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Exports, Imports and Economic Growth  
in Semi-Industrialized Countries

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Exports, Imports and Economic Growth  
in Semi-Industrialized Countries

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## ABSTRACT

Export-promotion policies as a superior development strategy for semi-industrialized countries (SICs) have found support in the statistically significant correlations established between export expansion and output growth. This positive export-GDP association is often attributed to the possible externalities of competition in world markets--e.g., efficiency of resource allocation, economies of scale, and various "demonstration" effects. In this paper, we show that the correlation mainly has been due to the contribution of exports to the reduction of import "shortages," which restrict the growth of output in many SICs. In this sense, export promotion is particularly important for countries that cannot obtain sufficient foreign aid or capital. A second contribution of this paper is the development of a simultaneous equations model to deal with the simultaneity problem between GDP and export growth rates.





## EXPORTS, IMPORTS AND ECONOMIC GROWTH IN SEMI-INDUSTRIALIZED COUNTRIES

### I. Introduction

In recent years, export-promotion policies have been strongly advocated as a superior development strategy for semi-industrialized countries (SICs). Part of the empirical support for this policy conclusion has been provided by the statistically significant correlations found between export expansion and output growth [see, for example, Michalopoulos and Jay (1973), Michaely (1977), Balassa (1978 and 1985), Tyler (1981), Feder (1982), and Kavousi (1984)].<sup>1</sup> This result is typically generated by adding a measure of export performance to the cross-country regression of GDP growth rate on proxy variables for employment and capital-stock growth rates. In these studies, the estimated coefficient of the export-performance variable is always found to be positive and statistically significant. This observed association of export expansion and GDP growth is often attributed to the possible externalities of competition in world markets--e.g., efficiency of resource allocation, economies of scale, and various "demonstration" effects. However, the neglected factor among these effects is the function of exports in SICs as the main source of foreign exchange for the much needed imports of intermediate and capital goods. Of course, as it is widely recognized in the "two-gap" model literature, such a function would be important only if the economy suffers from an import "shortage"; a condition implicitly assumed away in the above studies.<sup>2</sup> As we will show in the present paper,

because of import rationing in most SICs, a large part of the contribution of exports to GDP growth is due to their role in increasing the supply of foreign exchange and, thus, of imports.

It is important to distinguish between shortage-reducing and externality effects of outward-oriented policies, because the latter can only be achieved by export promotion, while the former can also be the result of foreign assistance or borrowing. If indeed the shortage-reducing effect of export expansion is more important for growth, countries that manage to borrow or to receive assistance would do just as well as export promoters. However, to the extent that foreign lending and aid are conditioned on export performance, outward-oriented policies would be the key to long-term development.

A second contribution of the present study is in terms of methodology. Most previous works on exports and economic growth specify a GDP production function that beside labor and capital includes exports as an input. This function is then linearized in terms of growth rates and estimated with and without the export variable. However, as it has long been recognized in the literature, the results of such a model are likely to suffer from a simultaneity bias, since export growth itself may be a function of the increases in output supply [Jung and Marshall, 1985]. In this paper, we deal with this simultaneity bias by specifying a second equation that relates export growth to output increases as well as to the shifts in the determinants of the export-output ratio. The two-equation system of GDP and export growth models is then estimated simultaneously.

To make a case for our argument regarding the importance of exports in SICs as a means of reducing import shortage, we begin in section II by examining the consequences of adding imports to the input list of the aggregate production function. We then show that the presence of a binding foreign exchange constraint implies that imports should be added to the right-hand side of the regression of GDP growth rate on capital, labor, and export growth rates. Since exports and imports are correlated, failing to include imports in the regression may bias the coefficient of exports upward and, thus, exaggerate the externality effects. Our empirical findings both with a single equation model in section III and with a simultaneous equations model in section IV strongly support this view.

Following Feder (1982), we have chosen a data set consisting of a sample of 31 countries identified by Chenery (1980) as semi-industrialized and "marginally" semi-industrialized.<sup>3</sup> The data comes from the 1983 edition of the World Bank's World Tables. We have used the labor force and trade data as well as the constant-price indices of national income accounts provided by this data set for the period 1960 to 1981.

## II. The Basic Model

Gross domestic product (GDP) of a country is usually defined as gross output less imports. More precisely, one defines

$$(1) \quad P_G G \equiv P_Y Y - P_M M$$

where  $G$ ,  $Y$ , and  $M$  are the volumes of GDP, gross output, and imports, and  $P_G$ ,  $P_Y$ , and  $P_M$  are price indices for these variables, respectively.

In a typical semi-industrialized country, gross output is produced by means of capital,  $K$ , labor,  $L$ , and imports,  $M$ . Since exports,  $X$ , may also have an impact on gross output through their externality effects, we may write

$$(2) \quad Y = F(K, L, X, M),$$

where  $F$  is the production function. Note that if all imports are final goods, the production function may be written as

$$(3) \quad Y = H(K, L, X) + (P_M/P_Y)M.$$

In this case,  $G = (P_Y/P_G)H(K, L, X)$  which implies that the level of imports is irrelevant for the analysis of GDP performance. This might have been the implicit assumption in some of the previous empirical investigations of the export-GDP relationship. However, such an assumption is by no means plausible in the context of SICs where imports are largely intermediate goods.<sup>4</sup> It is thus reasonable to maintain the general form of the production function  $F$ , and to rule out the possibility that imports can be separated from the process of production as specified by (3).

Even if imports are all intermediate products, as long as there is no import "shortage" import growth rate may not be an important factor in the analysis of GDP growth rate. To see this, first note that in the absence of a foreign exchange constraint, import level is determined by the following marginal productivity condition

$$(4) \quad (M/Y)F_M = (P_M M)/(P_Y Y) = s_M.$$

In this equation,  $F_M$  is the partial derivative of  $F$  with respect to  $M$  and  $s_M$  is the share of imports in total gross output. Naturally, the "optimal" level of imports defined by (4) depends on exchange rate and other trade policies that affect the relative price of imports. Next, let us log-differentiate (2) and denote the growth rate of each variable by its corresponding lower case letter:

$$(5) \quad y = (K/Y)F_K k + (L/Y)F_L \ell + (X/Y)F_X x + (M/Y)F_M m.$$

According to (1) the growth rate of the constant-price GDP is given by

$$(6) \quad g = \frac{1}{(1-s_M)} y + \frac{s_M}{(1-s_M)} m.$$

Therefore, substitution from (5) into (6) results in

$$(7) \quad g = \frac{F_K K}{(1-s_M)Y} k + \frac{F_L L}{(1-s_M)Y} \ell + \frac{F_X X}{(1-s_M)Y} x + \frac{(M/Y)F_M - s_M}{(1-s_M)} m.$$

Note that if equation (4) holds, the coefficient of  $m$  vanishes and (7) would be the type of relationship estimated in the past to measure the externality effects of export expansion on GDP growth rate. However, if because of a foreign exchange constraint, or for some other reason, the level of imports deviates from its "optimum" value determined by (4), import growth rate has to be included in the model. Failing to do so would bias the coefficient of export growth rate because of the significant positive correlation between  $m$  and  $x$ . This bias is likely to be upward, since in the presence of a foreign exchange "shortage," which is often the case in SICs,  $(M/Y)F_M - s_M$  will be positive. To examine the empirical significance of this bias, we estimate (7) with and without the import growth variable in the next section.<sup>5</sup> Note that



import "shortage" here is defined as the gap between the "optimal" and actual levels of imports. This gap may be induced by government policies towards exchange rate, tariffs, import quotas, and foreign borrowing.

For estimation purposes, equation (7) can be parameterized in various ways depending on which coefficients one expects to remain approximately constant across observations. For the first two terms, we assume a parameterization similar to that of Feder (1982):

$$(3) \quad F_K = \alpha'(1-s_M),$$

and

$$(9) \quad (L/Y)F_L = \beta(1-s_M),$$

where  $\alpha'$  and  $\beta$  are constant parameters. Equation (8) assumes that the marginal product of capital is proportional to the share of GDP in total output. In other words, the marginal product of capital in terms of GDP is assumed constant. If gross and net investment levels,  $I$  and  $I_n$ , are proportional, this parameterization helps the capital growth term in (7) to be written as  $\alpha'(I/I_n)(K/Y)k = \alpha'(I_n/Y) = \alpha(I/Y)$ , where  $\alpha = \alpha'(I_n/I)$ . In this case,  $I/Y$  works as a proxy for capital growth and helps us avoid the unavailable capital-stock data. Equation (9) states that the elasticity of output with respect to labor is proportional to the share of GDP in total output. This is in fact the kind of relationship that one can derive from a Cobb-Douglas-type production function.

To parameterize the coefficients of the trade variables in (7), we denote  $F_X = \gamma$ , and write the export term in (7) as

$$(10) \quad \frac{F_X^X}{(1-s_M)Y} x = \gamma \left( \frac{P_Y^X}{P_G} \right) x = \gamma s_X^* x.$$

Note that definition (1) implies that  $(1-s_M)Y = P_G G / P_Y$ , and  $s_X^* = P_Y^X / P_G G$  is the share of exports in GDP. Clearly,  $\gamma s_X^*$  can be interpreted as the elasticity of GDP with respect to exports. This parameterization has the advantage that makes the impact of export expansion on GDP growth rate dependent upon the importance of exports in the economy. This intuitive idea has been overlooked in most previous studies where authors have ignored the country differences in terms of the degree of development and the size of the economy that affect the role exports in GDP growth. However, Feder (1982) and Balassa (1985) introduce the export-share-times-export-growth-rate variable into their regressions.

Another factor which is expected to influence the externality effects of exports is the share of manufactured products in total exports,  $t_X$ . This hypothesis originates in the view that exports of primary products (and perhaps services) may not have much scale and "demonstration" externalities [see Kavousi (1984) and Balassa (1985)]. One way to model this effect is to consider  $\gamma$  as a function of  $t_X$ , which can be linearly approximated as

$$(11) \quad \gamma = \gamma_0 + \gamma_1 t_X.$$

The above hypothesis implies that  $\gamma_1 > 0$ .

To specify the import term in (7), we first define  $\lambda$  as a measure of import suboptimality by the following relationship

$$(12) \quad (M/Y)F_M = (\lambda+1)s_M^*.$$

Obviously,  $\lambda = 0$  would imply an optimal import level and, as we have seen, the import term would be eliminated from the model. Note that in light of (12), the import term in (7) can now be written as  $\lambda s_M^*$ , where  $s_M^* = s_M/(1-s_M)$  is the import-GDP ratio. The elasticity of GDP with respect to imports is, therefore, given by  $\lambda s_M^*$ .

Since the intensity of import shortage varies from country to country,  $\lambda$  cannot be considered a constant parameter. In particular, the marginal product of imports,  $F_M$ , and thus  $\lambda$  are expected to rise to the extent that the import-GDP ratio in a country falls short of its expected level given the country's size and level of development. Therefore, emphasizing the first order effects only, we may write

$$(13) \quad \lambda = \lambda_0 + \lambda_1 r_M,$$

where  $r_M$  is the residual term in the following import-share regression

$$(14) \quad s_M = \mu_0 + \mu_1(\log G_{pc}) + \mu_2(\log G_{pc})^2 + \mu_3(\log L) + \mu_4(\log L)^2 \\ + \mu_5(\log A) + \mu_6(\log A)^2 + r_M.$$

$G_{pc}$  in this equation is GDP per capita and  $A$  is the area of the country. Unlike previous studies of import-GDP ratio which use only GDP per capita and labor force (or population) as their explanatory variables [e.g., Syrquin and Chenery (1975)], we have tried to capture the effect of the country size by area as well as by labor force. These two variables may seem closely related, but their roles in reducing the

import-GDP ratio are quite distinct. The size of the labor force has negative effects on the import-GDP ratio because of wider markets and greater possibilities of division of labor in countries with larger labor forces. Area, on the other hand, reduces the need for imports because of greater variety of complementary resources which may exist in countries with larger areas. Also, because of the transaction costs involved in importing from other countries, various regions of a geographically large country are more likely to buy from each other than from abroad.

Estimates of two different versions of equation (14)--with and without area variables--are presented in Table 1 for average import-GDP ratios in three time periods--1960-1981, 1960-1973, and 1973-1981. The GDP data used for the 1960-1973 period is that of 1965 provided by Syrquin and Chenery (1975) and for the 1973-1981 period is that of 1977 given in World Development Report, 1979. For the 1960-1981 period we use the averages of the GDP data in the above two subperiods. The labor force data is the average size of labor force for the corresponding time periods. The regression results in Table 1 make it quite clear that area plays a major role in explaining the variations in import shares; not only the log of area and its square command high levels of statistical significance when they are added to the list of the right-hand side variables, the explanatory power of the regressions also doubles. The square of log of labor-force also has a significant coefficient, reflecting the increasing role of division of labor and of market size in reducing the import share.

The residual  $r_M$  in (14) captures the deviation of a country's import-output ratio from its "expected" level. The greater is the import shortage, the lower is  $s_M$ , and so is  $r_M$ . Since  $\lambda$  increases with the degree of import shortage,  $\lambda_1$  is expected to be negative. Of course,  $r_M$  may reflect other policy or non-policy influences besides import shortage as well.

Equation (7) is now fully parameterized. By substituting from (8)-(13) we can summarize equation (7) as

$$\begin{aligned} (15) \quad g &= \alpha k^* + \beta l + \gamma s_X^* x + \lambda s_M^* m \\ &= \alpha k^* + \beta l + \gamma_0 s_X^* x + \gamma_1 t_X s_X^* x + \lambda_0 s_M^* m + \lambda_1 r_M s_M^* m. \end{aligned}$$

Greek letter coefficients are the parameters to be estimated. In these estimations it is assumed that all SICs have the same production function and deviations from this common function are randomly distributed. Growth rate of variable  $z_t$  is defined as  $r = e^b - 1$ , where  $b$  is the coefficient of time,  $t$ , in the following regression

$$(16) \quad \log(z_t) = \text{constant} - bt.$$

### III. The Estimation Results

Table 2 shows the results of the direct estimations of (15). The first column presents the estimate of equation (15) for average growth rates of 31 SICs over the 1960-1981 period with capital, labor, and total export variable included only. This is similar to the models estimated in the previous studies, and renders relatively high  $t$ -ratios and  $R^2$ .<sup>6</sup> If this model is indeed the true one, the estimates



of its coefficients show that for a country with export share of 0.19 in GDP--which is the median in our sample--one percent increase in the rate of growth of exports raises the output growth rate by 0.07 percent. To the extent that exports are growing faster than GDP, the above effect will be reinforced by the increase in the share of exports. For example, for the median country with export growth rate of 6.29, export elasticity of GDP rises to 0.074 when changes in export share are also included.<sup>7</sup> Note that this externality effect is quite considerable, since it amounts to more than one third of the GDP-growth effect of a one-percentage point increase in the investment-output ratio.

The second column of Table 2 shows the estimation results of the regression when  $s_{Mm}^*$  is added to the list of right-hand-side variables. Clearly, compared to the first column, the explanatory power of the regression has increased substantially. Moreover, the export variable has lost its significance and even its sign has become negative. The import variable, on the other hand, shows a remarkable statistical significance. Adding  $t_X s_{Xx}^*$  and  $r_M s_{Mm}^*$  to the regression in the third column of Table 2 to take account of the roles of manufactured exports and of cross-country variations in import shortages further improves the regression and upholds our claim. According to the estimate of the complete model, the import elasticity of GDP for the median of the sample is 0.176, which implies that most SICs have on average suffered from import "shortage" and their exports have mainly provided foreign exchange for relieving this input constraint. Only few countries have been importing at "optimal" levels. Most countries either did not

export enough or did not obtain sufficient external funds to import optimally. It is interesting to note that our evidence of import "shortage" agrees with the findings of Eaton and Gersovitz (1980) which show that most developing countries are likely to have faced credit constraints in the early 1970s.

Unlike all other coefficient estimates in the complete model which have their expected signs, the estimate of  $\gamma_1$ , which reflects the impact of manufactured exports on GDP growth rate, is unexpectedly negative.<sup>8</sup> Although it is not statistically very significant, it may be indicating the absence of what Kavousi (1984) and Balassa (1985) suggest. In other words, non-manufactured exports may have had greater externality effects than manufactured ones. Many SICs may have been exporting economically "inappropriate" manufactured products because of distortions in their factor and product markets. A piece of evidence supporting this view is the results of an NBER project summarized by Krueger (1983). These results show that in many of the cases studied exports of SICs have lower direct labor coefficients per unit of international value added than import competing products, while one expects the opposite given their factor endowments relative to those of their trade partners.

Given the negative effect of the manufactured product share in exports, the net export elasticity of GDP diminishes to the insignificant level of 0.009. However, this is only the direct externality effect and does not include the indirect contribution of export expansion through increased imports. In fact, this indirect effect turns out to be the greatest advantage of export promotion in most SICs.

However, note that because of the large and statistically significant value of the estimated  $\lambda_1$ , this effect is subject to strong diminishing returns and will cease to help growth once the import-GDP ratio has increased sufficiently.

Repeating the above exercise for the average growth rates during the 1960-1973 and 1973-1981 subperiods reveals that the role of imports and exports in GDP growth may have been quite different before and after the 1973 oil shock. While the net impact of export expansion on GDP growth after 1973 seem to be negative, a similar effect before 1973 has a positive sign, although it is quite small. This outcome is in line with the results of Rana (1988) who finds, based on models similar to those of Feder (1982) and Balassa (1985), that the externality effect of exports has declined in the post-1973 era. However, like most other regressions of GDP growth on export expansion, our model may be suffering from a simultaneity bias since exports themselves could be a function of output supply. In the next section we modify our model to take account of this problem and reexamine the export externality versus import shortage hypotheses in that light.

#### IV. A Simultaneous Equations Model of Export and Output Growth in SICs

If export performance were exclusively determined by external conditions and government policy, then our regressions in section III would yield unbiased estimates of the externality effect of export growth. However, independence of export performance from output growth is not a very plausible assumption. To see the problem more clearly, note that exports may be written as  $X = s_X Y$ , where  $s_X$  is the share of

exports in total output.  $s_X$ , which reflects the division of total output between exports and domestic use, is determined by the size of the country, by the level of its development, and by government policy. Therefore, given these characteristics, growth of output due to increased productivity or factor availability in a country can directly lead to export growth. In fact, this was the basis of Michaely's (1977) criticism of estimating models such as (15). By differentiating  $X=s_X Y$ , we may write the export growth rate as

$$(16) \quad x = (1-s_M)g + s_M m + ds_X/s_X.$$

where we have substituted for  $y$  from (6). Substituting  $x$  from (16) into (15) would yield a model of GDP growth rate in which the change in export-output ratio,  $ds_X$ , rather than export growth rate, appears as an explanatory variable. This is the type of model that Michaely seems to advocate. He argues that  $ds_X$  is essentially a measure of export promotion policies and can be used as an independent variable. However, even this modification may not solve the simultaneity problem since  $s_X$  is likely to depend, among other variables, on GDP per capita.<sup>9</sup> Note that, assuming a model of export share determination similar to (14),  $ds_X$  may be written as

$$(17) \quad ds_X = v_1 g_{pc} + v_2 g_{pc} (\text{Log} G_{pc}) + v_3 l + v_4 l (\text{Log} L) + dr_X$$

where  $dr_X$  captures the effects of export promotion policies and  $g_{pc}$  is the growth rate of GDP per-capita. In the analysis that follows we will use per-worker rather than per-capita GDP in (17) in order to facilitate the formulation of our simultaneous equations model. This

replacement does not have any significant consequence for the model of change in export share employed in (17).

The above critique of the previous models of export externality effect suggests an easy way of handling the simultaneity problem.<sup>10</sup> By substituting  $ds_X$  from (17) into (16) and subtracting  $\ell$  from both sides of (16) we find

$$(18) \quad x_{pw} = (1-s_M)g_{pw} + s_M^m{}_{pw} \\ + v_1 \frac{g_{pw}}{s_X} + v_2 \frac{g_{pw}(\text{Log}G_{pw})}{s_X} + v_3 \frac{\ell}{s_X} + v_4 \frac{\ell(\text{Log}L)}{s_X} + \frac{dr_X}{s_X}$$

where the pw subscript refers to per-worker variables. Equation (18) is a model of export growth determination which should be estimated simultaneously with a per-worker version of (15). Assuming that the production function F is constant returns to scale in all of its inputs, equation (15) can be written in per-worker terms as

$$(19) \quad g_{pw} = \alpha k^* + \gamma_0 s_X^* x_{pw} + \gamma_1 t_X s_X^* x_{pw} + \lambda_0 s_M^* m_{pw} + \lambda_1 r_M s_M^* m_{pw}.$$

We estimate (18) and (19) simultaneously using the nonlinear system estimation method of SAS.<sup>11</sup> Since appropriate measures of export promotion policies are not available for all countries, the policy effect will be a missing variable in our model. However, the other independent variables should help us determine the structural coefficients of the model and test the externality versus foreign exchange provision effects of exports.

The estimation results for the subperiods 1960-1973 and 1973-1981 are presented in Table 3. The first notable aspect of these results,



when compared to those in Table 2, is that the simultaneity bias of the single equation growth model does not seem to be very large. However, removing the simultaneity problem seems to have strengthened our point that the role of exports in relieving foreign exchange constraint may be far more important than their externality effects. As we found in the case of the single equation regressions, when the import growth variable is not included the coefficient of the export variable in the GDP growth equation is large and statistically significant. Once the import variable  $s_{Mpw}^*$  is introduced into the GDP growth regressions, the export variable loses its significance to a considerable degree. However, unlike the single equation regressions of Table 2, this happens in both subperiods. In fact, import shortage seems to have been somewhat greater before 1973, giving rise to a larger coefficient for the export variable when imports are not included. The difference between the two periods in this respect is not statistically significant, but it may indicate an easing of the foreign exchange constraints on SICs after 1973, despite the oil price shocks, as a result of the enormous flow of petro-dollars to these countries. Coefficients  $\gamma_1$  and  $\lambda_1$ , which capture the role of manufactured goods exports and the degree of foreign exchange shortage respectively, have the same signs as before, but are not statistically significant.

## V. Conclusion

In evaluating the role of export expansion in the growth performance of semi-industrialized countries, the first and foremost purpose

of exports (i.e., provision of foreign exchange for imports) has been neglected and too much emphasis has been placed on the externality effects of competing in world markets. While the latter effects may carry some weight of their own, we have found that the major contribution of exports to the GDP growth rate is to relieve the import shortage that many SICs confront. Once the import supply effect of exports has been taken into account, there does not seem to be any significant externality effect left. Moreover, contrary to a number of previous studies, increases in the share of manufactured goods among exports do not seem to help the export externality effect. Gross distortions in the factor and product markets of the manufacturing sector in many SICs may indeed have cancelled out any external economies of participation in world markets.

In this study the relative import shortage of each country is defined as the discrepancy between the actual and "expected" import-GDP ratio of that country. To specify the expected import-GDP ratio, we ran a cross-country regression of import-GDP ratios on logs of GDP per capita, labor force, area, and squares of these logs. The area variables, which have been left out of previous studies of trade patterns, proved to be the most significant explanatory variables with highly negative effects on the import-GDP ratio.

Our findings are strengthened when the simultaneity bias of exports in the GDP growth equation is removed by introducing a second equation that determines export growth based on output growth and factors that affect the share of exports in total output. The simultaneous equations model of GDP and export growth rates developed in this study

addresses a problem that has long been recognized, but hardly dealt with, in previous studies.

Even though exports do not appear to have had much direct externality effect on the GDP of SICs, export promotion policies in these countries can be quite valuable in supplying foreign exchange, which relieves import shortages and permits output expansion. Although in this role exports may be temporarily replaced by foreign assistance, long term growth of any developing country ultimately depends on the steady and strong expansion of its export sector.

Notes

<sup>1</sup>For a recent survey of this literature, see Lal and Rajapatirana (1987).

<sup>2</sup>This point will be demonstrated in Section II below.

<sup>3</sup>The strictly semi-industrialized countries are: Argentina, Brazil, Chile, Colombia, Costa Rica, Greece, Hong Kong, Israel, Korea, Malaysia, Mexico, Portugal, Singapore, South Africa, Spain, Taiwan, Turkey, Uruguay and Yugoslavia. Taiwan was not included in our model due to lack of recent data. The 'marginally' semi-industrialized countries are: Dominican Republic, Ecuador, Egypt, Guatemala, India, Ivory Coast, Kenya, Morocco, Peru, Phillipines, Syria, Thailand, and Tunisia. Four major oil exporters--namely, Venezuela, Iran, Iraq, and Algeria--also fit into the above definitions, but they were excluded as special cases.

<sup>4</sup>Note that many imported final goods also need some processing and handling by the service sector. In particular, commodities such as grains should be considered as intermediate goods since they have to be processed before final consumption.

<sup>5</sup>Alternatively, we may write  $m = x + b$ , where  $b$  is the rate of change in trade deficit, and then test to see whether coefficients of  $x$  and  $b$  in the regression of the growth model are equal or not.

<sup>6</sup>As mentioned above, most authors use the export growth rate on the right-hand side without multiplying it by the export share in GDP. As we have argued above, the impact of export expansion on GDP growth rate is expected to be related to the significance of exports in the national economy. Our model here is similar to that of Feder (1982), Table 1.

<sup>7</sup>Note that for a  $dx$  increase in the rate of growth of export, GDP growth rate goes up by  $dg = \gamma(s_X^* dx + x ds_X^*)$ . But,  $ds_X^* = s_X^* (dx - dg)$ ; hence,  $dg = \gamma s_X^* [(1+x)/(1+\gamma s_X^* x)] dx$ .

<sup>8</sup>As in Kavousi (1984), we tested the difference between high and low income countries in this respect. However, the difference did not prove significant and the net effect of the share of manufactured exports remained negative for both groups.

<sup>9</sup>Also see Heller and Porter (1978) for a criticism of Michaely (1977) from a different perspective. Heller and Porter suggest that the spurious correlation between exports and GDP may be avoided if instead the relationship between  $X$  and  $G-X$  is examined. They argue

that Michael's method that relates  $g$  to  $ds_X^*$  does not avoid the spurious correlation problem because by definition  $g = d(G-X)/(G-X) + ds_X^*/(1-s_X^*)$ . Note, however, that Heller and Porter's approach does not deal with the simultaneity problem addressed in this paper either.

<sup>10</sup> In the past, Jung and Marshall (1985) have approached the interdependence of exports and GDP from a Granger-causality perspective, examining the relationship of each variable with the lagged values of the other variable. However, this approach does not establish causality in the sense of  $g$  being driven by  $x$ , or vice versa, since it only indicates whether the movements in one variable are correlated with the movements in the past values of the other one or not. Moreover, the Granger-causality approach does not deal with the simultaneity problem which is at the heart of the problem at hand. In any case, Jung and Marshall find that in many cases causality runs from GDP to exports and not vice versa. Also, in several cases where exports growth "causes" GDP growth, the impact is negative. Chow (1987) uses Sim's method to test for Granger causality between output and exports of the manufacturing sector in eight SICs. He finds a two-way causality in seven out of the eight cases. Unfortunately, he does not present the structural coefficients to give an assessment of the magnitude and sign of the effect of export expansion on GDP growth. Also, neither study includes variables other than lagged values of exports and GDP to test for spurious correlations.

<sup>11</sup> It should be pointed out that although imports are also simultaneously determined with the total output, we need not specify an import determination equation to find consistent estimates of  $\lambda_0$  and  $\lambda_1$ . The reason is that imports, as well as other inputs, are ultimately determined by relative prices and other policy measures. Therefore, they are unlikely to be correlated with the error term in (19) which is a multiplicative "technological" random variable in the production function  $F$ . This is in fact the justification for the direct estimation of production functions. For more on this, see Zellner, Kmenta, and Dreze (1966).



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Table 1

Regression Results for 31 Semi-Industrialized Countries  
 Dependent Variable: Import Share In Total Gross Output<sup>†</sup>

Right-hand-side Variables	1960-1981		1960-1973		1973-1981	
	Area Excluded	Complete Model	Area Excluded	Complete Model	Area Excluded	Complete Model
Intercept	3.877 (3.264)	2.232 (3.152)	2.264 (1.742)	2.369 (3.061)	3.683 (2.698)	1.696 (1.862)
Log(GDP/cap.)	-1.140 (-3.051)	-0.493 (-2.173)	-0.715 (-1.567)	-0.614 (-2.262)	-1.020 (-2.575)	-0.305 (-1.126)
[Log(GDP/cap.)] <sup>2</sup>	0.089 (3.044)	0.035 (1.991)	0.062 (1.564)	0.050 (2.123)	0.076 (2.638)	0.020 (1.012)
Log(LF)	-0.043 (-1.967)	-0.009 (-0.604)	-0.058 (-2.770)	-0.009 (-0.597)	-0.047 (-1.870)	0.010 (0.541)
[Log(LF)] <sup>2</sup>	0.007 (-1.036)	-0.012 (-2.994)	0.000 (0.032)	-0.010 (-2.277)	0.007 (-0.843)	-0.011 (-2.053)
Log(Area)		-0.093 (-6.323)		-0.098 (-6.167)		-0.085 (-4.967)
[Log(Area)] <sup>2</sup>		0.006 (3.499)		0.007 (3.817)		0.004 (2.292)
R <sup>2</sup>	0.491	0.859	0.402	0.816	0.499	0.824

<sup>†</sup> Numbers in parentheses are t-statistics.

Table 2

Regression Results for 31 Semi-Industrialized Countries  
Dependent Variable: GDP Growth Rate<sup>†</sup>

Right-hand-side Variables (Parameters)	1960-1981			1960-1973			1973-1981		
	Exports Included	Exports & Imports Included	Complete Model	Exports Included	Exports & Imports Included	Complete Model	Exports Included	Exports & Imports Included	Complete Model
Intercept	0.602 (0.472)	0.479 (0.412)	0.245 (0.229)	1.485 (1.499)	1.487 (1.489)	1.547 (1.714)	-0.119 (-0.053)	0.620 (0.390)	0.368 (0.236)
k* ( $\alpha$ )	0.192 (3.088)	0.184 (3.252)	0.190 (3.616)	0.181 (3.440)	0.176 (3.576)	0.166 (1.740)	0.181 (2.454)	0.180 (2.554)	0.188
l* ( $\beta$ )	0.601 (3.051)	0.551 (3.052)	0.473 (2.613)	0.392 (2.214)	0.396 (2.216)	0.231 (1.340)	0.541 (2.063)	0.133 (0.664)	0.072 (0.362)
x* ( $\gamma_0$ )	0.368 (4.213)	-0.343 (-1.204)	0.364 (0.699)	0.509 (5.765)	0.289 (0.970)	1.278 (2.621)	0.304 (2.801)	-0.636 (-3.304)	0.280 (0.529)
x** ( $\gamma_1$ )			-0.869 (-1.562)			-1.204 (-2.510)			-1.123 (-1.801)
m* ( $\lambda_0$ )		0.758 (2.597)	0.880 (3.020)		0.226 (0.773)	0.358 (1.311)		1.081 (5.320)	1.183 (5.731)
m** ( $\lambda_1$ )			-2.972 (-1.878)			-4.158 (-2.614)			-1.739 (-1.260)
R <sup>2</sup>	0.623	0.704	0.743	0.692	0.699	0.772	0.357	0.692	0.729

<sup>†</sup> Numbers in parentheses are t-statistics.

Table 3

Regression Results for 31 Semi-Industrialized Countries  
Simultaneous Equations for Growth Rates of per Worker GDP and Exports<sup>†</sup>

Coefficients	1960-1973			1973-1981		
	Exports Included	Exports & Imports Included	Complete Model	Exports Included	Exports & Imports Included	Complete Model
<u>GDP Growth Equation (19)</u>						
Intercept	0.084 (0.095)	0.355 (0.310)	0.313 (0.277)	-1.552 (-0.765)	-2.194 (-1.261)	-1.963 (-1.038)
$\alpha$	0.182 (3.564)	0.148 (2.166)	0.144 (2.070)	0.191 (1.836)	0.216 (2.468)	0.196 (2.021)
$\gamma_0$	0.795 (5.801)	-1.054 (-1.082)	-0.250 (-0.163)	0.435 (2.707)	-0.263 (-0.797)	1.339 (0.759)
$\gamma_1$			-0.889 (-0.724)			-1.950 (-0.930)
$\lambda_0$		1.730 (1.845)	1.664 (1.689)		0.773 (2.337)	0.864 (2.473)
$\lambda_1$			-0.608 (-0.153)			-0.501 (-0.109)
<u>Export Growth Equation (18)</u>						
Intercept	5.735 (3.393)	5.287 (2.991)	4.637 (2.756)	4.104 (1.859)	4.146 (1.852)	5.011 (2.393)
$v_1$	-0.749 (-3.402)	-0.572 (-2.432)	-0.535 (-2.322)	-0.657 (-1.573)	-0.918 (-2.139)	-0.865 (-2.130)
$v_2$	0.091 (2.594)	0.068 (1.821)	0.065 (1.796)	0.085 (1.438)	0.119 (1.947)	0.111 (1.913)
$v_3$	-0.080 (-1.053)	-0.133 (-1.649)	-0.130 (-1.646)	-0.224 (-2.191)	-0.208 (-2.004)	-0.260 (-2.656)
$v_4$	0.091 (3.498)	0.084 (3.008)	0.077 (2.889)	0.085 (2.889)	0.094 (3.106)	0.099 (3.402)

<sup>†</sup> Numbers in parentheses are t-statistics.









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