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Technological Factors in the Composition and Direction of Israel's Industrial Exports

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I. INTRODUCTION

In his celebrated paper "International Trade—The Long View," J. R. Hicks summed up his disappointment with the failure of economic theory to explain the composition and flow of international trade. Hicks felt that the classical theory could indeed explain the flow of minerals, raw materials, and agricultural produce from countries where they are naturally or easily available to those where they are not:

"All that, however, is very obvious—it needs no subtle economic reasoning to explain these comparative advantages. The crucial test for the factor-scarcity theory (and indeed, as we have seen, for any international trade theory) is to explain the advantages of the industrialized countries. And on that side, the factor-scarcity theory is not too successful." [5]

Hicks of course was not the only economist who felt that the law of comparative advantage in its classical, Ricardian sense or, in its more recent interpretation, in terms of the Heckscher-Ohlin "factor proportions" theorem failed to give a satisfactory explanation of the composition and flow of international trade. In view of the persistent dollar shortage in the decade that followed the war and following Leontief's claim that U.S. export industries are less capital-intensive than the country's import-competing industries, growing interest has been evidenced in the relationship between technology and trade (see Leontief [9], MacDougall [10], Hoffmeyer [7], and Posner [12]).

Some of the more interesting findings in this field concern the relationship between innovation and international competitiveness. In his study of the world plastics industry, C. Freeman showed that countries tend to enjoy a strong competitive position in world markets in plastic products developed by indigenous firms (Freeman [2]). Subsequent research conducted by Freeman into the electronics equipment industry yielded similar results [3]. These findings were confirmed by G. C. Hufbauer in his study of synthetic fibers [9] and by Gruber, Mehta, and Vernon, who studied the relationship between investments in research and development in a number of industries and the competitive position of the countries where this kind of investment took place [4]. All these researches tended to confirm the assertion that countries which pioneer new products tend to enjoy a quasi- or even absolute monopoly over these products in world markets, for a while. They enjoy this position even in those cases where they have no obvious comparative advantage in the inputs contained in the products.

This paper discusses the findings of yet another empirical study, conducted over the period 1965 to 1967, which sought to identify and explain some of the technological and other factors affecting the composition and direction of Israel's exports.

The approach used in this research and the methods adopted were determined by the basic premise that export performance as evidenced in statistics cannot be explained in terms of costs, market conditions, or even technological factors alone. Part of the explanation must be sought by reference to the exporting firm, the organization which transforms comparative advantage from an abstract concept into reality. Many firms could export some or all of their output, yet only some choose to become exporters whereas others stick to the domestic markets. Certain firms export the bulk of their output, whereas the exports of others, even in the same industry, may be negligible. Only in very few industries is export performance uniform; polished diamond manufacturers in Israel export, as a rule, the bulk of their output, and manufacturers of citrus products export, as a rule, a high proportion of their output. By contrast, few firms in the Israeli shoe industry engage in export. In most other industries, export performance varies between firms and between products, variations being almost infinite with respect to share of output exported, concentration of products, shares of different countries in exports, etc.

Numerous factors are undoubtedly responsible for these variations: among them, size, technology, factor costs and factor intensity, product policy, and government policies. Some of these factors, such as product policies, are within the control of the firms, whereas others, such as wage rates, are outside it. Certain factors, the exchange rate, for example, are established by governments, whereas others, such as availability of raw materials or the size of a potential export market, must be considered as given, as far as both the firm and the whole economy are concerned. Interaction among all these variables eventually produces export performance.

We reasoned that because individual firms have considerable latitude in their response to environmental factors, and because those factors influence but do not uniquely determine the firm's performance in the domestic and foreign markets, our research would be focussed on the individual firms. We sought to explain some aspects of the economy's export performance by studying their policies and behavior. Our basic postulate was that a significant proportion of variations in export performance of individual firms can be explained by reference to the characteristics of their products, which, in turn, are affected to an important degree by the skill intensity of the labor force employed in their manufacture. The model which our research was intended to test is spelled out, in some detail, below.

Products manufactured by skill-intensive firms (i.e., firms employing a high proportion of scientists, engineers, and highly skilled employees) have certain characteristics which distinguish them from products manufactured by firms with low skill intensity.

Firms employ a high proportion of skilled workers, engineers, and scientists when their products are comparatively new. At this stage, production runs are short, specifications are loose, and the production process must be frequently adjusted to take care of changes in specifications, design, or methods. To cope with these frequent changes and adjustments, the labor force must have high skill intensity. Existing, or mature products, by contrast, have different characteristics; the technology has been stabilized, specifications change rarely, designs are frozen, and production runs are long. Consequently, comparatively fewer scientists, engineers, and skilled employees are employed by the firms manufacturing these products.

The different characteristics of the high and low skill-intensive firms

affect the manner in which they are able to export their products. Demand for skill-intensive products tends to be inelastic because substitution among competing products made by relatively few manufacturers is rather imperfect, and price competition is not very keen. Quality, reliability, and service are important determinants of the competitive position of the individual manufacturer. None of these ingredients can be taken for granted by the buyer, who must be in close and direct contact with the manufacturer to inform him of his specific needs.

The situation in respect to low skill-intensive products is different. Demand is characterized by high price elasticity, since close substitutes are readily available. Specifications, performance characteristics, and quality standards are well established, and users of the products are fully aware of what they can expect to get for the well publicized prices they pay.

To sell new, skill-intensive products, the manufacturer must inform potential buyers of the availability of his product, while ascertaining that it suits their requirements. He must often provide pre-sale and post-sale services to ensure that the product does indeed conform to the needs and specifications of the buyer. To perform these tasks, connection with the market must be intensive and communications between manufacturer and buyer must flow freely and frequently.

Manufacturers desiring to export high skill-intensive products must maintain their own marketing organization, if they are to compete successfully. They are usually at a disadvantage vis-a-vis domestic competitors because of distance, high costs of communications, and high marketing overheads. These expenses must be duplicated in every market regardless of its size. To compete successfully in export markets, low skill-intensive manufacturers have a far less onerous task—they must merely meet the price of their competitors, be they domestic or foreign. Since specifications, performance characteristics, and quality of their products are familiar to potential buyers, they do not have to invest heavily in marketing organizations and communications. Services, if necessary, can be performed by agents, and costs of marketing may be shared with other firms.[1]

[1] The characteristics of high and low skill-intensive products are discussed by the writer in greater detail in [6].

If the above outline of the problems facing manufacturers and exporters of high versus low skill-intensive products represents a reasonable approximation of reality, then certain differences in the organization, policies, and behavior of the firm manufacturing these two kinds of products ought to be observed:

High skill-intensive firms will tend to regard prices and costs as a comparatively unimportant determinant of their competitive posture. Their export performance will tend to be strongly affected by their marketing effort and by maintenance of close connections with the markets. Successful exporters will have their own marketing departments, and the most successful ones might even have some sort of proprietary association with the organizations marketing their products abroad.

Low skill-intensive firms are, by contrast, expected to be much more affected by price and cost considerations. Export performance need not be correlated with the existence of a marketing department or with maintenance of proprietary connections in foreign markets. Similarly, communications and direct connections with the market need not be as intensive as in the case of the high skill-intensive firms.

Positive correlation between size and export performance is to be expected because of the high costs and more complex tasks performed by exporters; yet size is likely to figure less importantly in the case of low skill-intensive firms, which need invest comparatively less in export marketing and whose comparative disadvantage vis-a-vis domestic competitors is less marked.

Finally, we expect certain relationships between the geographic distribution of exports and the skill intensity of the products. Since price is assumed to be the main determinant of the competitiveness of low skill-intensive products, these products may be expected to be exported mainly to markets where price competition prevails. The markets of Western Europe and North America are undoubtedly more competitive in this sense than the markets of Eastern Europe or of the developing countries of Africa, Asia, or South America, where competition is often restricted. Moreover, low skill-intensive products are, because of their technological characteristics, among the first candidates for domestic production in countries where industrialization is in its early stages. Such countries tend to grant administrative and tariff protection to their

domestic industries should they be challenged by foreign competition. Consequently, a comparatively small proportion of low skill-intensive products will tend to be exported to the markets of the developing countries.

The exports of high skill-intensive products are expected to be distributed quite differently. Only a small proportion of high skill-intensive products exports are likely to be exported to the developed countries where manufacturers have a marketing cost advantage over foreign competitors. Many of the high skill-intensive products are not manufactured in the developing countries because of the scarcity of skilled workers, engineers, and scientists, and because of the small domestic markets. Israeli manufacturers of high skill-intensive products compete in the markets of the developing countries with other foreign manufacturers, who do not necessarily have a marketing cost advantage over the Israelis. Consequently, Israeli manufacturers of high skill-intensive products are expected to sell a high proportion of their exports in the developing countries.

These postulates are reformulated in Parts II, III, and IV, where they are tested against empirical data. Part II discusses the findings pertaining to the manufacturing process and pricing policies adopted by the firms which we interviewed and relates them to their skill intensity. Part III deals with the relationships between skill intensity, organization of the export marketing function and export performance. Part IV reviews the geographic distribution of the respondents' exports and relates it to their skill and capital intensities.

In Appendix A we discuss the methods used in selecting the firms which constitute our sample. The composition of the sample is discussed in Appendix B. Skill intensity, production concentration, and export performance are defined in Appendixes C, D, and E respectively.

II. PRODUCT CHARACTERISTICS IN RELATION TO SKILL INTENSITY

A number of postulates concerning the relationship between the skill intensity of the respondents and the nature of the products manufactured by them are formulated and tested in this part. The characteristics

examined include production concentration, production to customer orders and to customer specifications, methods of price determination, and capital intensity.

Concentration of production

Firms with high skill intensity which manufacture new products whose specifications frequently change, and whose production runs are short, as suggested in our model, might be expected to produce more products than the low skill-intensive firms whose production runs are long and whose products' specifications vary infrequently. One way of testing this proposition is to examine the degree of production concentration—how does the proportion of the most important products (in terms of value) vary with skill intensity?

A partial answer to this question is given in Table II.1 where data on production concentration are broken down by skill-intensity groups. The table shows that production concentration tends to decrease with skill intensity in accordance with our expectations. A more complete analysis requires that both size and industry be held constant since production concentration of a plant employing thirty workers is not quite comparable to that exhibited by a plant with five hundred

TABLE II.1

Distribution of Firms by Skill Intensity and Production Concentration

	Skill Intensity[b]							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Low	12	22	20	54	26	38	39	35
Medium	13	25	20	58	28	44	39	38
High	21	10	11	42	46	18	22	27
Total	46	57	51	154	100	100	100	100

Note: Inaccuracies due to rounding.

[a] For derivation of index see Appendix D.

[b] For definition of skill intensity and its measurement see Appendix C.

employees. Similarly, production concentration indexes of chemical plants employing continuous process methods should not be interpreted in exactly the same way as indexes calculated for metal fabricating plants where manufacturing is done in units or batches. Owing to the limited size of the sample, however, neither size nor industry was held constant. Correlation between skill intensity and production concentration might have been even more marked had this procedure been followed.

Production to order and to customers' specifications

We suggested in Part I that specifications for new products are worked out in cooperation with the market to a greater extent than those of mature products, whose specifications are stable and well known. If this is indeed the case then high skill-intensive firms should manufacture a higher proportion of their output to customers' order or to their specifications, than low skill-intensive ones.

Of the two measures, the proportion of production to customers' specifications is probably a better indication of the need for communications between customer and manufacturer, since communications between the two are implied by the definition of the term. On the other hand, production to customers' orders rather than to stock may be undertaken by the firm even when sales do not require intensive communications with customers, as when orders for a particular product are infrequent, or when unit costs are high. Our model suggests nevertheless the existence of a positive correlation between skill intensity and production to customers' orders because this method of production is likely to require, on the whole, more intensive communications with the customers than when the firm adopts the policy of producing to stock.

The evidence is presented in Tables II.2 and II.3 which show the relationship between skill intensity and the proportion of output manufactured to customers' orders and to customers' specifications respectively. The distribution of the respondents tends to conform to our expectations: skill intensity varies inversely with both variables. The figures also show that variations of the second measure are more strongly associated with skill intensity than those of the first.

TABLE II.2

Distribution of Firms by Proportion of Firm Output Manufactured to Order and by Skill Intensity

Proportion of Firms' Total Output Manufactured to Order	Skill Intensity							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Per Cent								
0 - 35	30	18	20	68	54	27	34	38
36 - 80	11	24	22	57	20	36	37	31
81 - 100	15	25	17	57	26	37	29	31
Total	56	67	59	182	100	100	100	100
Average	33	58	58	50				

Note: Inaccuracies due to rounding.

TABLE II.3

Distribution of Firms by Production to Customers' Specifications and by Skill Intensity

Proportion of Firms' Total Output Manufactured to Customers' Specifications	Skill Intensity							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Per Cent								
0	34	24	16	74	61	35	27	40
1 - 60	15	25	25	65	27	37	42	36
61 - 100	7	19	18	44	12	28	31	24
Total	56	68	59	183	100	100	100	100
Average	11	25	36	25				

Note: Inaccuracies due to rounding.

Methods of price determination

It was asserted in Part I that the demand for high skill-intensive products is less price sensitive than the demand for low skill-intensive products. This assertion was based on the assumption that manufacturers of high skill-intensive products enjoy a certain degree of monopoly since they have few or no competitors, at least in the short run. Low skill-intensive products, on the other hand, are marketed under competitive conditions, and their sellers must adjust their prices to those prevailing on the market.

To test this proposition, respondents were asked to indicate what proportion of their sales is priced on the basis of one of the following considerations: market price, institutional arrangements, average costs, and marginal costs. It was assumed that those who establish their prices on the basis of prevailing market prices have no control over prices since they are selling in a competitive market. Prices can be established on the basis of institutional arrangements when manufacturers cooperate in price fixing. Such cooperation is common in Israel where the Government encourages firms to cooperate in establishing agreed export prices and, in certain cases, even domestic prices. Where prices can be effectively established by cooperating manufacturers, competition is, by definition, reduced. Similar conclusions must be reached regarding the other pricing methods; if a firm can base its prices on costs, then it may be said to possess a certain degree of monopoly.

Tables II.4 and II.5 show the distribution of the respondents by skill intensity and by the dominant method they use to establish prices in foreign and domestic markets respectively. The tables show that most respondents consider their prices to be determined by the markets. Some difference, however, clearly exists between them. The dominant share of the market as the major determinant of price varies inversely with skill intensity. The higher the skill intensity, the lower the number of firms which regard their prices as being determined mainly by the market. This is especially noticeable in the domestic market, where competition is more subject to modification than in export markets. Here, less than half of the high skill-intensive firms report their prices to be determined by the market and nearly one-quarter price their products by means of institutional arrangements. The distribution of

TABLE II.4

Distribution of Firms by Dominant Method of Export Price Establishment and by Skill Intensity

Methods of Price Establishment	Skill Intensity							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Market determined	33	34	33	100	80	83	78	81
Institutional arrangement	4	1	0	5	10	2	–	4
Average costs	2	4	4	10	5	10	10	8
Marginal costs	2	2	5	9	5	5	12	7
Total	41	41	42	124	100	100	100	100

Note: Inaccuracies due to rounding.

TABLE II.5

Distribution of Firms by Dominant Method of Domestic Price Establishment and by Skill Intensity

Method of Price Establishment	Skill Intensity							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Market determined	38	49	26	113	72	72	48	64
Institutional arrangement	4	3	12	19	7	4	22	11
Average cost	9	15	16	40	16	22	30	23
Marginal cost	2	1	–	3	5	1	–	2
Total	53	68	54	175	100	100	100	100

Note: Inaccuracies due to rounding.

this group varies considerably from that of the medium and low skill-intensity groups.

Finally, we ought to consider the possibility of bias. It is of course

possible that respondents tended to overstate the importance of the market as the dominant price determinant, but as long as this bias was equally distributed among the three skill-intensity groups, then the conclusion that prices of high skill-intensive firms are less determined by the market than prices of the low skill-intensive firms must stand.

Capital intensity

Elsewhere we have argued that new products tend to be products characterized by high skill intensity and to be less capital intensive than mature products. As products become more mature, increasing substitution of capital for labor becomes both technically and economically feasible because the manufacturing process becomes more stable, and longer runs of relatively uniform specifications are made easier [6].

This argument refers, however, to the *trend* of capital intensity over the life cycle of a product; it does not apply to the *level* of capital used in conjunction with other inputs at any particular point in time in the manufacture of different products. Hence we have no particular expectations regarding the relationship between skill and capital intensities in a cross-section analysis of the kind undertaken here.

Analysis of the data suggests, however, that skill and capital intensity are associated with each other. Table II.6, which shows the distribution of capital intensity by skill-intensity groups, points to the existence of a positive correlation between the two variables.

The association found between skill and capital intensity in Israeli industrial firms suggests an interesting hypothesis: that capital and unskilled (but not skilled) labor are substitute inputs and skilled labor and capital are, by contrast, complementary inputs.

Capital intensity as depicted in Table II.6 is measured by the assets per employee ratio, and the denominator of this ratio—the number of employees—is, it will be recalled, also the denominator used here to measure skill intensity. If capital were a substitute for unskilled (but not for skilled) labor, as suggested by this hypothesis, skill and capital intensity would increase when capital is substituted for labor and decrease when labor is substituted for capital. This conclusion, moreover, does not depend on the method of measurement. If capital intensity were

TABLE II.6

Distribution of Firms by Capital Intensity and by Skill Intensity

Assets Per Employee (£ Israeli)	Skill Intensity							
	Number of Firms				Per Cent			
	Low	Medium	High	Total	Low	Medium	High	Total
Less than 16,000	15	21	11	47	43	40	22	34
16,000 - 32,500	13	18	15	46	37	35	30	34
32,501 - 320,000	7	13	24	44	20	25	48	32
Total	35	52	50	137	100	100	100	100

differently measured, by the ratio of depreciation plus interest costs plus profits to value added, for example, and if the hypothesis advanced here does indeed conform to reality our conclusion would remain unaltered. In that case, an increase in the quantity of capital raises the value of the numerator of the capital-intensity measure and reduces the value of the denominator of the skill-intensity measure, thus giving rise to a positive correlation between skill and capital intensities.

To summarize, we have found that skill intensity is associated with certain product characteristics as suggested by our model. Skill intensity varies inversely with production concentration and directly with the propensity to produce to customers' orders and to customers' specifications. In comparison with low skill-intensive firms, high skill-intensive firms appear to have more control over the pricing of their products, especially in the domestic market where price competition can be modified and controlled with relative ease. Finally, while not expecting any particular relationship between skill and capital intensities, the data show that the two variables are positively correlated. The existence of this correlation suggests that capital and skilled labor may be complementary inputs whereas capital and unskilled labor may be substitutes.

Next we examine certain characteristics of the firms.

III. CHARACTERISTICS OF THE FIRM IN RELATION TO SKILL INTENSITY AND EXPORT PERFORMANCE

The distinction between product characteristics discussed in Part II and firm characteristics considered in this part is based on the assumption that the former are determined mainly on the basis of technological and economic considerations over which the firm has little influence. Once a product has been chosen, production techniques, pricing methods, capital intensity, etc., are more or less dictated to the firm by the prevailing supply and demand conditions. Management, on the other hand, appears to have more discretion in establishing the size of the firm and its domestic and foreign marketing policies. By analyzing firm characteristics separately from product characteristics, we focus attention on those aspects of performance in general, and export performance in particular, which are determined to an important degree by management's "subjective" preferences.

Size of the firm

We have postulated in Part I that export performance varies with size: the larger plants tend to have a better export performance than the small ones because firms cannot export unless they invest in market research in foreign servicing and in the maintenance of stocks. These costs are partly fixed and can be recouped only if sales volume is sufficiently large.

It was further postulated that the marketing cost advantage enjoyed by domestic suppliers over foreign competitors increases with the skill intensity of the product because of the crucial role of communication in the marketing of high skill-intensive products. Obviously, the cost of communication, and especially of face-to-face communication, increases with distance, thus raising the relative marketing costs of the exporters. To be able to export, the manufacturer of high skill-intensive products must have a substantial cost advantage in manufacturing, and a large enough sales volume to enable him to reduce unit costs to a competitive level.

Relationship between size and export performance is shown in Table III.1, where respondents are divided into three size groups on the basis

TABLE III.1

Distribution of Firms by Number of Employees and by Export Performance[a]

Export Performance	Number of Employees: Number of Firms 0–59	60–159	160+	Total	Per Cent 0–59	60–159	160+	Total
Zero exports	30	20	1	51	52	32	2	30
Low	15	9	13	37	26	14	26	22
Medium	8	18	18	44	14	29	35	26
High	5	16	19	40	8	25	37	23
Total	58	63	51	172	100	100	100	100

Note: Inaccuracies due to rounding.

[a] For definition of export performance see Appendix E.

of the number of their employees. The table shows that size does indeed vary with export performance as expected. Medium and large firms appear to be superior to small firms as export performers.[2]

We examine next the proposition that export performance is more strongly correlated with size in the case of high skill-intensive firms. The evidence is presented in Table III.2 where the data given in Table III.1 are regrouped in skill-intensity groups. Analysis of the data does not confirm our expectations. Although there appears to be a reasonably strong correlation between export performance and size in the low and even the medium skill-intensity groups, the high skill-intensive group exhibits no such correlation.

The relationship between size, skill intensity and export performance was analyzed by an alternative method which is shown in Table III.3. The table shows the firms ranked by the volume of their output and exports from the largest firm down, and grouped in deciles against the volume of their output and export expressed in cumulative percentages.

[2] These findings agree with those reported in a survey conducted under the auspices of P.E.P. in Britain in 1963 where a strong positive correlation was found between size and export performance [11].

TABLE III.2

Distribution of Firms by Export Performance, by Number of Employees, and by Skill Intensity

Export Performance	Plants With			Per Cent of Plants With		
	0–59 Empl.	60–159 Empl.	160+ Empl.	0–59 Empl.	60–150 Empl.	160+ Empl.
Low Skill Intensity						
Zero export	7	5	1	50	25	6
Low	3	1	3	21	5	19
Medium	1	7	4	7	35	25
High	3	7	8	22	35	50
Total	14	20	16	100	100	100
Medium Skill Intensity						
Zero export	16	11	0	70	48	0
Low	5	4	2	22	17	14
Medium	1	5	7	4	22	50
High	1	3	5	4	13	36
Total	23	23	14	100	100	100
High Skill Intensity						
Zero export	7	4	0	33	21	0
Low	7	4	8	33	21	42
Medium	6	5	6	29	26	32
High	1	6	5	5	32	26
Total	21	19	19	100	100	100

Note: Inaccuracies due to rounding. Average number of employees per firm for the three categories of skill intensity: *low*, 165; *medium*, 185; *high*, 285.

The method enables us to gauge the degree of inequality in the distribution of output and exports between the firms. Two conclusions are suggested by the figures: (1) that exports of all skill-intensity groups are less equally distributed than domestic sales; and (2) that the

TABLE III.3

Distribution of Firms by Output Volume, by Export Volume, and by Skill Intensity

(in cumulative percentages)

	Low Skill Intensive		Medium Skill Intensive		High Skill Intensive		All Firms	
Deciles[a]	Output	Exports	Output	Exports	Output	Exports	Output	Exports
First	42.5	46.7	48.8	42.7	50.3	68.7	49.0	56.2
Second	62.3	67.9	66.1	69.4	66.5	82.7	68.2	75.3
Third	73.9	82.0	75.7	86.4	77.0	91.5	77.7	87.0
Fourth	82.9	89.2	82.4	93.2	83.1	95.4	84.4	92.9
Fifth	88.4	93.5	87.8	97.6	87.7	97.7	88.9	96.3
Sixth	92.8	96.7	91.5	99.1	91.3	99.1	92.6	98.4
Seventh	96.3	98.4	94.8	99.6	94.1	99.8	94.5	99.4
Eighth	98.4	99.2	97.3	99.9	96.6	99.9	97.6	99.8
Ninth	99.7	99.8	99.1	100.0	98.4	100.0	99.0	100.0
Tenth	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Firms are ranked by output and exports, from the largest firm downward.

inequality increases with skill intensity. Although both conclusions are consistent with our hypothesis, we must point out that export performance in Table III.3 refers to absolute volume and not, as elsewhere in this paper, to growth rates multiplied by export shares.[3] The apparent contradiction between the conclusions suggested by Tables III.2 and III.3 is probably due to the concentration of exports in a very few firms. The five large, high skill-intensive firms with high export performance shown in Table III.2 are probably the same firms which appear in the first decile in Table III.3.

Existence of a marketing department

The marketing function need not be performed by a special department; it may be performed by groups or individuals attached to other departments or even to no particular department. This is probably truer of small than of large firms, though other considerations (such as the type of the product and the practice of the industry) undoubtedly influence the decision to establish a marketing department.

Here we wish to test the proposition that export performance is affected by the existence of a marketing department, and that the connection is especially evident in high skill-intensive firms. This proposition is based on the assumption that high skill-intensive firms which give formal recognition to the marketing function and establish a department to perform it have a better export performance than those which do not. No such assumptions are made regarding the low skill-intensive firms.

Table III.4 gives the data on the existence of marketing departments in the three skill-intensity groups and their export performance. The table shows that a higher proportion of the high skill-intensive firms have marketing departments than the low skill-intensive firms. It also shows that few high skill-intensive firms with no marketing departments have a high export performance. Although the table indicates that high skill-intensive firms which have a high or even medium export performance tend to have a marketing department, it does not imply that the establishment of such a department is necessarily correlated with high export performance; 29 per cent of the high skill-intensive firms

[3] For details see Appendix E.

TABLE III.4

Distribution of Firms by Export Performance, by Existence of Marketing Departments, and by Skill Intensity

Export Performance	Number			Per Cent		
	Firms With Market Dept.	Firms Without Market Dept.	All Firms	Firms With Market Dept.	Firms Without Market Dept.	All Firms
			Low Skill Intensity			
Zero export	7	6	13	24	29	26
Low	2	5	7	7	24	14
Medium	9	3	12	31	14	24
High	11	7	18	38	33	36
Total	29	21	50	100	100	100
			Medium Skill Intensity			
Zero export	12	15	27	40	50	45
Low	6	5	11	20	17	18
Medium	5	8	13	17	27	22
High	7	2	9	23	6	15
Total	30	30	60	100	100	100
			High Skill Intensity			
Zero export	3	8	11	8	38	19
Low	11	8	19	29	38	32
Medium	14	3	17	37	14	29
High	10	2	12	26	10	20
Total	38	21	59	100	100	100
Grand Total	97	72	169	57	43	100

Note: Inaccuracies due to rounding.

with marketing departments were low export performers. Low skill-intensive firms appear, as expected, to be less dependent on a marketing department for a high export performance.

It may be argued at this point that we should not expect export

performance to depend on the existence of a marketing department at all; that, if there is a relationship between the organization of the marketing function and export performance, it should be sought in the existence of an *export* department. This reasoning, however, does not appear to apply to Israeli firms, most of which seem to be too small to be able to have an independent export department. The few firms which have export departments are distributed equally between the three skill groups. Although the distribution of export performance of firms having marketing departments definitely varies with that of firms which have no marketing departments, the number of the firms in the first group is too small to draw definite conclusions. The pattern that emerged is nevertheless worth noting since it differed somewhat from that exhibited in Table III.4. A high proportion of low skill-intensive firms with no marketing departments have a high export performance, and a low proportion of high skill-intensive firms with no marketing department have a high export performance. Possession of a marketing department is generally associated with medium or high export performance in all three skill-intensity groups.

In summary, it may be stated that high skill-intensive firms which have a high export performance tend to have marketing departments, though many which have a marketing department are not high export performers. The association is even less clear in the case of the low skill-intensive firms where a considerable proportion of the high export performers do not have a marketing department.

Proprietary association abroad

Another form of association we were looking for was between proprietary associations abroad and export performance. One inevitable conclusion suggested by our previous analysis is that firms which have parent companies, subsidiaries, sales offices, or other proprietary connections abroad will tend to have a superior export performance because of the marketing connections which this form of association provides. We would also expect that the relationship between proprietary association abroad and export performance is more decisive for the high skill-intensive firms, which require particularly close communications with the markets, than for the low skill-intensive firms, which do not.

The data are given in Table III.5. Let us first examine the marginal

TABLE III.5

Distribution of Firms by Export Performance, by Foreign Proprietary Connections Abroad and by Skill Intensity

Export Performance	Number			Per Cent		
	Firms With Foreign Prop. Con.	Firms Without Foreign Prop. Con.	All Firms	Firms With Foreign Prop. Con.	Firms Without Foreign Prop. Con.	All Firms
			Low Skill Intensity			
Low	0	7	7	0	21	19
Medium	2	10	12	67	29	32
High	1	17	18	33	50	49
Total	3	34	37	100	100	100
			Medium Skill Intensity			
Low	3	8	11	30	35	33
Medium	2	11	13	20	48	39
High	5	4	9	50	17	28
Total	10	23	33	100	100	100
			High Skill Intensity			
Low	3	16	19	17	53	40
Medium	7	10	17	39	33	35
High	8	4	12	44	14	25
Total	18	30	48	100	100	100
Grand Total	31	87	118	26	74	100

Note: Inaccuracies due to rounding.

distributions which appear to be quite interesting. Of thirty-one firms having proprietary associations abroad, well over one-half were high skill intensive, about one-third were medium skill intensive, and less than one-tenth low skill intensive. Turning next to the analysis of the relationship between proprietary association abroad and export performance, we note that nearly all high export performers among the

low skill-intensive group had no proprietary associations abroad, whereas three-quarters of the high export performers among the high skill-intensive group did have proprietary associations abroad.

These figures suggest that the expectations regarding the association between proprietary associations of the three skill-intensity groups and export performance are largely confirmed.

The degree of confidence in the conclusions which emerge from the above analysis should, however, not be exaggerated. True, a definite association was found between export performance of the high skill-intensive firms and proprietary associations abroad; it was not shown, however, whether exports are sold in the markets where the responding firms have their associates. It may well be that a firm having a parent company in the United States exports the bulk of its output to Iran. As long as the connection between geographic distribution of exports and location of foreign associates is not known, no cause-and-effect relationship can be claimed with confidence between the foreign associations of high skill-intensive firms and their export performance.

It is perhaps proper to claim even at this stage that high skill-intensive firms with foreign associations appear to be conscious of international marketing opportunities and to realize them to a larger extent than high skill-intensive firms which have no such associations. The existence of foreign proprietary associations appears, by contrast, to be definitely unrelated to the export performance of the low skill-intensive firms.

Time spent abroad on export business

Finally, we analyze the relationship between the length of time spent abroad by senior executives of firms belonging to the three skill-intensity groups and the export performance of the firms. As in the previous case, we postulate that, *ceteris paribus,* high skill-intensive firms' executives must spend more time abroad if they are to have a satisfactory export performance. The nature of the products and of the marketing function demands intensive and, occasionally, personal communication with customers. Personal communication with the buyers is required to a lesser extent by manufacturers of low skill-intensive products.

To test this postulate we asked respondents to state the number of months spent abroad by the general manager ("president" in American terminology), marketing manager, and other executives, on matters

pertaining to exports. The responses were divided into three groups: zero months, less than two months, and more than two months. Table III.6 gives the data on the distribution of the time spent by senior executives abroad, by skill intensity, and by export performance groups. The figures refer to total time spent by all executives abroad.

The table shows striking differences between the skill groups. Few of the high export performers among the low skill-intensive firms spent

TABLE III.6

Distribution of Firms by Export Performance, by Length of Time Spent Abroad, and by Skill Intensity

Export Performance	Number of Firms: 0 Months Abroad	0–2 Months Abroad	2+ Months Abroad	All Firms	Per Cent of Firms: 0 Months Abroad	0–2 Months Abroad	2+ Months Abroad	All Firms
			Low Skill Intensity					
Low	3	4	0	7	50	19	0	19
Medium	0	7	4	11	0	33	44	31
High	3	10	5	18	50	48	46	50
Total	6	21	9	36	100	100	100	100
			Medium Skill Intensity					
Low	2	6	3	11	50	38	25	34
Medium	2	6	4	12	50	37	33	38
High	0	4	5	9	0	25	42	28
Total	4	16	12	32	100	100	100	100
			High Skill Intensity					
Low	4	10	5	19	66	67	19	41
Medium	2	3	11	16	34	20	42	34
High	0	2	10	12	0	13	38	25
Total	6	15	26	47	100	100	100	100
Grand Total	16	52	47	115	14	45	41	100

Note: Inaccuracies due to rounding.

two or more executive months abroad in export matters. By comparison, there appears to be a positive correlation between export performance and executive time spent abroad in the medium and especially in the high skill-intensive groups.

As in the previous section, which discussed the relationship between proprietary associations abroad and export performance, not too much faith should be put in the apparent relationships. Although these appear to confirm our expectations, it ought to be remembered that the table does not describe the relationship between executive months spent in particular markets and export performance in these markets; it only shows relationship between total executive time spent abroad and export performance in all markets. Therefore, the most that can be said about the relationship between the three variables at this stage is that high skill-intensive firms which demonstrate their awareness of foreign marketing opportunities by having their senior executives spend time abroad have a higher export performance than firms which do not adopt this policy. There appears to be a weaker association between executive time spent abroad and export performance in the case of low and medium skill-intensive firms.

Summary

Part III has discussed certain characteristics of firms and their relationships to skill intensity and to export performance. In accordance with our expectations size appears to be associated with export performance; a higher proportion of large firms than of small ones have a high export performance. Contrary to expectations, however, we found no particular association between export performance and size in the high skill-intensity group. A different test of the hypothesis revealed that a small proportion of the firms accounted for a high proportion of total exports in each of the skill-intensity groups. In agreement with our hypothesis, the inequality was most pronounced in the high skill-intensity group.

Several aspects of the firms' marketing policies were analyzed in the remainder of Part III. Firms possessing marketing departments appear to have higher export performances than firms which do not. The associations between the existence of a marketing department and export performance appeared to be more marked in the case of the high than in the case of the low skill-intensive firms.

Similar associations were found between export performance and the existence of proprietary associations abroad, as well as the length of time spent by senior executives abroad. In both cases, associations with export performance were more marked in the case of the high skill-intensive firms.

These findings tend to confirm the hypothesis that in order to export, high skill-intensive firms must maintain close communication with the markets. Such communication appears to be less essential in the case of the low skill-intensive firms, because they can obtain the necessary market information and maintain the required contacts with their customers through less direct methods.

IV. GEOGRAPHIC DISTRIBUTION OF EXPORTS

Certain propositions pertaining to the geographic distribution of Israel's exports have been suggested in Part I, viz.: that low skill-intensive industries sell a high proportion of their exports to developed and a small proportion to developing countries, whereas high skill-intensive industries sell a high proportion to developing and a low proportion to developed countries.

Another question to consider is the relationship between capital intensity and geographic distribution of exports. We noted earlier that there appears to be a definite association between skill and capital intensity, that high skill-intensive firms tend to have a high ratio of assets to employment. We shall therefore examine the extent to which capital intensity is associated with the destination of exports and discuss the implications of such an association.

Skill intensity and geographic distribution of exports

The respondents' exports, grouped by skill intensity and by markets in the years 1964 and 1967, are shown in Tables IV.1 and IV.2. Changes in the distribution of exports during the four-year period are shown in Table IV.3.

Table IV.1 shows that exports in 1964 tended to be distributed according to our expectations. The developed countries, which bought two-thirds of total exports, imported the bulk of the exports of the low skill-intensive firms, whereas their share of the exports of the medium

TABLE IV.1

Export Distribution by Skill Intensity and by Country Group, 1964

Country Group	Skill Intensity of Industry			
	Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	998	3,465	7,693	12,156
Eastern Europe	126	653	7,309	8,088
Developed countries	24,142	6,023	11,274	41,437
Total	25,266	10,141	26,274	61,681
	Distribution by Importing Countries (per cent)			
Developing countries	4	34	29	20
Eastern Europe	1	6	28	13
Developed countries	95	59	43	67
Total	100	100	100	100
	Distribution by Skill-Intensity Group of Exporting Industries (per cent)			
Developing countries	8	29	63	100
Eastern Europe	2	8	90	100
Developed countries	58	15	27	100
Total	41	16	43	100

Note: Inaccuracies due to rounding.

and high skill-intensive firms was considerably smaller. An analysis of the shares of the different country groups of the respondents' exports shows that the developing countries and Eastern Europe imported mainly from high, and to a lesser degree, medium skill-intensive firms. The developed countries, on the other hand, bought well over half of their imports from low skill-intensive firms.

The figures in Table IV.2 are indicative of an interesting develop-

TABLE IV.2

Export Distribution by Skill Intensity and by Country Group, 1967

Country Group	Skill Intensity of Industry			
	Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	1,191	3,191	11,488	15,870
Eastern Europe	245	1,805	8,375	10,425
Developed countries	27,103	7,585	28,598	63,286
Total	28,539	12,581	48,461	89,581
	Distribution by Importing Countries (per cent)			
Developing countries	4	25	24	18
Eastern Europe	1	14	17	12
Developed countries	95	60	59	71
Total	100	100	100	100
	Distribution by Skill-Intensity Group of Exporting Industries (per cent)			
Developing countries	8	20	72	100
Eastern Europe	2	12	80	100
Developed countries	43	12	45	100
Total	32	14	54	100

Note: Inaccuracies due to rounding.

ment that appears to have taken place between 1964 and 1967. The developing countries and Eastern Europe continued to import mainly those products manufactured by high skill-intensive firms. But the developed countries, while continuing to buy practically all the exports of the low skill-intensive firms, increased their share of the exports of the high skill-intensive firms by a very substantial margin.

The change in the distribution of exports is analyzed in Table IV.3.

TABLE IV.3

Changes in Export Distribution by Skill Intensity and by Country Group between 1964 and 1967

Country Group	Skill Intensity of Industry			
	Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	193	(274)	3,795	3,714
Eastern Europe	119	1,152	1,066	2,337
Developed countries	2,961	1,562	17,326	21,849
Total	3,273	2,440	22,187	27,900
	Distribution by Importing Countries (per cent)			
Developing countries	6	(11)	17	13
Eastern Europe	4	47	5	8
Developed countries	90	64	78	79
Total	100	100	100	100
	Distribution by Skill-Intensity Group of Exporting Industries (per cent)			
Developing countries	5	(7)	102	100
Eastern Europe	5	49	46	100
Developed countries	14	7	79	100
Total	12	9	79	100

Notes: Negative figures denoted by ( ). Inaccuracies due to rounding.

Nearly 80 per cent of the increase in exports between 1964 and 1967 was sold to the developed countries, which took practically all the additional exports of the low skill-intensive firms and a very substantial proportion of the additional exports of the high skill-intensive firms. The table also shows that high skill-intensive firms accounted for nearly 80 per cent of the additional exports between 1964 and 1967. The

trend exhibited by these figures is highly significant, since they pertain to an increase of nearly one-half in the value of exports in the three year interval.

If the trend exhibited in the 1964–67 period continues, the pattern of Israel's exports might look roughly as follows by the middle of the 1970's: (1) The share of the high skill-intensive industries in the country's exports will rise at the expense of the low skill-intensive industries. (2) A larger proportion of exports will be directed toward the developed countries. (3) Exports to the developing countries will continue to consist mainly of high skill-intensive products. (4) The developed countries will increase their share of exports of both high and low skill-intensive industries. The increase in the share of the developed countries in exports of the high skill-intensive industries will be more marked, since their share in exports of the low skill-intensive industries is already very high.

This forecast of the future distribution of Israeli exports is based not only on the trends exhibited by total exports, but also on the export performance of the individual firms. Export performance, it will be recalled, measures both growth rate and proportion of output exported, and it varies considerably between the three country groups, as Table IV.4 clearly indicates. The table shows that the firms which concentrate their exports on the developed countries "outperform" those firms

TABLE IV.4

Export Performance by Major Country Group

Destination of Exports	Export Performance			
	Low	Medium	High	Total
	Number of Firms			
Developing countries	21	14	5	40
Eastern Europe	0	5	1	6
Developed countries	12	20	31	63
Total	33	39	37	109

Note: Exporting firms are distributed vertically according to the country group taking the largest share of their exports.

which export mainly to developing countries and to Eastern Europe in the sense that they either export a higher proportion of their output, or experience a higher rate of export growth, or both.

Capital intensity and geographic distribution of exports

It was reported in Part II of this paper that a positive correlation appears to exist between skill and capital intensity—high skill-intensive firms tend to have a higher ratio of assets to employment than low skill-intensive firms. Here we examine the question whether, and to what extent, this association tends to carry over into the distribution of exports to the three country groups.

The relevant data are given in Tables IV.5, IV.6 and IV.7, which show the geographic distribution of exports by capital intensity groups in 1964 and 1967 and the changes in distribution between the two periods.

There is a remarkable similarity between the figures in Tables IV.5 and IV.6 and those in Tables IV.1 and IV.2 showing the geographic distribution of exports by skill intensity. Looking at the margins, we note, first, that high capital-intensive exports are considerably larger than low capital-intensive exports in both 1964 and 1967, though low capital-intensive exports increased by a higher proportion between the two periods. Turning to the distribution among country groups, we note that low capital-intensive firms, like low skill-intensive firms, tend to sell the bulk of their exports to the developed countries and very little to the developing countries. The share of the latter group is much higher in the case of exports by high capital-intensive and high skill-intensive firms, though still less than that taken by the developed countries.

An analysis of changes in the two distributions shows, first that, although high skill-intensive products accounted for the bulk of the increase in exports between 1964 and 1967, this is not true to the same extent of high capital-intensive products, which accounted for less than 50 per cent of the increase. Also, while developing countries hardly increased their imports of low skill-intensive products, they increased their imports of low capital-intensive products by a considerable margin.

Two additional differences in the distribution are noteworthy. Exports

TABLE IV.5

Export Distribution by Capital Intensity and by Country Group, 1964

Destination of Exports	Capital Intensity			
	Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	642	1,700	7,101	9,443
Eastern Europe	42	287	8,823	9,152
Developed countries	9,894	18,172	15,530	43,596
Total	10,578	20,159	31,454	62,191
	Distribution by Importing Countries (per cent)			
Developing countries	6	9	23	15
Eastern Europe	–	1	28	15
Developed countries	94	90	49	70
Total	100	100	100	100
	Distribution by Capital-Intensity Group of Exporting Industries (per cent)			
Developing countries	7	18	75	100
Eastern Europe	1	3	96	100
Developed countries	23	41	36	100
Total	17	32	51	100

Note: Inaccuracies due to rounding.

of the medium skill-intensive firms tend to be distributed similarly to those of the high skill-intensive firms (with the notable exception of sales to Eastern Europe), while medium capital-intensive firms tend to resemble more closely the low capital-intensive firms in the distribution of their exports. The other dissimilarity also concerns the medium intensity group. While exports of the medium skill-intensive firms accounted for 16 per cent and for 14 per cent of total exports in 1964

TABLE IV.6

Export Distribution by Capital Intensity and by Country Group, 1967

Destination of Exports	Capital Intensity			
	Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	2,962	2,730	8,789	14,481
Eastern Europe	182	400	9,249	9,831
Developed countries	16,765	21,833	26,723	65,321
Total	19,909	24,963	44,461	89,633
	Distribution by Importing Countries (per cent)			
Developing countries	15	11	20	16
Eastern Europe	1	2	20	11
Developed countries	84	87	60	73
Total	100	100	100	100
	Distribution by Capital Intensity Group of Exporting Industries (per cent)			
Developing countries	20	19	61	100
Eastern Europe	2	4	94	100
Developed countries	26	33	41	100
Total	22	28	50	100

Note: Inaccuracies due to rounding.

and 1967, respectively, the share of the medium capital-intensive group in total exports was considerably higher, ranging from 28 per cent in 1967 to 32 per cent in 1964.

These findings, paradoxically enough, tend to agree with expectations derived from bilateral applications of the factor proportions theorem, which suggest that Israel, where capital is likely to be more expensive than in the developed countries and less expensive than in the develop-

TABLE IV.7

Change in Export Distribution by Capital Intensity and Country Group between 1964 and 1967

Destination of Exports	Capital Intensity: Low	Medium	High	Total
	Distribution by Importing Countries ($ thousands)			
Developing countries	2,320	1,030	1,668	5,038
Eastern Europe	140	113	426	679
Developed countries	6,871	3,661	11,193	21,725
Total	9,421	4,804	13,307	27,442
	Distribution by Importing Countries (per cent)			
Developing countries	25	22	13	18
Eastern Europe	2	2	3	3
Developed countries	73	76	84	79
Total	100	100	100	100
	Distribution by Capital Intensity Group of Exporting Industries (per cent)			
Developing countries	46	21	33	100
Eastern Europe	20	17	63	100
Developed countries	32	17	51	100
Total	34	18	48	100

Note: Inaccuracies due to rounding.

ing countries, would tend to export low capital-intensive products to the former and high capital-intensive products to the latter. Before adopting this conclusion, however, we should recall that capital intensity, as measured here, reflects only direct capital and labor inputs at the manufacturing stage and does not include indirect inputs via materials purchased by the manufacturing firm. Capital intensity measured by

direct inputs will be similar to that measured by total (direct plus indirect) inputs only when value added by manufacture is a high proportion of the value of output or when capital-labor ratios in manufacturing are not markedly different from those embodied in purchased materials.

Lacking the relevant data, we have no way of telling whether either of these alternatives does in fact occur. We must therefore conclude that we cannot regard our findings as being consistent with the factor proportions theorem, though they certainly do not conflict with it. Bearing in mind that several empirical research findings such as Leontief's and Bruno's were in direct conflict with this theorem, we should regard the findings reported here as worthy of note [9, 1].[4]

Our findings concerning the relationship between the skill intensity of different export products and their geographic distribution could also be interpreted in terms of Hufbauer's model [8]. Hufbauer distinguished between two kinds of products which enter international trade—"comparative advantage" and "technological gap" products. The former, consisting of those products which contain a high proportion of abundant inputs as suggested by the factor proportions theorem, will tend to be exported to countries with different factor endowments. Manufacturers of "technological gap" products have a competitive edge by virtue of the fact that they are first on the market. They can export their products to all countries even if they contain a high proportion of scarce inputs, because there is inevitably an "imitation lag" during which these products cannot be manufactured on a competitive basis by others.

How, then, do our findings fit into Hufbauer's model? Israel exports mainly high skill-intensive products to the developing countries. These products contain "technological gap" as well as "comparative advantage" elements; the former are reflected in their high skill content, and the latter in their high capital content. Israel's exports of low skill-intensive products to the developed countries may be regarded as belonging to the pure "comparative advantage" category. The high skill-intensive products which are exported in growing proportions to the developed countries also have elements of "technological gap" and of "comparative

[4] On the other hand we should take note that these findings agree with those of Tatemoto and Ichimura who showed that Japan exports labor-intensive products to the West and capital-intensive products to Asia [13].

advantage." The "technological gap" element is reflected in the high proportion of scientists, engineers and skilled employees in the labor force and the "comparative advantage" element in the relatively low cost of these production factors in Israel. This factor may, incidentally, compensate for the relatively high capital intensity of the high skill-intensive products.

Summary and conclusions

The expectation that Israel tends to export high skill-intensive products to developing countries and low skill-intensive products to developed countries is confirmed. An analysis of changes in the distribution of exports showed, at the same time, that a large proportion of the increase in exports between 1964 and 1967 consisted of high skill-intensive products sold mainly to the developed countries. If this trend continues, then the developed countries will absorb a growing share of the products exported by the high skill-intensive industries.

The analysis also showed that the capital intensity, like the skill intensity, of exports sold to Eastern Europe and the developing countries is higher than that of the exports sold to the developed countries.

Those findings pertaining to the geographic distribution of Israel's exports and to their skill intensity are undoubtedly welcome to the country's economic planners. Trade with most East European countries and with some of the developing countries is conducted within the framework of bilateral trade and payments agreements. The ability of Israel's industry to divert a growing proportion of its international transactions to markets where competition is less restricted and trade less subject to political direction signifies an improvement in its international competitiveness.

The conclusion regarding the trend in the distribution of exports by skill-intensity groups is perhaps even more significant. If Israel's exports in the future were to be dominated by products with a low-skill content, the country would have to compete increasingly with developing countries possessing abundant supplies of low-skill labor. Assuming that productivity per unit of labor in these industries does not vary widely between Israel and the developing countries, then average income cannot diverge too widely, either, in the long run. The average income level in Israel would therefore tend to be pulled toward that of its com-

petitors. If, on the other hand, the country's major competitors are in the developed countries, and if we again assume that productivity variations are not too enormous, average income in Israel will tend to rise to the level enjoyed by those countries.

APPENDIX A, DISTINCTION BETWEEN FIRMS AND PLANTS

Distinction between firms and plants may be of crucial importance to a study which seeks to identify the role of the individual business unit in determining export performance. The need for such a distinction raises certain problems because of the difficulty involved in devising indexes and other measures which reflect equally well the operations and performance of single- and multiplant firms. Due to the composition of our sample, which contained fewer than ten plants owned by multiplant firms, the following procedure was adopted: (1) The unit for which data were gathered and on which analysis was performed, was the individual plant, except in those cases (two in the total) where data were available only for the entire firm; (2) services provided by multiplant firms to their individual units were recorded separately for each plant.

This procedure affects the analysis of product or firm characteristics in the sense that it ascribes to the plant certain characteristics possessed by the entire firm. For example, where a multiplant firm maintained a single marketing department, each plant was regarded as having its own marketing department. Although this procedure may overstate the marketing effort of the multiplant firm, it does not affect other centrally provided services such as R&D where the data provided by the respondents usually facilitated the allocation of costs, personnel, or other inputs between the individual plants.

In the text, the terms "plant" and "firm" are used interchangeably.

APPENDIX B, THE SAMPLE

The sample consists of 190 firms, operating in eleven industries, with which interviews were completed. The industries were chosen because they were major export industries in 1967 or were considered to be potentially significant exporters. The list of firms to be interviewed was

provided by the Israel Government Central Bureau of Statistics on the basis of the following considerations:

1. The sample was to consist of 300 firms.
2. The probability of a firm's inclusion in the sample was proportional to the number of its employees.
3. Firms employing less than thirty people were excluded.
4. At least twenty firms per industry were to be included in the sample. In those industries which had fewer than twenty firms employing thirty people or more, all firms were included.
5. Classification by industry was based on the Central Bureau of Statistics classification system.
6. The list of industrial plants maintained by the Social Security Institution constituted the universe or the frame from which the sample was drawn.

Of the 306 firms included in the sample 190 were eventually interviewed. Of the 110 firms not interviewed, about one-third declined an interview. Most of the remainder were unsuitable because they were found to employ fewer than thirty people, because they had gone bankrupt or had merged with other firms, because of misclassification, or because they declined to give sufficient information to make their inclusion worthwhile.

Appendix Table 1 gives data on the industries studied in the survey and lists the number of firms employing over thirty people in each industry, the number of firms included in the sample, and the number of firms with completed interviews. About 35 per cent of the 544 firms in the eleven industries were interviewed. The share of these firms in the industries' exports in 1966 was roughly the same—37 per cent. However, if firms in the diamond industry are excluded from the calculations, the percentage of firms interviewed rises to 38 and that of exports to 68. Of the 190 respondents, 52 were nonexporters; the remaining firms exported varying proportions of their output.

Finally, a word of caution: since many of the findings are reported in the form of frequency distributions, totals or subtotals may be found to vary from table to table. These apparent inconsistencies are due to the fact that respondents did not usually answer all the questions posed to them. The reader is cautioned to bear this in mind when interpreting the findings.

APPENDIX TABLE 1

Distribution of Firms Employing over Thirty People in Eleven Industries in 1966

ISIC Industry Category (SITC equivalent in parentheses)	Number of Firms			Per Cent of Total	
	Total	in Sample	Interviewed	in Sample	Interviewed
Textiles 23 (65)	168	56	33	33	20
Leather and clothing 24, 29 (61, 84, 85)	103	38	20	37	19
Canned fruits and vegetables 203 (053)	31	31	16	100	52
Diamonds 394 (667.20)	86	25	16	29	19
Plastic products 399 (893)	27	27	16	100	59
Plywood and plumbing fixtures 251, 350 (695, 696, 631.21)	18	18	11	100	61
Nonmetallic mining 19 (27)	6	6	4	100	67
Chemicals 31-32 (51-59)	30	30	20	100	67
Electrical equipment 370 (72)	31	31	25	100	81
Electronics 370, 391, 392, (861, 724, 726, 729)	17	17	14	100	83
Machinery 36 (71)	27	27	15	100	56
Total	544	306	190	56	35

Source: For number of firms in each industry, Israel Government, Central Bureau of Statistics.

APPENDIX C, SKILL INTENSITY

The measure here employed is the share of engineers, scientists, and other employees having academic degrees and of highly skilled workers in the labor force. Holders of academic degrees were distinguished from other employees on the basis of a simple and objective criterion, whereas the classification of highly skilled employees was left to the respondents who were asked to include in this group employees in the three top grades of their skills or crafts. In certain crafts, such as welding, machine operating, wood working, etc., the classification is relatively simple, since it is based on formal examinations. In many other occupations, the classification is less formal and the respondents were asked to use their best judgment to classify their employees.

The skill-intensity index (SI) was constructed as follows:

$$SI = \frac{2.\ A + HS}{TE}$$

where A = employees holding academic degrees,

HS = highly skilled employees belonging to the three top grades of skill classification, or classified as such by management, and

TE = Total number of employees

Employees holding academic degrees were given a higher weight on the assumption that they contributed more to the special characteristics and the value of the products than did other skilled employees.

In the preceding analysis, firms are frequently grouped into three subgroups on the basis of the skill-intensity index. The distribution and the grouping are described in Appendix Table 2.

APPENDIX TABLE 2

Distribution of Respondents by their Skill Intensity Index

Skill Intensity Group	Range	Average	Number of Firms
Low	$0 < SI \leq 0.1$	0.06	56
Medium	$0.1 < SI \leq 0.3$	0.18	68
High	$0.3 < SI \leq 1.05$	0.48	60
Entire distribution	$0 < SI \leq 1.05$	0.26	184

APPENDIX D, CONCENTRATION OF PRODUCTION

The production concentration index (PC) is constructed as follows:

$$PC = \sum_{i=1}^{3} x_i^2$$

where x_i = share of product i in total output.

PC can range from zero to 1. It will assume the value 1 if only one product is manufactured and will decline in value as the number of products increases.

Respondents were divided into three production concentration groups on the basis of the following grouping of calculated index values:

Group	Index Value
Low	$0 < PC \leq 0.4$
Medium	$0.4 < PC \leq 0.8$
High	$0.8 < PC \leq 1.0$

APPENDIX E, EXPORT PERFORMANCE

The export performance of the firms interviewed is gauged from two points of view:

1. the proportion of output exported
2. the rate of growth of exports.

The proportion of output exported is obviously an important indicator of export performance. Firms whose export ratio is high are deemed to exhibit a better export performance than firms exporting a low proportion of their output. Growth rate, too, is indicative of export performance; firms whose exports increase at a high rate should be considered better performers than firms whose exports show little or no increase.

The export performance index (EP) is constructed as follows:

$$EP = \sqrt[n-1]{\frac{E_t}{E_1}} \cdot \frac{\sum_{t=1}^{n} t\, S_t}{\sum_{t=1}^{n} t} \qquad t = 1 \ldots 4$$

where E_t = Exports in year.

E_1 = exports in 1963.

E_2 = exports in 1964, etc.

S_t = Share of sales exported in year t. S_t is weighted, the weights varying from 1 (for share of exports in 1963) to 4 (for share of exports in 1966).

The share of sales multiplied by the weights and summed over the periods 1 to 4 is divided by the sum of the weights to obtain the weighted share of sales exported. The weight for a given year t is 0 if during that year no exports took place.

In theory the index could vary between 0 and infinity. In practice it varied between 0 (the value assigned to the export performance of firms which had no exports) and 5.70. The average value was 0.50.

In the analyses, respondents are frequently divided into four groups on the basis of their export performance index. The groups are analyzed in Appendix Table 3, which gives the breakdown of the respondents by export performance groups and indicates the extent to which their inclusion in a particular group was determined by both average annual export growth rate and weighted export share. An analysis of the feasible combinations of these two components of the export performance index suggests that the tradeoff permitted them is limited within a range, which makes intuitive sense. Thus, firms whose export share exceeds 0.25 can be included in Group I—low export performers—only if their exports declined between 1963 and 1966. In fact, not a single firm whose export share exceeded 0.25 was included in Group I. Turning to Group III—high export performers—we note that firms with negative export growth can be included only if their export share exceeds 0.5. The two firms included in Group III which met this criterion actually exported nearly 100 per cent of their output. Analyzing further the distribution within the various export performance groups, we note that most respondents in Group I are characterized by low or negative export growth rate and by low export shares. By contrast, most respondents in Group III have a high export share and a positive export growth rate.

The distribution of respondents belonging to the middle export per-

APPENDIX TABLE 3

Distribution of Respondents by their Export Performance Index and its Components

Group	Average Annual Growth Rate $\left(G = \sqrt[t-1]{\frac{E_t}{E_1}}\right)$	Weighted Share of Exports in Sales $\left(S = \frac{\sum_{t=1}^{n} t\ S_t}{\sum_{t=1}^{n} t}\right)$			
		$S \leq .25$	$.25 < S \leq 0.5$	$S > 0.5$	Total
52 Nonexporters					
EP = 0	G = 0	52	–	–	52
37 Low exporters	G < 1	22	–	–	22
$0 < EP \leq 0.1$	$1 < G < 1.3$	5	n.f.	n.f.	5
	$1.3 < G \leq 2$	6	n.f.	n.f.	6
	$2 < G$	4	n.f.	n.f.	4
44 Medium exporters	G < 1	8	5	–	13
$0.1 < EP \leq 0.5$	$1 < G < 1.3$	7	9	n.f.	16
	$1.3 < G \leq 2$	8	3	n.f.	11
	$2 < G$	4	n.f.	n.f.	4
40 High exporters	G < 1	n.f.	n.f.	2	2
0.5 < EP	$1 < G < 1.3$	n.f.	1	15	16
	$1.3 < G \leq 2$	n.f.	5	10	15
	$2 < G$	2	3	2	7

Note: n.f. = not feasible. (Because of the criteria by which firms have been classified there are no entries in the indicated cells.)

APPENDIX TABLE 4

List and Rank of Respondents by Industry, Skill Intensity, and Export Performance

Industry	Average Skill Intensity Index	Rank	Average Export Performance Index	Rank
Nonmetallic mining	0.57	1	0.96	4
Chemicals	0.52	2	2.89	1
Electronics	0.36	3	2.20	3
Electrical equipment	0.31	4	0.65	6
Machinery	0.28	5	2.31	2
Plywood and Plumbing fixtures	0.27	6	0.45	8
Leather and clothing	0.18	7	0.22	10
Plastic products	0.15	8	0.06	11
Textiles	0.14	9	0.33	9
Canned fruits	0.12	10	0.46	7
Diamonds	0.04	11	0.85	5

Note: n.f. = not feasible. (Because of the criteria by which firms have been classified there are no entries in the indicated cells.)

formance group shows, as might be expected, a wider dispersion among the feasible combinations. Appendix Table 4 gives the breakdown of the respondents by industry, ranking each industry by average skill intensity and export performance.

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COMMENT

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Professor Hirsch's paper contains a wealth of suggestive hypotheses and empirical evidence about firm behavior, product differences, and the nature of export markets. His essential thesis is that there are systematic relationships between types of products, the skill intensity of their production, and export market characteristics. The thesis is technological in that Hirsch believes that products requiring large skill inputs are generally comparatively new products with short production runs, loose specifications, much production to individual customer order, and considerable service and communications requirements by buyers. By contrast, established products are believed to have widely accepted specifications, standard technologies, and long production runs. This basic hypothesis generates a number of interesting corollaries with regard to the nature of price competition, size of firm, and the like. Hirsch then subjects these hypotheses to tests based on Israeli data for a sample of 190 firms.

Hirsch's paper contains too many provocative hypotheses and ideas to comment on them all in the time provided. These comments will focus upon only two aspects of his paper: (1) the relationship between technology, human capital, and the factor proportions model of international trade, and (2) the extent to which Hirsch's empirical research in fact tests the hypotheses with which he started.

Technology, human capital, the Heckscher-Ohlin model

Since Leontief [6] showed that American trade patterns could not be explained by the capital intensity of export- and import-competing pro-

duction, the factor proportions explanation of trade has been suspect. It is evident that a simple two-factor model of trade cannot be used to predict or explain trade patterns. The basic question is, what is wrong? Is the Heckscher-Ohlin model based upon one or more assumptions in flagrant violation of reality, or has the model been misinterpreted empirically?

Some attempts have been made to develop alternative models of trade and determination of comparative advantage. However, most research efforts have been focussed upon the incorporation of either "technology" or "human capital" as an additional explanatory variable in trade theory. Kenen [5], Roskamp and McMeekin [7], and Keesing [4] have found that the incorporation of human capital into models of comparative advantage determination reversed the apparent paradox pointed out by Leontief. Keesing [3], Hirsch [2], Vernon [8], and Gruber, Mehta, and Vernon [1] have investigated the role of research and development (R&D) as an explanatory variable and believe that its explanatory power is high.

With both human capital and R&D showing considerable explanatory power, the significant question is the relationship between them and the relative importance of each in determining comparative advantage and trade patterns. From the viewpoint of trade theory, the essential question is the relationship between technology and production functions. The factor proportions model is based upon the assumption that the same technologies are available for production in all countries. If technologies differ, it is quite possible that labor-abundant countries might export capital-intensive goods because of superior technologies, and vice versa. If, on the other hand, technologies are the same between countries but some products require a relatively large input of skilled labor (including design to individual specification, servicing requirements, and the like), the prospect for standard trade theory is far brighter. Then, the factor-proportions explanation of trade, in its empirical application, needs to be amended to cover more factors of production. It would not be that the theory did not fit the world; it would be that the simple two-factor interpretation of the theory was in error.

The outline of a dynamic model of comparative advantage for incorporating human capital explicitly into trade theory has begun to emerge. There are four basic hypotheses: (1) Skill classes are imperfect substitutes, so that as countries accumulate more highly skilled individuals,

wage differentials (in the absence of factor price equalization) tend to fall. (2) As suggested by Kenen [5], when countries increase their capital stock, it is allocated between investment in humans and investment in machines in such a way as to equate the rates of return on various investments. (3) With an increasing total capital stock per head, the rate of return on all types of investment declines, thereby changing (a) the skill-human capital proportions and (b) the relative distribution of skills among various classes. Little is known empirically about the directions of change. (4) For a given capital-rental and wage-differential structure, it will always pay firms to use more capital services with more skilled workers than with less skilled workers.

If these hypotheses are accepted, the rudiments of a theory can be pieced together. Rich countries will have to employ more skill and more capital per man in exports than will poor countries, and, conversely, poor countries will tend to export resource-intensive products, requiring less skill to produce. High per-capita-income countries will be those with a relatively large endowment of skills and physical capital. Technology can be regarded as an intermediate good produced with a high skill input. It would be used most intensively in the production of skill- and capital-intensive products. The ratios of physical capital to skill will vary with total capital endowment, but, without further assumptions or information, the direction of change cannot be specified. It might be the case that at intermediate income levels countries would have a higher ratio of physical to human capital than at high incomes, and that therefore they would find their comparative advantage in goods requiring relatively large amounts of physical capital, or vice versa.

Hirsch's results and Israel's comparative advantage

My chief concern with Hirsch's paper is that it is impossible to choose between the technological explanation and the skill explanation. Hirsch's findings are compatible with either the extended Heckscher-Ohlin model outlined above, or with a technological hypothesis.

Casual empiricism would suggest that Israel has a peculiar skill mix; many immigrants have come with very high skill levels, others have been virtually without skills. If this is true, Israel might well have a two-tail comparative advantage, concentrating her resources (1) in high skill activities to absorb her relative abundance of highly skilled workers and (2) in low skill activities to absorb the unskilled workers.

All this, of course, has to be taken in the context of other countries' comparative advantages (with a more normal skill distribution) as postulated above.

Such a hypothesis is consistent with Hirsch's findings. Hirsch does not use an independent measure of technology. Rather, he identifies technological firms as those having a high skill index and seeks to ascertain whether a high skill index [1] is correlated with the attributes of technological products he postulates. Hirsch's size measure fails his hypothesis, quite possibly because his unit is number of workers, rather than the amount of human capital or another more economically relevant unit. Hirsch was surprised to find the skill-intensive industries were also the capital-intensive industries. This is contrary to his technological hypotheses (although not essential to them) and consistent with the capital-accumulation view outlined above. The extended comparative advantage model would predict that Israel's skill-intensive industries would also be the capital-intensive industries, as Israel's relatively scarce capital stock would be allocated more toward the high skill workers than the low skill workers.

Hirsch finds that Israel's low skill and high skill industries, which he *identifies* with nontechnological and technological industries, have had a better "export performance" than the intermediate skill industries.[2] He

[1] Hirsch's skill index is open to criticism on several counts. He gives persons holding academic degrees a weight of two, other "skilled workers" a weight of one. Implicitly, he considers an academic degree holder a perfect substitute for two skilled workers and allows no substitution between these two groups and other employed persons. A comparable physical capital index might be the number of machines of twenty horsepower or less plus twice the number of machines of more than twenty horsepower divided by the total number of machines.

[2] Hirsch's export performance index is open to some criticism. Consider two firms with the following experience over a three-year period:

	Output		Exports	
Year	Firm 1	Firm 2	Firm 1	Firm 2
1	100	1000	50	100
2	90	1200	45	200
3	80	1500	40	300

I calculate the export performance of the first firm to be the cube root of .8 times one-half, or something in excess of .45. For the second firm, the export performance index is the cube root of three times .17, or less than .3. The first firm, with declining exports, outperforms the second firm, with tripled export sales and a rising share of exports in output.

explains this in terms of the existence of some resource-based industries. It would appear quite possible that the finding is a consequence of the two-tailed nature of Israel's comparative advantage, rather than the resource-base theory. Further support for this view comes from Hirsch's finding that Israel exports high skill products to the developing countries and low skill products to the developed countries. The double nature of Israel's comparative advantage appears, at least a priori, a more satisfactory explanation of this phenomenon than the technological content of the industries involved.

In summary, Hirsch has raised many interesting hypotheses about the nature of technology and its implications. From the viewpoint of international trade theory, however, he has not devised a test which can distinguish between the technological thesis and the human capital-physical capital explanation of orthodox trade theory.

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