Industry Competitiveness - The Role of Regional Distance-Sensitive Input Sharing (The Israeli – Arab Case)

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ABSTRACT

This study offers a method to estimate how the availability of distance-sensitive inputs affects industrial performance of neighboring countries. It shows that replacing either distant foreign input suppliers or inefficient local ones with neighboring suppliers, could enhance the competitiveness of specific industries within a country. Whereas the suggested method could be generalized for any type of regional trade liberalization, we focus on the case of removing trade barriers between former non-trading neighboring countries. More specifically, the case of regional distance-sensitive input sharing between Israel and three of its Arab neighbors (Egypt, Jordan and Syria) is demonstrated.

I. INTRODUCTION

The Hecksher-Ohlin-Samuelson (H-O-S) theory of comparative advantage claims that countries' comparative advantage is essentially the outcome of their comparative factor endowment. Hence, countries comparatively endowed with labor are likely to export labor-intensive products whereas countries comparatively endowed with capital are likely to export capital-intensive products. If we relax the H-O-S theory's assumption on the international immobility of factors then the theory's logic may be extended to claim that a country's comparative advantage is determined by the availability of specific inputs, whether acquired locally or imported. Japan, for example, became a world leader in shipbuilding without having internal supplies of iron and steel, but through utilizing superior technology and management skills while importing metal scrap, which was widely available in the world markets.

The problem with the latter argument is that procurement of inputs from distant sources is subject to transportation costs and other trade barriers that increase the price of the acquired inputs. Thus, in the absence of trade barriers between neighboring countries, availability of specific inputs in a neighboring country might be as good as the availability of local inputs for the creation of comparative advantage. The reason for that is the negligible wedge between local transportation costs and transportation costs from neighboring countries. One may therefore argue that in many cases comparative advantage may stem from the ability to source inputs from neighboring countries, rather than from local inputs endowment. In any case it is clear that access to locally scarce inputs in a neighboring country may reduce production costs and thus improve the overall competitiveness of specific industries within a country. The U.S. automobile and electronics industries, for example, rely on Mexican inputs as a crucial factor to reduce production costs and hence maintain their worldwide competitiveness (Fatemi, 1990).

If certain inputs are not available within a country and the access to such inputs in neighboring countries is hampered (by tariff or non-tariff barriers) or denied (e.g. as a result of a political conflict), a country's comparative advantage in the industries requiring these inputs may be offset. The latter argument is particularly true if the scarce inputs are distance sensitive, i.e. have high transportation cost per unit relative to their unit production cost (Hirsch and Hashai, 2000; Hummels, 1999; Krugman, 1991). In this case imports of inputs from distant sources are expected to be very expensive. Removal of trade barriers and allowing access to inputs located in neighboring countries may enhance the competitiveness of these industries, i.e. enable them to manufacture a given quantity Q in per unit cost $C_2 < C_1$ (C_1- per unit manufacturing cost *before* the removal of trade barriers; C_2- per unit manufacturing cost *after* the removal of trade barriers).

Whereas the above argument might be generalized to any type of regional trade liberalization, this study focuses on the more extreme case of removing trade barriers between former non-trading neighboring countries. More specifically we relate to Israel and three of its surrounding Arab neighbors- Egypt, Jordan and Syria. Most research regarding the Israeli-Arab trade potential focuses on a comparative analysis of the current trade patterns of Israel and its Arab neighbors (Arnon and Weinblatt, 1994; Ben Haim, 1993; Ben Shahar et al., 1989; Halbach et al., 1995; Halevi, 1994; Sagi, 1999). This line of research ignores the probably more important question: "*Does the fact that Israel and its neighbors are virtually 'economic islands' affect the competitiveness of certain industries in these countries?*"

An 'economic island' is a country with negligible border trade. Israel is surely an economic island. It cannot trade with its enemy neighbors (Lebanon and Syria) and its trade with past enemies (Egypt and Jordan) is negligible (about 0.3 % of Israel's international trade volume). Evidently the political tension in the Middle East, the need to take severe security measures, administrative trade barriers, and the ongoing Israeli-Palestinian conflict have negatively affected the volume of trade between Israel and its neighbors (Economist Intelligence Unit, 2001). Israel's surrounding Arab neighbors may also be regarded as economic islands since: a) their trade with Israel is negligible, b) the similarity of their industrial structure inhibits the possibility of extensive trade in inputs and finished products. Thus, the ratio of intra-Arab trade to their overall international trade is very low (Halbach et al., 1995; Fischer, 1992). The fact that the economies of Israel (comparatively well endowed with capital and skilled labor) and the Arab countries (comparatively well endowed with unskilled labor and natural resources, such as petrochemicals) are of complementary nature (Economist Intelligence Unit, 2001), may impact these countries' comparative advantages once bilateral trade is allowed. If this is the case, once all trade barriers between Israel and its neighbors are removed, we may witness an increase in the volume of output and exports in the concerned countries that stems from distance sensitive input sharing.

Several studies have tried to estimate the potential for Israeli-Arab trade in *distance-sensitive products* (Hirsch and Hashai, 2000) and the potential for trade based on *input sharing* (Hirsch et al., 1999; Rivlin and Hashai, 2000). The two latter studies have focused on the potential trade in inputs with 'Revealed' comparative advantage (Balassa, 1965), thus ignoring the fact that the comparative advantage of certain distance sensitive industries in Israel and its Arab neighbors may be hindered. The current study offers a new perspective to the analysis of the Israeli-Arab trade potential, by combining distance and input sharing and analyzing the impact of *regional distance-sensitive input sharing* on the overall industrial performance.

The study presents a partial equilibrium analysis to estimate how the output and exports of a country's industrial sector are affected when imported and locally purchased inputs are substituted by inputs from neighboring countries with which trade was previously forbidden or distorted. The fact that imports of distance sensitive inputs were costly, forced manufacturers either to absorb international transportation costs or to rely on local non-efficient suppliers. Thus, taking an absolute advantage point of view, the ability to purchase cheaper inputs from a neighboring country is expected to enable a more competitive production of finished products (stemming from the cheaper cost of production) that will be reflected in increased local sales and expanded exports.

II. ANALYTICAL FRAMEWORK

A product's cost reflects the cost of raw materials and semi-finished products purchased to produce it, as well as the cost of hired labor. We refer to all these cost components as 'inputs'. Some inputs are immobile (e.g. natural resources and to a certain extent labor). The availability of these inputs is perceived as a 'location advantage' of a country (Dunning, 1977). Other inputs are mobile (raw materials and intermediate products). While scarcity of local immobile inputs forces firms to acquire them through foreign direct investment, mobile inputs can be acquired through imports. The current study focuses on the ability to access mobile inputs that are unavailable in the home country through imports from neighboring countries. Gaining access to such inputs will henceforth be referred to as 'input sharing'.

The volume of input sharing between firms from different countries is clearly affected by the costs of transferring the inputs from one country to another. These include transportation costs, tariffs costs and the cost of non-tariff barriers (Ayal et al. 1990; Casson, 2000; Helpman and Krugman, 1985; Hummels, 1999). The higher these costs are, the lower the volume of input sharing is expected to be. Thus, other things being equal, neighboring suppliers of distance sensitive inputs have an inherent cost advantage over more distant suppliers.

To capture the impact of input sharing on a product's production cost, we consider a world consisting of three countries: A and B – two former non-trading neighbors and R – a third distant country. Assuming production is comprised of *n* inputs, the following notation is used:

C(k,i) - unit cost of input *i* in country *k*.

T(lk,i) – international transportation cost from country *l* to country *k* of one unit of input *i*.

For the sake of simplicity we assume that the markets for inputs and final goods are perfectly competitive, that profit margins of input suppliers in A, B and R are similar and that tariff barriers and local transportation costs may be ignored. We further assume that the *n* inputs are either distance sensitive or non-distance sensitive. For all distance sensitive inputs (*i*'):

$$T(BA,i') \ll T(lk,i');\ (k=A,B;\ l=R) \qquad (1a)$$

For all non-distance sensitive inputs (*i*):

$$T(BA,i) \approx T(lk,i);\ \ (k=A,B;\ l=R) \qquad (1b)$$

The overall cost of producing a product in A (C_A), **before** trade between A and B is allowed, represents an optimal allocation of *m* locally purchased inputs and (*n-m*) imported ones:

$$C_A = \sum_{i=1}^{m} C(A,i) + \sum_{i=m+1}^{n} \{C(R,i) + T(RA,i)\} \qquad m<n \qquad (2)$$

After trade between A and B is allowed, (1a) and (1b) imply that two phenomena may occur. One is the replacement of (*n-n'*) distance sensitive inputs (from R) with inputs from B, hence saving on transportation costs. The production costs function in this case is:

$$C'_A = \sum_{i=1}^{m} C(A,i) + \sum_{i=m+1}^{n'} \{C(R,i) + T(RA,i)\} + \sum_{i'=n'+1}^{n} \{C(B,i') + T(BA,i')\} \quad m<n'<n \qquad (3)$$

The second phenomenon is the replacement of *m'* local distance sensitive inputs by cheaper inputs from B. Production cost in this case is:

$$C''_A = \sum_{i=1}^{m'} C(A,i) + \sum_{i'=m'+1}^{m} \{C(B,i') + T(BA,i')\} + \sum_{i=m+1}^{n} \{C(R,i) + T(RA,i)\} \quad m'<m<n \qquad (4)$$

As profit margins of the various input suppliers are assumed to be similar, differences in inputs' cost represent differences in their price. Thus, we refer to two economic effects. If (3)<(2) (i.e. $\sum_{i'=n'+1}^{n} \{C(B,i') + T(BA,i')\} < \sum_{i'=n'+1}^{n} \{C(R,i') + T(RA,i')\}$) one may refer to the *distance effect* – importing distance-sensitive inputs from cheaper proximate sources (in Cost, Insurance, Freight (CIF)) terms, as a substitute for importing these inputs from more distant suppliers. The main stimulus of this effect is savings on transportation costs. If (4)<(2) (i.e. $\sum_{i'=m'+1}^{m} \{C(B,i') + T(BA,i')\} < \sum_{i'=m'+1}^{m} C(A,i')$) one may refer to the *inefficiency effect* – importing distance-sensitive inputs from neighboring countries at cheaper prices (in CIF terms), as a substitute for purchasing more expensive inputs from local suppliers. Here the main stimulus is the superior efficiency of neighboring suppliers. Needless to say both effects are additive and thus may conjunct.

If A and B represent Israel and its Arab neighbors respectively, and R represents the rest of the world, then allowing manufacturers from A to acquire B's inputs, is expected to enable a rightward shift of their supply curve, hence enabling them to offer lower prices at each production level. This price reduction is expected to give rise to output expansion and facilitate sales to the markets in A, B and R. Clearly, the demonstrated case for country A is identical for country B as well.

III. EMPIRICAL ANALYSIS AND DATA

In order to empirically assess the impacts of regional distance-sensitive input sharing we present a partial equilibrium analysis, at the industry level (4 digits International Standard Industrial Classification (ISIC))[1]. The empirical analysis assumes all trade barriers between Israel and its neighbors are removed. Additionally, we assume that the markets for inputs and final goods at 4 digits ISIC level are perfectly competitive. This view is supported by the fairly large number of firms per 4 digits ISIC industries in Israel, Egypt, Jordan and Syria (Israel Central Bureau of Statistics, 1998b; UNIDO, 2001a, 2001b).

Once the distance and inefficiency effects are estimated, input-output tables are the most suitable mechanism to measure the effect of cheaper inputs procurement on production costs and output volumes. These tables provide statistics on the volume and cost of input purchases by each industry (in a specific country) from local and foreign industries. Thus, input-output tables provide a reasonable estimate to the effect of a given input cost on the overall production cost in other industries (Bruno and Sachs, 1983; Davar, 1994; Leontief, 1953a, 1953b). In the absence of input-output tables for the concerned Arab countries' industrial sectors, the following empirical analysis examines only the effect on Israeli industries acquiring inputs from the Arab countries.

[1] Where required self conversion from different classifications into ISIC was employed.

Estimating the Distance and Inefficiency Effects

The distance and inefficiency effects relate to differences in international transportation costs between Israel's current suppliers of distance sensitive inputs and potential Arab suppliers, as well as to differences in the ex-factory price of these suppliers. Hence, both effects can be estimated by (5):

$$Dis-InEff_i = DS_i * (RDist_i - BDist_i) + [\frac{EmpOut_{i,R}}{EmpOut_{i,B}} * \{LabShare_i * (\frac{EmpWage_{i,B}}{EmpWage_{i,R}}) + (1 - LabShare_i)\} - 1] \quad (5)$$

Dis-InEff $_i$ - Distance and Inefficiency effects in input industry i
DS_i - Distance sensitivity index of industry i
$RDist_i$ - The weighted average distance (in kilometers) from Israel's current import sources of industry i ($RDist_i$ =0 in the case of local Israeli suppliers)
$BDist_i$ - The distance in kilometers between Israel and a neighboring Arab country
$EmpOut_{i,R}$ - Average output per employee in the manufacturing of input i (in its current sources)
$EmpOut_{i,B}$ - Output per employee in the manufacturing of input i (in an Arab country)
$EmpWage_{i,R}$ –Average annual wages cost per employee in input industry i (in its current sources)
$EmpWage_{i,B}$ -Annual wages cost per employee in input industry i (in an Arab country)
$LabShare_i$ - Ratio of labor cost to the overall production cost in input industry i

Equation (5) has two parts. First, we estimate the wedge in transportation costs to Israel, between current suppliers and potential Arab suppliers of a given input industry *i*. This wedge is proxied by subtracting $BDist_i$ from $RDist_i$ in each industry. $BDist_i$ is proxied by the aviation distance between Tel Aviv the capital cities of Egypt, Jordan and Syria (approximately 420 kilometers to Cairo, 120 kilometers to Amman and 250 kilometers to Damascus, respectively). $RDist_i$ represents the 'weighted average distance' between Israel and it's current import sources of input industry *i*. $RDist_i$ is the product of the shortest naval distance between Israel and each current import source country[2] (Waterman Steamship Corporation, 1959) and this source's share of the overall imports of input *i* to Israel in 1994 (United Nations, 1994a). The calculation refers to major import sources, supplying 70% of the 1994 imports in industry *i*.

Next, the term (*$RDist_i$-$BDist_i$*) is multiplied by a Distance Sensitivity (DS_i) index. The DS_i index measures the ratio of international transportation costs per kilometer to input *i*'s CIF value at its port of destination. As we need to relate to data that is not biased because of political circumstances, calculation of the DS_i index is based on 1994 data for the U.S. industrial sector. The percentage of transportation costs (including insurance cost) from the overall CIF import value (as derived from Frankel 1997, Table 3.1b, Appendix B), of an input industry *i*, is divided by the 'weighted average distance' from the U.S. to its major import sources in that industry (United Nations, 1994b; Waterman Steamship Corporation, 1959). The DS_i index is a continuous measure of distance sensitivity. It is always positive; the higher it is, the greater is the input's sensitivity to distance (for a detailed calculation of the DS_i index see Hashai, 2002). In the case of substituting imported inputs with Arab inputs the wedge in transportation costs yields the percentage of savings in transportation cost for a given input *i*. In the case of substituting Israeli inputs with Arab ones the outcome yields the percentage of additional transportation costs of Arab suppliers compared with current Israeli suppliers.

The second part of (5) relates to differences in input *i*'s production costs. Differences in production costs of Israel's current suppliers of input *i* and potential Arab suppliers are underpinned by two additional assumptions:

a) The technology and manufacturing techniques, of input industry *i*, are similar for suppliers at A, B and R (hence, no factor reversal is expected).

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[2] In calculation of distance from landlocked countries, land distance to the nearest exit port is added.

b) Since capital is a mobile factor of production, capital costs are assumed to converge around the globe. Hence, differences in the cost of producing input *i* are mainly a function of labor cost and labor productivity (Casson, 1985).

The difference in production cost between Israel's current input *i*'s suppliers and potential Arab ones is a function of the per employee wage ratio of these suppliers, adjusted by the ratio of labor cost to the overall production cost ($LabShare_i * (\frac{EmpWage_{i,B}}{EmpWage_{i,R}}) + (1 - LabShare_i)$) and then multiplied by the suppliers' comparative productivity ($\frac{EmpOut_{i,R}}{EmpOut_{i,B}}$). The product of these two terms enables us to estimate the difference in the production cost of input *i*.

In the case of substituting imported inputs, average wages and output per employee for each input industry were calculated according to the weighted share of imports to Israel (UNIDO, 2001a; United Nations, 1994a). The calculation refers to major import sources, supplying at least 50% of the 1994 imports in industry *i*. Wages and output data relates to 1992-1996, according to data availability of the concerned countries. In the case of substituting Israeli inputs, per industry wages and output data are derived from Israel Central Bureau of Statistics (1998b) and UNIDO (2001a). In both cases the ratio of labor cost to the overall production cost ($LabShare_i$) is derived from the Israeli input-output (Israel Central Bureau of Statistics, 1998a). This underlines the assumption that the technical factor composition is similar internationally.

Cost Reduction in the Purchasing Industries

In order to estimate the overall production cost reduction of input purchasing industries due to the distance and inefficiency effects we use Israeli input-output tables

(Israel Central Bureau of Statistics, 1998a). Nevertheless, due to technical limitations of input-output tables, the calculation of cost reduction when substituting imported inputs differs from that of locally purchased inputs.

In the case of substituting *imported* inputs, the cost-reduction ratio in the procuring industries is composed of direct and indirect impacts. The direct impact relates to production cost reduction in an industry as a result of reducing inputs prices. The indirect impact stems from the fact that the above reduction in production costs also benefits industries that do not procure inputs from the Arab countries, but procure inputs from industries that do. As detailed below, in the case of substituting *local* inputs we can only relate to the direct cost-reduction of industries procuring inputs from Arab suppliers.

Imported Inputs

Calculation of the cost-reduction ratio in the substitution of imported inputs is based on input-output tables in monetary values (Davar, 1994). The calculation employs the direct coefficients matrix, the Leontief matrix and the production factors direct coefficients matrix. The direct coefficients matrix (A_{nn}) is a matrix where the a_{ij} term represents the local input of industry i required to produce one product unit of industry j. We use A_{nn} to calculate matrix B_{nn}, according to (6):

$$B_{nn} = (I_{nn}-A_{nn})^{-1} \tag{6}$$

B_{nn} is the inverse matrix of the Leontief matrix (Leontief, 1953a, 1953b), which is the difference between the unit matrix and the direct coefficient matrix. The b_{ij} term represents the overall input (direct and indirect) of industry i required to supply one product unit of industry j. B_{nn} relates both to industry i's inputs procured directly by industry j and to industry i's inputs procured by other industries, from which industry j in turn procures inputs. The production factors direct coefficients matrix (C_{mn}) is a matrix where the c_{kj} term represents the inputs of production factor f required to produce one product unit of industry j. Production factors in input-output tables include inputs of import industries, as well as labor, taxes and subsidies.

Matrix S_{mn}, the matrix of 'overall production factor coefficients', equals:

$$S_{mn} = C_{mn} * B_{nn} \tag{7}$$

The s_{kj} term represents the overall input (direct and indirect) of production factor f required to supply one product unit of industry j. If we define a vector P_n as the cost vector of the various final products in the input-output tables and a vector F_m as the cost vector of the various production factors, we can note that:

$$P' = A'*P' + C'*F' = B'*C'*F' = S'*F' \tag{8}$$

In the initial general equilibrium (before input sharing), all the terms in vectors P and F equal 1. Substituting the new cost rate for the imported inputs (as production factors) yields the reduction in the cost of final products.

Local Inputs

In the case of the substituting *local* inputs, cost reduction is calculated as the product of input i's cost reduction and input i's proportion of the overall input cost per dollar of output in industry j. Repeating this exercise for all input industries where Arab input suppliers are cheaper than current Israeli ones yields a quantitative estimate of the total cost reduction achieved per one dollar of output in industry j. This kind of calculation does not take into account the *overall* impact of procuring cheaper inputs, as it ignores the fact that local industries with lower production costs (due to cheaper input procurement from Arab suppliers) may provide cheaper inputs to other industries (which do not necessarily procure inputs from Arab suppliers). Input-output tables in monetary terms enable this effect to be calculated only for production factors (imported inputs, labor, taxes, etc.), and not for the local input industries themselves (Davar, 1994). Thus calculation of the impact of replacing local input suppliers constitutes only a first-degree approximation for the overall expected cost reduction.

Calculation of the cost-reduction ratio in the substitution of local inputs also employs the direct coefficients matrix (A_{nn}), where the change in the cost of any input *i,* represented by a_{ij} term (the direct coefficient) affects the overall production cost of industry *j*. Thus, the overall cost reduction rate per industry *j* is calculated according to (9):

$$CR_j = 1 - \sum_{i=1}^{n} a_{ij} \times cr_i \qquad (9)$$

CRj - The overall cost reduction rate in industry j.
a_{ij} - The proportion of input i of the overall production cost in industry j.
cr_i - Rate of cost reduction of input i.

Estimating Output Expansion

Substituting to cheaper input suppliers should lead to output expansion, as the supply curve in the concerned industries shifts rightward. For the sake of simplicity, this study assumes that at 4 digits ISIC level there are two industry groups. Industries in which imports exceed exports are defined as import substitute industries whose output is targeted to the local market (hereinafter – “Israeli local industries”). Most of the products that are classified within these industries are assumed to be designated to the local market. Local industries are expected to compete with imports. Industries in which exports exceed imports are defined as “Israeli export industries”. Export industries sell to the Israeli market as well as to export markets. Because this partition is somewhat arbitrary, we have verified that the mean ratios of exports to output for these two groups are significantly different (T value = 3.163; df=58; $p \leq 0.02$).

In order to calculate the link between cost reduction and output volume we need data on supply and demand price elasticity for industries at 4 digits ISIC level. In the absence of such detailed data for Israel we use international elasticities as a proxy. This approach is supported by studies that reveal similar demand elasticities in specific industries in Israel and the U.S. (Aigner et al., 1994; Tishler, 1983).

Based on various sources (Brown et al., 1991; Davenport, 1986; Deaton, 1997; Dixit and Stiglitz, 1977; Lluch et al., 1977; Stern et al., 1976) we have derived minimum and maximum values (in absolute terms) for supply and demand elasticities of 4 digits ISIC industries in Europe and the U.S. As these sources list different values for supply and demand elasticities in certain industries, we chose to be conservative in relating to upper and lower limits reported in the literature. The range of industry demand elasticities employed for our calculations was (–0.5) to (–2.7), while the range of supply elasticities was 0.5 to 2.0[3]. The range of demand elasticities conforms to Kondor's (1982a, 1982b) estimations that demand elasticities for imports to Israel average between (–0.8) to (–1.6).

In order to estimate the output expansion in Israeli local industries, the per industry demand and supply functions are assumed to be linear (as changes in production costs expected to be relatively small) and are defined as:

$$P_{supply} = \alpha + \beta Q \text{ ; (P - price, Q - quantity, } \alpha,\beta > 0) \qquad (10a)$$

$$P_{demand} = \gamma - \delta Q \text{ ; } (\gamma,\delta > 0) \qquad (10b)$$

We arbitrarily define an industry's import price to Israel as $P_w+M_x=1$(P_w-world price; M_x-transportation costs to Israel. As Israel is relatively small compared to the world economy, one may assume an indefinite supply at that price and that Israeli customers bear international transportation costs. Hence, in Israeli local industries the intersection between the demand and supply curves is at a price higher than 1.

Since supply elasticity (E_s) and demand price elasticity (E_d) equal:

$$E_s=(dQ/Q)/(dP/P)=(1/\beta)/(Q/P) \qquad (11a)$$

$$E_d=(dQ/Q)/(dP/P)=(1/\delta)/(Q/P) \qquad (11b)$$

And since the current output designated to the local market, the current demand (i.e. consumption, Israel Central Bureau of Statistics, 2000), and the supply and demand elasticities are also known, we can compute the parameters α, ß, γ and δ for each industry.

Now, let x denote the per-unit production cost-reduction rate resulting from procuring inputs in Arab countries. We can derive the new supply function after cost reduction by (12):

$$P' = \alpha-x + \beta Q \text{ ; (P' – new price, Q - quantity, } \alpha,\beta,x>0) \qquad (12)$$

Since each of the required values is known, the ratio and volume of output expansion can be estimated according to the intersection between the new supply curve and the demand curve[4], as specified in (13):

$$\Delta Q=(1-\alpha_i+x)/\beta_i-Q \qquad (13)$$

ΔQ- Output expansion
Q - Industry output <u>before</u> input sharing
α_i,β_i - Parameters of the supply curve, as calculated for minimal/maximal supply elasticity

[3] Per industry elasticity data can be obtained from the author.
[4] If the new supply curve and the demand curve intersect bellow P_w+M_x, the calculation should be slightly altered. In our case the curves of all local industries intersect above P_w+M_x.

x.– Rate of cost reduction, due to distance and inefficiency effects.

Similarly, we can use (10)-(12) to estimate the export expansion (i.e. output designated for exports) of Israeli export industries. We arbitrarily define the export price of Israeli exporters as P_w-M_x =1. The net price Israeli exporters face equals to the world price (P_w) minus transportation costs to the world markets (M_x). As Israel is relatively small compared to the world markets, we assume an indefinite demand in this price. This implies that the demand and supply curves intersect at a price lower than 1. As the current export volume and the supply elasticity are known, we can calculate the parameters α and ß for each industry. Then we use (13) to calculate the ratio and volume of export expansion at the point of intersection between the new supply curve and the export price (P_w-M_x).

IV. RESULTS

Equation (5) was used to calculate input costs differences for 34 input industries identified as distance sensitive in previous studies (Hirsch and Hashai, 2000; Hashai, 2002). Table 1 sums up the distance and inefficiency effects of 11 input industries (out of the 34) for which imports from Egypt, Jordan or Syria are identified as cheaper than Israel's current local and foreign input sources. For the remaining 24 input industries the distance and inefficiency effects were negative, i.e. current input suppliers are cheaper than potential Arab suppliers. For each of the 11 industries, the cheapest supplier was chosen among Egypt, Jordan and Syria.

[Insert Table 1 about here]

Some of the values in Table 1 are negative. As implied from (3) and (4), when substituting imported inputs, negative values of the inefficiency effect indicate that savings on transportation costs have to be adjusted due to the comparatively higher productivity of Israel's current input suppliers (in the rest of the cases both effects are in the same direction). In the case of substituting inputs currently purchased in Israel, the inefficiency effect has to be adjusted by a negative distance effect due to the higher transportation costs that potential Arab suppliers incur.

Table 1 reveals that though only a few Arab industries are able to supply cheaper inputs to Israeli industries, most of these input industries exhibit substantial cost reductions, averaging between 33% to 55% of Israel's current input costs. Input cost reduction is mainly expected in the food, wood, paper and machinery industries (ISICs starting with 31,33,34 and 38). Syria is likely to be the most prominent input supplier.

Table 2 presents percentage values for the accumulated production-cost reduction in selected Israeli industries, resulting from substituting imported and local inputs with cheaper Arab inputs (as identified in Table 1). The highest cost reductions are in the paper industries (ISICs 3411,3412). This result probably stems from the fact that wood and paper, for which substantial cost reduction was identified in Table 1, are major inputs of these industries. Other industries with high cost reductions are the food and wood industries (ISICs starting with 31 and 33). Cost reduction in these industries probably stems from intra-industry input procurement. On average (for all industries) production cost reduction is 2.6% (1.26% as a result of imported inputs substitution and 1.34% as a result of local inputs substitution).

[Insert Table 2 about here]

Table 3 describes the output expansion in Israeli local industries as a consequence of importing cheaper distance-sensitive inputs. Columns 1 and 2 respectively list the minimum and maximum volumes of output expansion, as calculated based on (13). Columns 3 and 4 respectively present the minimal and maximal percentage of change in the output of Israeli local industries, as an indication for the relative impact of input sharing. Table 3 indicates that Israeli local industries procuring cheaper inputs from suppliers in neighboring Arab countries are expected to increase their output by about $430-$900 million per annum, which is an increase of about 2.5-5% in these industries' output. The most prominent industries in which output expansion is expected are paper, paper products and the printing and publishing industries (ISICs 3411,3412, 3420).

[Insert Table 3 about here]

Table 4 describes the export expansion in Israeli export industries as a result of importing cheaper distance-sensitive inputs. Columns 1 and 2 respectively indicate the minimum and maximum expected volume of export expansion, calculated according to (13). Columns 3 and 4 respectively present the minimal and maximal percentage of change in the exports of Israeli industries. Israeli export industries are expected to increase their exports by about $230-$520 million per annum, indicating an increase of about 1-2.5% in their total exports. Most of the export expansion is concentrated in Israeli chemical industries (ISICs starting with 35).

[Insert Table 4 about here]

V. CONCLUSION

The findings of this study reflect the impact of the distance and inefficiency effects on the output of the Israeli industrial sector as a result of distance-sensitive input sharing with Egypt, Jordan and Syria. The analysis assumes that all political and administrative trade barriers between Israel and its Arab neighbors are removed. Our results show that about two thirds of the output expansion is expected to be designated to the Israeli local market, whereas about a third will be targeted to export markets. The overall output expansion to local and export markets is estimated by about $660-1,420 million per annum, contributing 0.7%-1.5% to the 1996 Israeli gross domestic product.

Various implications arise from the above results. In the Israeli-Arab context the identified output and export expansion represents a missing part in previous forecasts of the Israeli-Arab trade potential (Ben Shahar et al., 1989; Ben Haim, 1993; Halevi, 1994; Arnon and Weinblatt, 1994; Halbach et al., 1995; Sagi, 1999). Even though the analysis doesn't assess the impact of purchasing Israeli distance sensitive inputs by Arab industries, the estimates for Israel itself are large enough to indicate that the impact of potential Israeli-Arab trade is larger than the previous estimations of the Israeli Arab trade potential. These forecasts estimate the trade potential of Israel with *all* the Arab countries by only tens to few hundred million dollars annually.

However, it is important to stress that the current study is based on a partial equilibrium analysis and on quite a few simplifying assumptions. This inhibits the analysis from capturing substitution effects (e.g. the transfer of production factors between industries), income effects (changes in wages due to the growth in output), potential labor market constrains and exchange rates consequences that can only be assessed by a general equilibrium framework. Moreover, comparison of the minimum and maximum estimations presented in Tables 3 and 4 reflects a high sensitivity of the results to price elasticities. In addition our estimations assume the absence of any trade barriers between Israel and its neighbors and ignore the large difference in per capita income in Israel and its neighbors (Economist Intelligence Unit, 2001) that may imply for trade inhibiting Linder effects

(Linder, 1961). Thus, the estimations presented in this study should be treated cautiously and interpreted as upper limit estimations.

The analysis shows that Israeli-Arab input sharing is expected to occur as a result of replacement of imported inputs as well as inputs currently procured in Israel. This fact indicates that conflicts with current local input suppliers, who may be harmed by the commencement of trade with Arab countries, are expected (Hirsch et al., 1999). Even though economic integration theory indicates that replacement of inefficient local suppliers by more efficient foreign ones is likely to improve economic welfare (Viner, 1950), policy makers should be aware of such potential conflicts, due to the political sensitivity of commencing trade relations between former enemy countries.

In the broader context, we argue that regional distance-sensitive input sharing, could be a major enhancer of comparative advantage in a region due to trade liberalization. If comparative advantage is interpreted according to the basic notion of the H-O-S model as the outcome of comparative input endowment, then input sharing increases the volume and variety of inputs within a region in comparison to the rest of the world. Thus, countries within that region may improve their comparative advantages due to distance-sensitive input sharing.

The method to quantify the impact of regional input sharing, which was demonstrated in this study, could also be applied to regional preferential trade agreements (PTAs). Relating to suppliers' comparative cost of tariffs, in addition to the distance and inefficiency effects, is quite straightforward. Quantifying the cost of non-tariff barriers, when comparing local, regional and foreign input suppliers, is probably more complex. Overall, it is evident that input-output tables are useful in order to capture the full impact of trade liberalization. Moreover, the fact that Israel and its Arab neighbors differ significantly in their standard of living indicates that PTAs between developed and developing countries may stimulate trade due to the complementary nature of their inputs' availability.

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Table 1 - The distance and Inefficiency effects (percentage)

No.	ISIC	Industry	Arab Source Country	Distance Effect	Inefficiency Effect	Total Cost Reduction
				Imported Inputs Substitutes		
1	3312	Wooden and cane containers and small cane ware	Syria	23.97	37.33	61.30
2	3320	Furniture and fixtures, except primarily of metal	Syria	4.61	31.82	36.43
3	3411	Pulp, paper and paperboard	Syria	27.72	42.79	70.51
4	3512	Fertilizers and pesticides	Jordan	30.37	-5.97	24.40
5	3812	Furniture and fixtures primarily of metal	Syria	4.77	-4.54	0.23
6	3841	Ship building and repairing	Syria	3.54	-0.39	3.15
					Average	**32.67**
				Israeli Inputs Substitutes		
1	3115	Vegetable and animal oils and fats	Jordan	-0.10	46.83	46.74
2	3117	Bakery products	Syria	-0.48	91.38	90.91
3	3311	Sawmills, planking and other wood mills	Syria	-1.10	29.57	28.47
4	3312	Wooden and cane containers and small cane ware	Syria	-1.10	19.55	18.45
5	3412	Containers and boxes and other articles of paper, paperboard and pulp	Syria	-0.73	69.36	68.64
6	3825	Office, computing and accounting machinery	Egypt	-0.13	76.64	76.51
					Average	**54.95**

Source: Author's calculations.

Table 2 - Cost reduction in Israeli industries procuring inputs from Egypt, Jordan and Syria (percentage, industries for which cost reduction is above 4%)

No.	ISIC	Israeli Industry (Inputs Purchaser)	Cost Reduction
1	3115	Vegetable and animal oils and fats	5.8
2	3116	Grain mill products	5.6
3	3117	Bakery products	6.3
4	3121	Food products n.e.c.	4.1
5	3219	Manufacture of textiles n.e.c.	6.9
6	3311	Sawmills, planking and other wood mills	4.6
5	3312	Wooden and cane containers and small cane ware	7.2
9	3411	Manufacture of pulp, paper and paperboard	24.5
10	3412	Containers and boxes and other articles of paper, paperboard and pulp	21.2
11	3420	Printing, publishing and allied industries	7.0
12	3825	Office, computing and accounting machinery	6.1
		Average for all industries	**2.6**

Source: Author's calculations based on Input-Output tables (Israel Central Bureau of Statistics, 1998a)
n.e.c – not elsewhere classified

Table 3- Output expansion in Israeli local industries

(1996 data, Millions of US dollars and percentage)*

No.	ISIC	Industry	Total change in output ($, M)		Change in output (%)	
			(1)	*(2)*	*(3)*	*(4)*
			min	**max**	**min**	**max**
1	3117	Bakery products	18	55	3.2	9.5
2	3311,3312	Sawmills, wood mills, wood and cork products	13	26	5.9	11.8
3	3320	Furniture and fixtures, except primarily of metal	27	55	3.7	7.4
4	3411	Manufacture of pulp, paper and paperboard	45	90	24.5	49.0
5	3412	Containers and boxes and other articles of paper, paperboard and pulp	115	230	21.2	42.4
6	3420	Printing, publishing and allied industries	96	192	7.0	14.0
7	3521	Manufacture of paints, varnishes & lacquers	12	23	7.0	14.0
8	3699	Manufacture of non-metallic mineral products n.e.c.	11	22	0.9	1.8
9	3812,3813,3819	Structural metal products and fabricated metal products	16	32	0.5	1.0
10	3825	Manufacture of office, computing & accounting machinery	11	22	6.1	12.2
11		Other industries	62	155	(-)	(-)
		Total output expansion & Average change	**426**	**902**	**2.3**	**4.8**

Sources: Author's calculations based on Israel Central Bureau of Statistics (2000)
* Note: Selected industries with minimal output expansion of $10M.
Legend:
Min: output expansion, calculated by minimal demand and supply elasticities
Max: output expansion, calculated by maximal demand and supply elasticities
%- Percentage

Table 4- Export expansion of Israeli industries

(1996 data, Millions of US dollars and percentage)*

No.	ISIC	Industry	Total change in exports ($, M)		Change in exports (%)	
			(1)	*(2)*	*(3)*	*(4)*
			min	**max**	**min**	**max**
1	3121	Food products not elsewhere classified	16	48	2.1	6.2
2	3511	Manufacture of basic industrial chemicals except fertilizers	75	150	4.6	9.2
3	3512	Manufacture of fertilizers and pesticides	24	48	1.7	3.4
4	3529	Manufacture of chemical products not elsewhere classified	20	41	1.1	2.2
5	3560	Manufacture of plastic products	16	32	0.8	1.6
6	3832	Radio, television & communication equipment	46	92	0.7	1.4
7		Other industries	34	107	(-)	(-)
		Total export expansion & Average change	**232**	**518**	**1.0**	**2.3**

Sources: Author's calculations based on Israel Central Bureau of Statistics (2000)
*Note: Selected industries with minimal output expansion of $10M.
Legend:
Min: export expansion, calculated by minimal demand and supply elasticities
Max: export expansion, calculated by maximal demand and supply elasticities
%- Percentage