	8	34	4	95

[a] Does not include the 12 successful equations for the iron and steel industry, since only one demand variable — an index of world steel production led one quarter — was used for this industry.

Other variables were frequently and successfully used in the best equations to capture short-run swings in demand not adequately accounted for by either the sum of all orders or the "production"-demand variable. The cyclical variable was used in a wide variety of equations for several countries; when it was entered, any readily recognizable pattern previously in the residuals was noticeably reduced, if not totally eliminated. A speculative variable was also successfully included in the German, but not in the British, equations. This variable was strongly positive and either may have reflected anticipatory purchasing before a possible revaluation of the German mark or may just have impounded all the factors which made that currency so strong during the 1960's. Quarterly seasonal dummies were seldom significant and therefore appear in few of the final equations.

The difference in waiting times was a significant variable in equations covering a wide range of industries and in all countries (or regions) included in this study (see Table 10). Of the 55 separate country-industries for which export-demand equations were estimated, 39 provided at least one equation with a statistically significant waiting-time coefficient. Furthermore, satisfactory results were obtained for every industry group in each of the exporting countries.

TABLE 10

SUMMARY OF ESTIMATED EXPORT-DEMAND EQUATIONS BY INDUSTRY AND BY EXPORTING COUNTRY: ALL EQUATIONS

	EEC		*Germany*		*Japan*		*Netherlands*		*Norway*		*U.K.*		*U.S.*		*Total*	
Industry	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*	*N*	*Acc*
Iron and steel	5	2							5	5	5	5			15	12
Fabricated metal products			12	7			12	2			12	12			36	21
Mechanical engineering			16	8	16	14	16	9			16	7			64	38
Engines and turbines			8	6	8	0					8	6			24	12
Metalworking equipment			8	0	8	0					8	1			24	1
Machine tools			8	3	8	7					16[a]	7[a]	8	7	40	24
Rolling-mill equipment			2	2							2	0			4	2
Construction, mining, and mechanical handling equipment			8	4	8	0					8	8			24	12
Construction machinery			8	7	8	0					8	3			24	10
Mining machinery			8	0	8	0					8	0			24	0
Mechanical handling equipment			8	3							8	5			16	8
Chemical plant and apparatus			6	0	6	0					6	6			18	6
Industrial equipment			10	4	10	0					10	0			30	4
Textile machinery			6	1	6	0					6	0			18	1
General industrial equipment			8	2							8	1			16	3
Pumps and valves			8	2	8	3					8	1			24	6
Electrical engineering			14	11			14	3			14	7			42	21
Generating, transmission, and distribution equipment					8	2					8	2			16	4
Insulated wire and cable					6	0					6	6			12	6
Domestic appliances											6	1			6	1
All industries	5	2	138	60	108	26	42	14	5	5	171	78	8	7	477	192

[a] Includes equations based on both the quarterly and the monthly data.

NOTE: *N* represents number of equations estimated. *Acc* represents number of acceptable equations.

The export-demand equations were not equally successful for all countries, however. The most disappointing were the Japanese experiments. Of 108 equations attempted, 19 were not significant relationships and only 26 provided significant waiting-time coefficients. This relatively poor showing may reflect statistical deficiencies. Since data on Japanese waiting time and on new orders were available for a shorter period than for other countries, there were fewer than usual observations for these equations and multicollinearity frequently was more serious. Or this poorer performance may simply indicate that foreign demand for Japanese goods cannot be described by one stable relationship of the type posited here throughout the period of the 1960s. With Japanese output becoming so sophisticated over the sample period, it may be considerably more difficult to measure the effect of various competitive variables without first taking account of changes in quality.

Nor were the results equally good among industries. For industries in which discrepancies in the classification could not be overcome — as in generating, transmission, and distribution equipment[7] — the results were noticeably poorer than average. Furthermore, for several of the industries in which one or more of the waiting-time estimates appeared to be subject to estimation error — as in mining machinery, textile machinery, or rolling-mill equipment (Greene, 1972, p. 75) — the equations were frequently less successful. But even for industries in which classification errors were serious or the waiting-time estimate may have contained measurement error, a majority of the rejected equations had correctly signed coefficients for the waiting-time differentials.

Estimates of Monthly Rates of Discount

The estimated coefficients of the waiting-time differentials can be used to estimate the monthly rate of discount if it can be assumed that this discount rate, per month increase in the waiting-time differential, is a constant. In the Cobb-Douglas function used to estimate export demand, the waiting-time coefficient was shown to represent an estimate of the product of the relative-price elasticity and the discount factor, $\varepsilon_1 ln(A)$.

[7] For the United Kingdom and Japan, this category pertains almost entirely to heavy machinery for the electricity industry; for the United States and Canada, it refers simply to electrical transmission and distribution equipment, including such items as doorbell transformers.

This regression result can be used, therefore, to derive an estimate of the rate of discount ($\hat{\alpha}$) which would be equal to

$$\hat{\alpha} = e^{(\hat{b}_2/\hat{\varepsilon}_1)} - 1 . \tag{3.1}$$

Unfortunately, as already indicated, the estimate of the relative-price elasticity was the least reliable of all the coefficients estimated. Moreover, it is difficult to apply tests of significance to the ratio of two regression coefficients. I therefore adopted a two-part procedure to derive $\hat{\alpha}$. As a first approximation, I treated the price elasticity as if it were equal to -1.0 for all "successful" weighted and pairwise comparisons. This treatment is consistent with most of the price estimates obtained. For the machine-tool industry (see again Table 6), my estimates of the waiting-time coefficients ranged from $-.04$ to $-.19$. On the basis of equation (3.1), these coefficients correspond to a rate of discount of about 4 to 21 per cent per month if $\hat{\varepsilon}_1 = -1$.

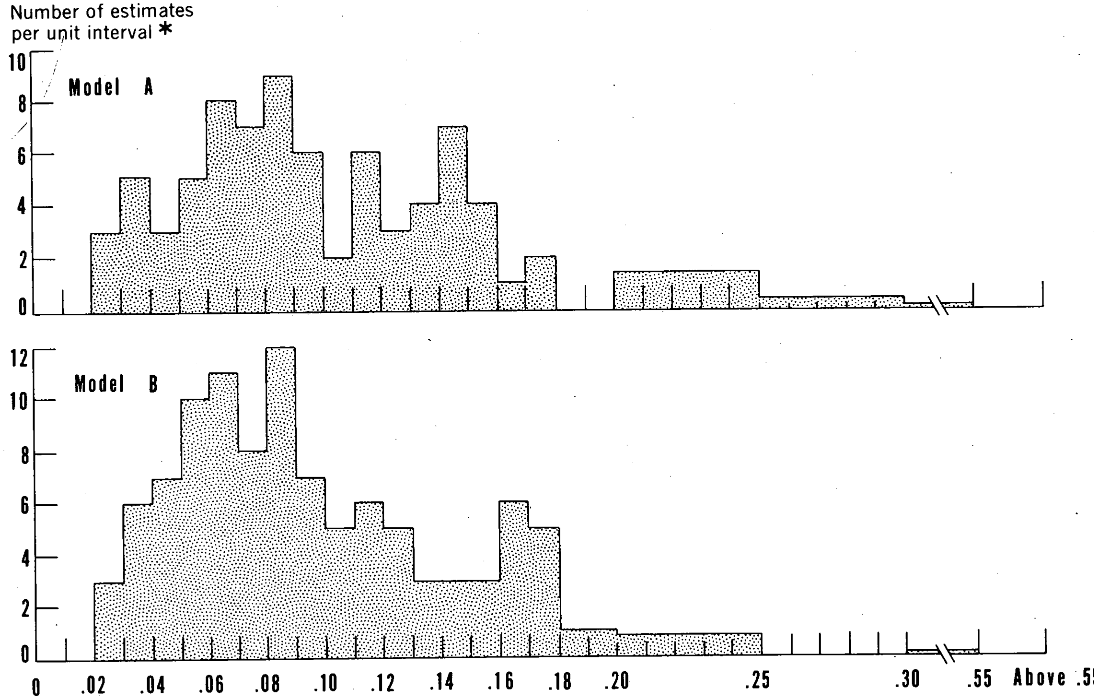
For all 39 country-industries with significant $\hat{b}_2$ coefficients, the coefficients ranged from $-.02$ to one extreme of $-.41$. On the assumption that all price elasticities are -1.0, and using the same approximating procedure described above, these coefficients would correspond to monthly rates of discount of 2 to 50 per cent per month. The most frequent values of these estimates for both models were between 8 and 9 per cent, values which on an annual basis are indeed quite high. As can be seen in Figure 3, the estimated rates of discount are somewhat more concentrated for Model B than for Model A. For Model B, the median for the distribution of $\hat{\alpha}$ fell between 8 and 9 per cent and more than half the estimates were within a range of 6 to 10 per cent. The median rate of discount for Model A was higher, falling between 9 and 10 per cent, and half the estimates were within a range of 5 to 11 per cent.

These estimated rates of discount showed some consistent characteristics. When Japanese export equations were successful, the implied rates of discount were frequently higher than for other countries. However, the standard errors also were larger, indicating that the estimates were less precise. For other countries, the rates of discount in export markets were more similar. There was, however, some tendency for the discount rates from British export-demand equations to exceed those from German equations.

As a refinement to these initial approximations, I re-estimated the rate of discount, using the actual estimate of the relative-price elasticity in equation (3.1) for country-industries where a significant price elasticity was obtained. The number of estimates for the discount rate that could be

FIGURE 3

FIRST-APPROXIMATION ESTIMATE OF DISCOUNT RATE PER MONTH



* Up to .20, the individual bars in these charts represent the actual number of estimates that fell in the indicated intervals. For estimates of .20 or above, the bars represent the average number of estimates that fell in the intervals .20–.25, .25–.30, and .30–.55. For example, in Model A, there were 7 estimates within the range .20–.25, which, when interpolated, gives an average of 1.4 percentage point.

made on this basis was reduced by about half for Model A and by almost 60 per cent for Model B. Therefore, these estimates did not contain a group of country-industries that was comparable with the first-approximation estimates. Moreover, these results may not be representative of all country-industries, as those with low relative-price elasticities have been excluded.

One difference between the two sets of estimates was striking, however. These final estimates of the discount rate were individually and for the group as a whole sharply lower, since, on balance, the estimated price elasticities exceeded unity. For the machine-tool industry, for example, the final estimates ranged from 1 to 4 per cent. For all industries, the estimates ranged from 0.6 to 31.7 per cent (see Figure 4). For both Models A and B, the median rate of discount obtained in this second group of estimates was between 3 and 4 per cent. In other respects, the estimates for Model A were lower than those for Model B. The mode fell between 1 and 2 per cent, and half the estimates were less than 4 per cent for Model A. For Model B, the mode fell between 3 and 4 per cent, and half the estimates were between 1 and 5 per cent. This difference in the results for the two models probably reflected differences in the country-industry composition of successful estimates.[8]

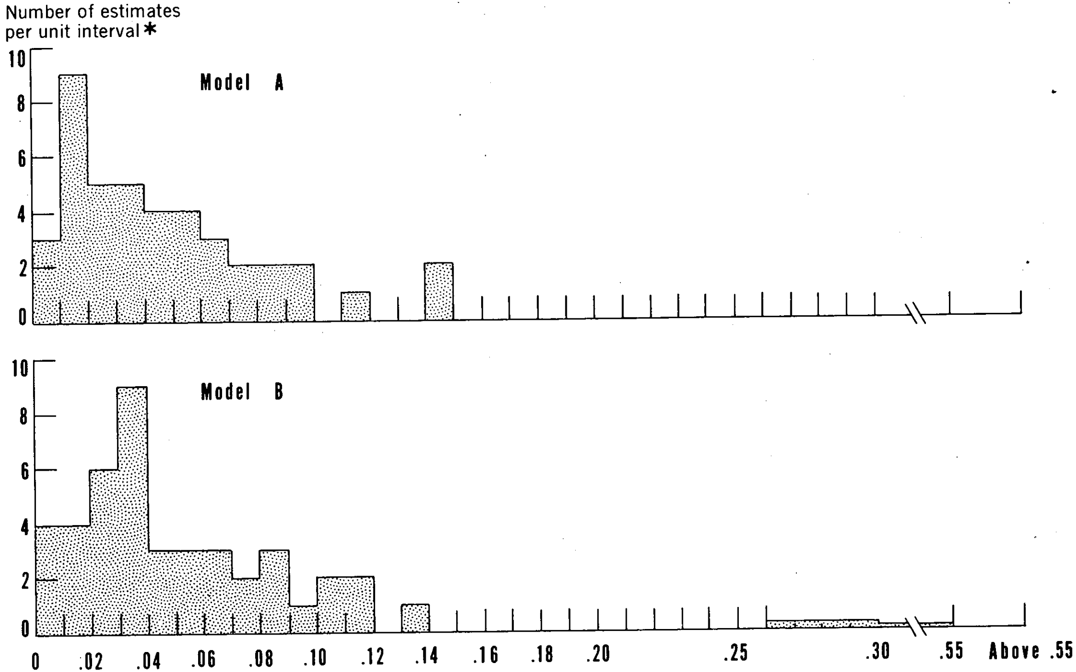
The more refined estimates of the rate of discount for each industry are presented in Table 11, together with the estimated relative-price elasticities. Few waiting times from Japanese export-demand equations are included in this second group of estimates, but those that are retained are much lower than before, all falling between 1 and 4 per cent. In this group, estimated rates of discount for British exporters again were somewhat higher than those for German exporters. It is not possible to determine, however, whether this pattern reflected possible errors introduced by using my calculated export-unit-value indices as a measure of British prices, by differences in the industries for which these estimates were obtained, or by differences in time preferences in the export markets for these two countries.

Although as a group these estimates seem more reasonable, as they clearly are lower than the first approximation, several estimates remain

[8] Such a difference would also emerge if there were serious discrepancies in the estimates of the relative-price elasticity provided by the two models for the same country-industry. As it turned out, however, such discrepancies were minor in cases where both Model A and Model B estimates could be calculated; where there were discrepancies, Model A estimates of the discount rate were higher than Model B estimates about as often as they were lower.

FIGURE 4

ESTIMATE OF DISCOUNT RATE BASED ON ESTIMATED PRICE COEFFICIENTS



* See footnote to Figure 3.

surprisingly high for monthly rates of discount. It would not be surprising if the price elasticities obtained in the single-equation experiments here were biased downward. Indeed, estimated price elasticities are feared to be subject to such a downward bias, and an underestimate here would serve to augment the estimated discount rates artificially. Moreover, if the optimal time of delivery were at some future date rather than the current period, as assumed for simplicity throughout this study, the b_2 coefficient from which the estimates are drawn would contain another argument that has not been separated out, an argument that accounts for the additional cost of too early delivery (see the final paragraph of Chapter I). Under this circumstance, the actual discount rate should be lower than these estimates suggest. It is to be hoped that subsequent work will be undertaken to refine the estimating procedures and provide some grounds for comparison for the results obtained here. On the basis of this preliminary study, however, even after taking account of any possible upward bias, these results do seem to suggest that prospective purchasers are willing to pay a premium — sometimes a rather sizable premium — to get delivery as early as possible.

TABLE 11

FINAL ESTIMATES OF DISCOUNT RATE PER MONTH INCREASE IN WAITING-TIME DIFFERENTIAL ($\hat{\alpha}$) AND RELATIVE-PRICE ELASTICITY ($\hat{\varepsilon}_1$)

Exporter: Competitor, by Industry	*Model A*		*Model B*	
	$\hat{\alpha}$	$\hat{\varepsilon}_1{}^{ab}$	$\hat{\alpha}$	$\hat{\varepsilon}_1{}^{b}$
Iron and steel:				
EEC: W[c]	n.a.	n.a.	.113	−1.094#
EEC: U.K.	n.a.	n.a.	.132	− .898#
U.K.: C	n.a.	n.a.	.317	− .804#
Fabricated metal products:				
G: W	.059	θ#	.027	−1.513#
G: C	.113	θ#	.108	− .936#
G: U.S.	.093	−2.200	.093	−1.308#
Ne: No	.035	−4.700#†	.037	−4.371†
Mechanical engineering:				
G: W	.026	−1.912#†	.039	−1.486†
G: C	.016	−1.796#	.080	− .743
G: No	.011	−2.571#†	.011	−1.933†
G: U.S.	.013	−2.430#	.040	−1.305#
J: G	.026	−7.131	.030	−6.517
Ne: J		xx	.009	−6.331†

TABLE 11 (*Continued*)

Exporter: Competitor, by Industry	Model A		Model B	
	$\hat{\alpha}$	$\hat{\varepsilon}_1{}^{ab}$	$\hat{\alpha}$	$\hat{\varepsilon}_1{}^{b}$
U.K.:W	.088	θ#	.047	−1.515#
U.K.:Ne	.069	θ#	.074	−1.136#
U.K.:U.S.	.061	θ#	.050	− .993#
Engines and turbines:				
G:W	.145	θ#	.101	−1.472#
G:U.S.	.019	−4.302#†	.030	−2.738†
Metalworking equipment:				
U.K.:G	.021	−2.466#		xx
Machine tools:				
G:U.S.		xx	.016	−2.729#
J:W	.013	−9.081	.027	−4.945†
J:G		xx	.031	−4.259†
J:U.K.	.035	−5.630		xx
J:U.S.	.013	−8.467		xx
U.K.:G[d]	.031	−2.009#		xx
U.S.:J	.010	−3.826†	.012	−3.095†
Rolling-mill equipment:				
G:U.K.	.009	−3.183#†	.011	−2.353†
Construction, mining, and mechanical handling equipment:				
U.K.:W	.044	−2.481#†	.060	−2.050†
U.K.:J	.080	−2.120#†	.083	−2.018†
U.K.:U.S.	.049	−2.708†	.063	−2.222†
Construction machinery:				
G:W	.028	−2.712#†	.027	−1.992†
G:J	.142	θ#	.059	−1.889#
G:U.S.		xx	.016	−3.669
Mechanical handling equipment:				
G:W	.075	θ#	.031	−2.502#
G:U.S.		xx	.034	−1.940#
U.K.:W	.055	−2.589#†	.043	−2.524†
U.K.:J	.090	−2.638#†	.065	−2.417†
U.K.:U.S.	.041	−3.485†		xx
Chemical plant and apparatus:				
U.K.:J	.006	−12.431#		xx
Industrial equipment:				
G:W		xx	.018	−1.984†
Textile machinery:				
G:J		xx	.022	−2.731†
Pumps and valves:				
G:U.K.	.033	−2.528#†	.036	−2.076†
Electrical engineering:				
G:W	.060	θ#	.025	−1.705#
G:Ne	.015	−3.614†		xx
G:No	.009	−4.319	.014	−2.344†
G:S	.016	−4.156†		xx
G:U.S.	.071	θ#	.033	−1.321#

Table 11 (*Continued*)

Exporter: Competitor, by Industry	*Model A*		*Model B*	
	$\hat{\alpha}$	$\varepsilon_1{}^{ab}$	$\hat{\alpha}$	$\hat{\varepsilon}_1{}^{b}$
Generating, transmission, and distribution equipment:				
U.K.:J	.024	−4.810#†	.024	−5.217†
Insulated wire and cable:				
U.K.:W	.044	−2.430#†	.073	−1.494†
U.K.:C	.037	−2.630#†	.058	−1.729†
U.K.:J	.050	−2.246#†	.088	−1.309†
Domestic appliances:				
U.K.:U.S.		xx	.288	−1.658†

[a] The estimated relative-price elasticity used for the Model A equation is $\hat{\varepsilon}_1 = \hat{b}_3 - 1$, since the difference between the relative-price elasticity and the coefficient obtained in a current-value demand equation is unity.

[b] To compare the estimated price elasticities of the two models for country industries where both a Model A and a Model B discount-rate estimate were obtained, certain standard significance tests were applied to the relative-price coefficients ($\hat{b}_3$). The results of these tests are indicated by the following symbols:

- \# Price coefficient not statistically different from −1.0 at the 0.05 level of significance.
- θ# Model A price coefficient not statistically different from zero and Model B elasticity not statistically different from −1.0 at 0.05 level of significance.
- † Price coefficient not statistically different from −2.0 at 0.05 level of significance.
- #† Model A price coefficient not statistically different from −1.0 and Model B elasticity not statistically different from −2.0 at 0.05 level of significance.

[c] To designate which waiting-time differential is being referred to in this table, the Exporter for each industry is shown to the left of the colon and the Competitor to the right, where country codes used are as follows: C = Canada, EEC = European Economic Community, G = Germany, J = Japan, Ne = the Netherlands, No = Norway, S = Switzerland, U.K. = United Kingdom, U.S. = United States, and W designates a weighted comparison.

[d] Estimates based on monthly rather than quarterly data for British export orders for machine tools are as follows:

Model A		*Model B*	
$\hat{\alpha}$	$\hat{\varepsilon}_1$	$\hat{\alpha}$	$\hat{\varepsilon}_1$
.054	−2.416#	.116	−1.000#

NOTE:

n.a. = Not available. No Model A equations were estimated for iron and steel industry.

xx = No final discount-rate estimate possible on basis of estimated export-demand equations.

IV. SUMMARY AND CONCLUSIONS

The purpose of this study was to determine if and to what extent waiting times are a factor in export demand for manufactured goods. In recent years, several authors have attempted to include various measures of waiting time or of order backlog into their estimated export-demand equations. This study differs from previous work in two important respects.

First, I attempted to specify an export-demand function that includes waiting time as a variable in a manner consistent with traditional demand theory. In previous studies, waiting times for different countries were entered as ratios or, sometimes, as separate arguments. However, it was shown in Chapter I that, if consumers are utility maximizers, the appropriate specification of demand includes the difference, not the ratio, of waiting times. If, furthermore, consumers have a positive rate of discount between present and future consumption and they are faced with two otherwise identical commodities, they will prefer the one with the quicker delivery. Not only is the difference in waiting times theoretically more appealing, but it also facilitates the estimation; a regression equation that includes the waiting-time differential is less likely to suffer from serious multicollinearity than one that includes two or more waiting-time estimates as separate arguments.

Second, I focused on obtaining comparable results for many industries in several countries. Earlier studies had focused intensely on one industry; Steuer *et al.* (1966) had concentrated on the British machine-tool industry, and subsequent work had been directed either to this industry or to all manufacturing (or engineering) industries as a whole. By limiting my experiments to two basic specifications of the export-demand function, I was able to consider whether waiting times have a general influence on export demand for manufactures or affect only specific industries.

My results suggest that waiting times are an important factor in export demand for a wide range of industries. Significant waiting-time-differential coefficients were obtained for industries with relatively standardized products and short delivery times — such as iron and steel products and domestic appliances — as well as for industries with specialized commodities and relatively longer delivery times — such as engines and turbines. If consumers are assumed to have a constant discount rate between present and future consumption, then, according to my final estimates, a one-month increase in a country's waiting time, when delivery terms in other countries remain unchanged, is for most commodities equivalent for the consumer to an increase in the ratio of quoted prices of up to 5 per cent.

To obtain estimates of the effect of changes in the time of delivery on demand, waiting-time estimates were calculated for a wide range of industries, and separate estimates were derived for export and domestic markets whenever possible. These estimates showed the expected pattern. Waiting times were shorter for industries which, because of the nature of their product, can adjust to fluctuations in demand by building up inventories than for industries where individual specification is more important. However, neither the full-industry waiting-time estimates nor the individual estimates for foreign and domestic markets were readily "explained" by contemporaneous changes in the country's own industrial-production index. This result suggests that the relationship between length of delivery and cyclical variations in overall output is probably quite complex, and may differ among industries.

In many important respects, this study represents a preliminary, albeit comprehensive, survey of the effects of waiting time on export demand. As indicated in Chapter III, the final estimates of the discount rate seem surprisingly high. It would be interesting to determine how well these initial results would hold up if the price and waiting-time arguments were estimated together as a single, collected argument using a variety of assumed discount rates, including those obtained here. This study raises other interesting questions as well, since no attempt was made to determine why waiting times differ among industries or, for a given industry, among countries.

Despite the questions that remain to be answered, these results give compelling evidence of the importance of waiting time in demand for products of a wide range of country-industries. The inclusion of waiting time as an element of the total cost of a product has significant theoretical as well as empirical implications, because some aspects of observed market behavior can now be easily reconciled with traditional theory. For example, it has long been observed that international trade has not fully equalized commodity prices in the exporting countries, a condition usually assumed under conditions of perfect competition. The discussion here suggests that a potential consumer can be indifferent between a whole set of market prices and waiting times and, as a result, it is the time-discounted prices that have to be equalized. This additional consideration may introduce difficult complications concerning the factor-price equalization theorem in international trade.

Another observed market phenomenon that can more readily be analyzed is the role of the specialty traders, "importers" and "exporters." One of the functions of these agents is to keep inventories of imported (exportable) products that can easily be shipped to the prospective buyer, who then does not have to order directly from the manufacturer, wait for his order to be processed, and allow additional time for the product to be transported. These "middlemen" can make a profit by offering to buyers who place a high premium on quick delivery imported goods at prices that cover not only the selling prices of the goods but also the opportunity cost of the funds the importer has tied up while waiting for delivery. The markup in the prices the traders receive is an indication of the value of time for final customers.

By including in the theory of demand the role of waiting time, we can explain why purchasers would be willing to negotiate long-term contracts with price-escalator clauses. Clearly, if prices are permitted to rise to cover increases in production costs, one of the frequently cited advantages of a long-term contract, a fixed price, no longer pertains. Yet escalator clauses are now quite common, especially in the shipbuilding industry, as they meet the requirements of both buyer and seller when delivery terms become extended. Producers at some point will no longer wish to accept more orders at a fixed price because they may not be able to complete the order at the stated cost; however, they are willing to be assured of more work if they can recoup any cost rises. Purchasers are unable to find a manufacturer who can offer better terms, and a contract assures that they keep their place in the order queue.

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