THE LEVEL OF DEVELOPMENT AND GSP TREATMENT: AN EMPIRICAL INVESTIGATION INTO THE DIFFERENTIAL IMPACTS OF EXPORT EXPANSION

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FOREWORD

This paper seeks to identify the impact of the level of development on the return to export expansion, while controlling for capital and labor in a neoclassical rendering of an economy. The paper utilizes a switching regression estimation procedure to determine the level of development that best divides middle from high income countries as regards growth associated with export expansion. Such a division may be used, among other things, to provide an objective criterion for graduation from GSP (Generalized System of Preferences) treatment. The results suggest that the current GSP graduation level may be too high.

Robert E. Moore is Assistant Professor of Economics and Senior Associate in the Policy Research Center. An earlier version of this paper was presented at the Western Economic Association International 66th Annual Conference in Seattle, July, 1991.

Roy Bahl
September 1991
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THE LEVEL OF DEVELOPMENT AND GSP TREATMENT: AN EMPIRICAL INVESTIGATION INTO THE DIFFERENTIAL IMPACTS OF EXPORT EXPANSION

I. INTRODUCTION

This paper empirically evaluates the degree to which structural changes due to export expansion can be detected in the advanced stages of the development process. Its primary purpose is to provide an empirically justifiable, objective, and non-arbitrary determination of the level of real GNP per capita which is best suited for dividing the high income (developed) countries from the low income (less developed) countries based on structural transformation in a modified neoclassical growth model. Such a division may be used to provide, among other things, an objective criterion for evaluating the graduation level from GSP (Generalized System of Preferences) treatment. Furthermore, such a division provides insight on why divergent outcomes result from the application (in different countries) of similar policies. This paper also provides insight on differences in the returns to capital investment, the degree of superfluous labor, and the degree to which there are benefits to trade, that are associated with the different levels of development. Finally, this paper allows a determination of differences of both the nature and the magnitude of export expansion-related growth between middle income and high income countries where the defining split between the two groups of countries is data-determined.

The methodology employed is a switching regression estimation with unknown sample selection based on GNP per capita. The base model for the switching regression estimation is a modified Feder-style (1982) growth model. In this model labor, capital, and export expansion may contribute to growth. Furthermore, the contribution of export expansion to growth can be attributed to either a factor-productivity effect or a sector-externality effect or both. Differences in the nature and the magnitude of the contribution of exports to growth may be interpreted as information on the suitability for GSP designation. The model is estimated with data from the World Tables of Economic and Social Indicators, 1960-1986.
II. BACKGROUND

The rapid growth of the South-East Asian NICs (Newly Industrializing Countries) has brought pressure to bear on the question of when a "less developed country" (LDC) or a "developing country" can be considered to have become "developed" (DC). This is more than a semantic issue. Relations and obligations in international organizations depend, in part, on the distinction. Specifically of concern for the United States is determining when a country should no longer receive trade preferences as a beneficiary developing country (BDC) under the Generalized System of Preferences (GSP), which was originally established as a part of the Trade Act of 1974. Under the original GSP there existed a system of "competitive need limitations" which removed preferential treatment basically for domestic protectionist reasons. An additional system of "discretionary graduation" for removing GSP treatment was added in 1981, but it tends to be subjective in nature and specifically it is subject to protectionist pressure from import-competing domestic firms as well (Sapir and Lundberg, 1984). The US-GSP system was renewed and revised by the Trade and Tariff Act of 1984. Responding to evidence indicating that the lion's share of the benefits accrued to the more advanced BDCs, the 1984 law provided for country graduation from GSP treatment based on a country's GNP per capita\(^1\) (Dorris, 1985).

There is a case for the desirability of an objective means for determining the level of development at which a country would be graduated from GSP treatment. The 1984 trade law determines that this "level of development" be a specific level of real GNP per capita (Dorris, 1985). But choosing which specific level of real GNP per capita to use is problematic. Rather than letting the choice remain arbitrary, empirical methods can be employed that determine at what level of real GNP per capita structural change is most apparent. Chenery (1960, 1979, and 1986), Syrquin (1984, 1986, and 1988), and their joint work (1975, 1986a, and 1986b) provide an extensive foundation for the investigation of structural transformation in LDCs. Much of this is

\(^{1}\)This act made graduation mandatory when a country's GNP per capita exceeded $8500 in 1984. The mandatory graduation level for subsequent years is indexed to one-half the growth rate of US GNP.
pioneering work, however it is primarily descriptive in nature. Much of what is empirical uses cross-sectional data and even though dynamic consequences are hypothesized, it is not, strictly speaking, correct to infer a dynamic process from cross-sectional data. Syrquin (1988), for example, divides countries into four per capita income intervals: I $300-600, II $600-1200, III $1200-2400, and IV $2400-4500, and considers the transformation from primary (agriculture, etc.) production to manufacturing production as a (hypothetical) country passes through the intervals. However, with cross-sectional data, no country in the sample actually moves from one stage to another. Furthermore, the income intervals are arbitrarily determined.

In Hotchkiss, Moore, and Rockel (1991), a panel data set constructed from the World Tables data is used to determine differences in the contribution of export expansion to growth between low income LDCs and middle income LDCs. The methodology used allowed for the data to determine the appropriate level of real GNP per capita that divides the observations into the two categories. This split is determined by finding the level of real GNP per capita which gives the best representation of the underlying data (as indicated by the likelihood function value which is calculated at each discrete split). In other words, this procedure determines the level of GNP at which the growth structure is most alike within the two groups. Then the structural parameters of the modified neoclassical growth equation are tested for significantly different parameters using a Wald test. Similar data and procedures can be employed to investigate the question at hand.

III. DATA AND METHODOLOGY

The primary data source is the World Tables of Economic and Social Indicators, 1960-1986. This data set includes annual data for 27 years for 126 countries.\textsuperscript{2} Up to four time periods, or observations, for each country are used: 1960-1966, 1966-1973, 1973-1979, and 1979-1986.\textsuperscript{3} Country observations for periods when initial year real (1986) GNP per capita is

\textsuperscript{2}This data set was acquired through the Inter-university Consortium for Political and Social Research in machine-readable format (tape).

\textsuperscript{3}The annual data are not used because, as Feder (1982) notes, there is substantial noise in the annual data that tends to be eliminated by the procedure of averaging. Furthermore, the
below US$450 are dropped because it was found in Hotchkiss, Moore, and Rockel (1991) that a structural transformation occurs between "low-income" and "middle-income" LDCs at that level.\footnote{Moschos (1989), using different data and a different model, but employing a switching regression procedure, also finds evidence of a structural transformation between "low income" and "middle-income" LDCs but at a slightly lower level of GNP per capita.} This eliminates the possibility of the structural differences between low and middle income countries confounding any possible differences between middle and high income countries. After deleting observations where real GNP per capita is below US$450, there remain 271 observations in the data set representing 87 countries.

This study utilizes a modified neoclassical growth model for the parameter estimation. The primary explanatory variables of interest are measures of change in the labor force and capital stock. The dependent variable is GNP growth.

The neoclassical growth model can be estimated as:

\[ \dot{(Y/Y)}_t = \alpha \cdot (I/Y)_t + \beta \cdot (L/L)_t + \epsilon_t \]  \hspace{1cm} (1)

where Y is GNP, L is Labor force, and I is Gross Domestic Investment (and is an approximation for the change in capital stock). The dot indicates the change in the over-struck variable. In this specification, \( \beta \) is interpreted as the elasticity of output with respect to labor and \( \alpha \) is interpreted as the marginal product of capital.

Two basic modifications to (1) are made. First, an export variable is included to capture the contribution of export expansion to growth. This is particularly of interest for interpretation of the results in terms of GSP treatment. Appendix A provides the details of the derivation and interpretation of the model when exports are included. Two model specifications including exports are estimated. Both models capture export's contribution to growth through both a sector-externality effect and a factor-productivity effect. The second model is differentiated from the first in that it allows for separate identification of the the two effects. The sector-externality effect measures the positive externality of the export sector on the non-export sector. The factor-potential problem of lagged responses is less severe when using averages across a multiple year time period rather than annual data (Feder, 1982).
productivity effect measures the gain due to the higher productivity of factors in the export sector (indicating, when positive and significant, that fewer than optimal resources are allocated to the export sector).

Second, instead of the standard single equation model, a switching regression formulation of the basic model with an unknown sample selection criterion is utilized. The basic switching regression model is described in Goldfeld and Quandt (1976, Chap. 2). The sample selection criterion is based on GNP per capita (as a measure of the level of development).

The model below presents the first specification that is estimated. This specification is based on equation (A15) from Appendix A.

\[
(\dot{Y}/Y)_{it} = \gamma_1(\dot{X}/Y)_{it} + \alpha_1(\dot{I}/Y)_{it} + \beta_1(\dot{L}/L)_{it} + \gamma_2(\dot{X}/Y)_{it} + e_{it}
\]

for \( it \) if \( GNPc_{it} \geq \mu \)

and

\[
(\dot{Y}/Y)_{it} = \gamma_2(\dot{I}/Y)_{it} + \beta_2(\dot{L}/L)_{it} + \gamma_2(\dot{X}/Y)_{it} + u_{it}
\]

for \( it \) if \( GNPc_{it} < \mu \).

The subscript \( i \) refers to the country, and the subscript \( t \) to the time period. \( Y \) is GNP, so \( \dot{Y}/Y \) is its annualized growth rate; \( I \) is Gross Domestic Investment for the period; \( L \) is labor (population), so \( \dot{L}/L \) is the annualized growth rate of labor; and \( X \) is exports, so \( \dot{X}/Y \) is the simplified form of the annualized growth rate of exports weighted by the proportion of exports in GNP [that is, \( \dot{X}/Y = (\dot{X}/X) \cdot (X/Y) \)]. The \( \mu \) is the level of real GNP per capita (GNPc) at which the structural split occurs. The \( r \)'s are the intercepts and are interpreted as the underlying rate of growth of \( Y \). The \( \alpha \)'s and \( \beta \)'s are structural parameters and the \( \gamma \)'s are reduced-form parameters. \( \beta_1 \) and \( \beta_2 \) are interpreted (loosely) as elasticities of output with respect to labor in the non-export sector.\(^5\) \( \alpha_1 \)

\(^5\) We must be willing to assume that the ratio of output to labor in the non-export sector is similar to that in the economy as a whole to strictly interpret these parameters as the stated elasticities. See Appendix A, equations (A14) and (A15).
and $\alpha_2$ are interpreted as marginal products of capital in the non-export sector. $\gamma_1$ and $\gamma_2$ capture both the differential of factor productivities between the export and the non-export sector (the \textit{factor-productivity effect}) and the externality of the export sector on the non-export sector (the \textit{sector-externality effect}).\(^6\) In this form [equations (2)], separate identification of the two effects is not possible. The structural parameters that measure the two effects can be recaptured in the second specification [equations (3) below].

This second version of the model allows for the separation of the two effects picked up by the parameters on the export variables ($\gamma_1$ and $\gamma_2$) in equations (2). This specification is based on equation (A18) from Appendix A and is given as:

\[
\begin{align*}
(\dot{Y}/Y)_{it} &= r_1 + \alpha_1(l/Y)_{it} + \beta_1(\dot{L}/L)_{it} + \phi_1(\dot{X}/Y)_{it} + \theta_1(\dot{X}/X)_{it} + c_{it} \\
\text{for } it \text{ if } GNPc_{it} \geq \mu \\
\text{and} \\
(\dot{Y}/Y)_{it} &= r_2 + \alpha_2(l/Y)_{it} + \beta_2(\dot{L}/L)_{it} + \phi_2(\dot{X}/Y)_{it} + \theta_2(\dot{X}/X)_{it} + u_{it} \\
\text{for } it \text{ if } GNPc_{it} < \mu .
\end{align*}
\]

The variables are defined as for equations (2) above with the addition of $\dot{X}/X$ which is the annualized growth rate of exports (un-weighted). The parameters $\alpha_1$, $\alpha_2$, $\beta_1$, and $\beta_2$ are interpreted as in equations (2), though they, of course, are not constrained to have the same point estimates. $\theta_1$ and $\theta_2$ are interpreted as the elasticities of output in the non-export sector with respect to the level of exports and thus measure the \textit{sector-externality effect} of exports. $\phi_1$ and $\phi_2$ are not interpreted the same way that $\gamma_1$ and $\gamma_2$ are in equations (2).\(^7\) The parameter pairs $\phi_1$ and $\theta_1$, and $\phi_2$ and $\theta_2$ can be used to calculate the difference in the factor productivities between the export and the non-export sectors. For simplicity and identification, the sectoral productivity

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\(^6\)See equation (A15) in Appendix A for the complete specification of $\gamma$.

\(^7\)The explicit expression for $\phi$ is shown in equation (A18) in Appendix A.
differences of both factors are assumed to be equal [e.g., \( D = \lambda = \delta \) where \( \lambda \) and \( \delta \) are as defined in equation (A18) of Appendix A]. Specifically, \( D \) equals the percentage by which the marginal factor productivities are higher in the export than in the non-export sectors and is calculated as:

\[
D = \left( \phi_1 + \theta_1 \right) / \left[ 1 - \left( \phi_1 + \theta_1 \right) \right] \text{ if } GNPc_{it} \geq \mu
\]

and

\[
D = \left( \phi_2 + \theta_2 \right) / \left[ 1 - \left( \phi_2 + \theta_2 \right) \right] \text{ if } GNPc_{it} < \mu.
\] (4)

Estimation of the first model [equations (2)] provides information on how the magnitude of the contribution of export expansion to growth differs between middle and high income countries. Estimation of the second model additionally allows identification of differences in the nature of the contribution of exports to growth between the two groups of countries.

The procedure followed for estimating each of the two model specifications is similar. First the individual equations in each pair are estimated (using OLS) where discrete values of \( \mu \) (GNP per capita) are chosen to divide the data set into the middle and high income groups. At each discrete value of \( \mu \), a Wald test is performed to determine if the parameters in the two equations represent statistically different structures. Specifically, the Wald test is used to test the null hypothesis that \( \alpha_1 = \alpha_2, \beta_1 = \beta_2, \) and \( Y_1 = Y_2 \) in the first model and that \( \alpha_1 = \alpha_2, \beta_1 = \beta_2, \theta_1 = \theta_2 \) and \( \phi_1 = \phi_2 \) in the second. The log-likelihood function value for the equation system is calculated for each split to determine the split that is best supported by the data.\(^{10}\)

\(^{8}\)The discrete values for \( \mu \) used for the split were 300, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 3000, 3500, 3600, 3800, 4000, 4500, 5000, 6000, 7000, 8000, 9000, 10000, 11000 and 12000. The units of \( \mu \) are real 1986 US dollars.

\(^{9}\)The Wald test is chosen over a Chow test to allow for unequal variances between the two sets of observations. See Honda (1982).

\(^{10}\)This procedure is outlined in Quandt (1958) and has been used recently by Field (1988), and Hotchkiss (forthcoming).
The specification for both models allows the marginal products of labor to vary across countries and time periods. Rana (1988) and Balassa (1985, 1978) have not found the labor variable to be significant when estimating similar single equation models for developing countries only. Balassa (1985) attributes this to the use of labor force data instead of employment data and the fact that both countries with and without surplus labor are included in his studies. In this paper population growth is utilized as a proxy for labor force growth. This is not optimal, particularly for the lower income countries where the problems of unemployment and labor surplus mentioned by Balassa (1985) would appear to be most severe.

Both model specifications force the marginal product of capital to be equal across countries. This is theoretically implied by the assumption of perfect mobility of capital internationally. Furthermore, it allows the elasticity of output with respect to capital to vary across countries and time periods. There are enough degrees of freedom to attempt and test a specification in which country dummy variables are interacted with the \( I/Y \) variable, allowing the marginal product of capital to vary across countries. This is done and, using an \( F \) test on each of the single equations, the parameters on these country-capital interaction variables are not found to be statistically significant. Lacking empirical support, these interaction variables are omitted from the equations.

The most obvious limitation of this study is that it does not specifically control for factors other than capital and labor that influence the growth rate. For example, Scully (1988) has found that institutional aspects such as political, civil, and economic liberty significantly affect economic growth. To the extent that these or other institutional characteristics are dynamically invariant, we might control for them by use of a fixed effects model. Scully (1988) reports a high degree of correlation across time of measures of the institutional variables used in his paper. In fact, he uses

---

11 The elasticity of output with respect to labor is estimated (as constant across countries and time periods). The average product of labor varies across countries and time periods, hence so does the marginal product.

12 The limited availability of labor force data would significantly reduce the number of countries in our sample, especially at the lower income levels.

13 Caves (1982: Chap. 2) discusses the validity (or lack thereof) of the assumption of international capital mobility.
institutional data for 1973-1980 as an indicator for their levels for the entire period 1960-1980. This suggests, at least to a certain extent, dynamic invariance of these variables. Use of a fixed effects specification was tested, but the results are not reported due to the collinearity between the country-specific intercepts and the labor (L/L) and capital (I/Y) variables.

The methodology of this paper can also be criticized for its single equation approach and use of aggregate data. The approach taken here is justified on the grounds that the detailed data necessary for a Computerized General Equilibrium (CGE) or other more detailed analysis is simply not available for consistent time series for so wide a range of countries. Furthermore, the paper does not attempt to say anything about specific individual countries, but rather it seeks to yield insight on and to compare the general orders of magnitude for certain parameter values for middle and high income countries as groups. The methodology used in this paper enables one to uncover significant limited (aggregate) information that is of substantial interest utilizing the aggregate data.

IV. ESTIMATION RESULTS FOR THE SWITCHING REGRESSION MODELS

In the estimation of the first model [equations (2)], calculation of the log-likelihood function values for each of the discrete splits (as well as with no split) indicated that the split at \( \mu = 6000 \) best fit the data. The Wald test results indicated that the parameter structures were significantly different at the 99% confidence level for the split at 6000. The parameter estimates for the first model are presented in Table 1, columns 1 and 2. Column 1 provides the parameter estimates for the high income countries and column 2 provides the estimates for the middle income countries.
Table 1. Parameter Estimates

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model: Equations (2)</th>
<th>Model: Equations (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GNPc ≥ $6000</td>
<td>GNPc &lt; $6000</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.0089</td>
<td>0.0161°</td>
</tr>
<tr>
<td>LI/L</td>
<td>(0.0149)</td>
<td>(0.0095)</td>
</tr>
<tr>
<td></td>
<td>(0.1863)</td>
<td>(0.2153)</td>
</tr>
<tr>
<td>I/Y</td>
<td>0.1265*</td>
<td>0.0395</td>
</tr>
<tr>
<td></td>
<td>(0.0592)</td>
<td>(0.0280)</td>
</tr>
<tr>
<td>X/Y</td>
<td>0.2379°</td>
<td>0.7415**</td>
</tr>
<tr>
<td></td>
<td>(0.1249)</td>
<td>(0.0713)</td>
</tr>
<tr>
<td>X/X</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>R²</td>
<td>.39</td>
<td>.38</td>
</tr>
<tr>
<td>N</td>
<td>61</td>
<td>210</td>
</tr>
<tr>
<td>countries</td>
<td>23</td>
<td>77</td>
</tr>
<tr>
<td>log(L)</td>
<td>563.05</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. °, *, ** indicate significance at the 90%, 95%, and 99% level, respectively.

The estimation of the second model [equations (3)] resulted in the split at μ=3800 best fitting the data (as indicated by the log-likelihood function). The Wald test indicates that at this split the parameters of the two groups were significantly different at the 95% confidence level. The parameter estimates for the second model are given in columns 3 and 4 of Table 1. Column 3 provides the parameter estimates for the high income countries and column 4 for the middle income countries.

The first model captures the magnitude of the contribution of exports to growth, while the second model allows us to separate that contribution into two distinct sources. Apparently this difference in the sources or nature of the contribution of exports to growth is the driving factor behind the lower split point in the second model.

Recall that the parameter estimates for the labor (L/L) variable are interpreted (loosely) as an elasticity of output with respect to labor in the non-export sector. For the first model, for the high
income countries (GNPc ≥ 6000), this elasticity is large, positive and highly significant. For the middle income countries (GNPc < 6000), this elasticity is not as large, though still positive and significant. In the second model, for the high income group (GNPc ≥ 3800), the labor elasticity is again large, positive, and highly significant. For the middle income countries (GNPc < 3800), it is not as large, though still positive and significant. This indicates that surplus labor was not the prevalent situation in the sample countries for the periods covered by the data. Furthermore, the relatively large (small) magnitude of the labor elasticity in the high (middle) income countries for both models suggests a relative scarcity (abundance) of labor in the high (middle) income countries.

The parameter estimates for the capital (I/Y) variable are interpreted as marginal products in the non export sector. These point estimates are positive in all cases, but only significant for the high income countries in the first model and weakly significant for the middle income countries in the second model.

In the first model, the parameter on exports (X/Y) picks up both the sector-externality effect and the factor-productivity effect. Though we can not separate the two effects in this model, it is clear that the combined magnitude of the two effects is both larger and more significant for the middle income countries than for the high.

The parameter estimates for the two export variables (X/Y, X/X) in the second model allow for the separation of the two export effects. The parameter on X/X is interpreted as the elasticity of non-export output with respect to export output and measures the sector-externality effect. This externality is positive and significant for both groups, but is larger for the high income group (GNPc ≥ 3800). This indicates that the nature of the contribution of exports to growth is different for middle income countries as compared to high income countries. Specifically, countries may benefit more from the externality of exports as they reach more advanced levels of development.

Using the point estimates on both export variables from the second model and referring to equations (4), the difference, D, in the marginal factor productivities in the export and non-export
sectors can be calculated and it measures the *factor-productivity effect*. Specifically, for the high income countries, $D = 0.58$. This indicates that, on average, the factors used in the export sectors are 58% more productive (at the margin) than those used in the non-export sectors. For the middle income countries, $D = 1.62$.

That there is a greater marginal factor productivity differential for middle income countries than for high income countries is further evidence of the difference in the nature of the contribution of exports to growth between the two groups of countries. That the factor productivity differentials are as large as they are suggests that resource allocation is distorted from the optimal allocation and that, therefore, productivity gains could be had with the allocation of more resources to the export sectors in both groups of countries.

An overall measure of the impact of export expansion on growth can be obtained by calculating the total marginal productivity of capital in exports using the parameter estimates from the second model.\(^{15}\) This measure is .1612 for the middle income countries and .0928 for the high income countries.

V. POLICY IMPLICATIONS AND CONCLUSION

The purpose of the paper has been to determine whether there is an empirical basis for determining the level of GNP per capita at which a BDC should be graduated from GSP treatment. Two models have been estimated. In both models the impact on output of labor growth is greater for the high income countries than for the middle income countries. The difference in the two models estimated is in the treatment of the contribution of exports to growth. Estimation of the first model [equations (2)] captures the magnitude of the contribution of exports to growth. It indicates that the best data-determined dividing line, measured in terms of GNP per capita, between high income (or "developed") countries and middle income (or "less developed") countries is at

\(^{14}\) The $D (= -0.58)$ for the high income countries is significant at the 95% level, while the $D (=1.62)$ for the middle income countries is significant at the 99% level. The procedure for calculating the variance of the nonlinear restriction and constructing the test is found in Greene (1990:228-230).

\(^{15}\) See equation (A20) in Appendix A.
$6000 (in real 1986 US dollars). This is considerably lower than the US-GSP graduation level of $8500 (in 1984).

The estimation of the second model [equations (3)] captures both the difference in the magnitude of the contribution of exports to growth as well as the difference in the nature of the contribution of exports to growth between the middle and high income countries. When this difference in the nature of exports' contribution is captured in the estimation process, the dividing line, measured in terms of GNP per capita, that best separates the high income countries from the low income countries is down to $3800 (in real 1986 US dollars). This is less than half of the US-GSP graduation level.

As interesting as the determination of the dividing line between the middle and high income countries is, perhaps even more intriguing is the difference in the nature of the contribution of exports to growth between the two groups of countries. For the high income countries (GNPc $3800), the impact of the upstream linkage of the export sector to the non-export sector (the sector-externality effect) is more than double that experienced in the middle income countries and is a major reason for the contribution of export expansion to growth.

For the middle income countries, while the sector externality effect is substantial, though smaller than for the high income countries, there is also a large contribution to the impact of export expansion on growth because of the much higher productivity differential of factors in the export sector than in the non-export sector (the factor-productivity effect). This factor-productivity effect implies a misallocation of resources. Specifically, when it is positive and significant, it indicates that there are fewer than optimal resources allocated to the export sector of the economy. This, along with the higher total marginal productivity of capital in the export sector for the middle income countries, suggests that, in terms of encouraging LDCs to reallocate resources to their export sectors in order to stimulate development goals (whether with GSP treatment or other measures), the greatest improvement can be had by focusing on those countries with per capita GNP below $3800 (in real 1986 US dollars).
Appendix A

This appendix will describe the theoretical derivation of the models estimated [equations (2) and (3) in the text]. For the most part this follows Feder (1982), sections 2 and 3, pp. 60-67. There are some modifications.

First we assume an economy with two sectors, export and non-export, so GNP is equal to the sum of the output from each sector. Let $Y = GNP$, $N = output$ of non-export sector, and $X = output$ of export sector. Then:

$$Y = N + X.$$  \hspace{1cm} (A1)

Then we specify production functions for $N$ and $X$ such that the production of $X$ may provide an externality for $N$. Then:

$$N = F(K_N, L_N, X).$$  \hspace{1cm} (A2a)

$$X = G(K_X, L_X),$$  \hspace{1cm} (A2b)

where $K_N + K_X = K$ and $L_N + L_X = L$.

The subscripts on $K$ and $L$ refer to the sectors.

Let the dot notation symbolize the change of the overstruck variable. From (A1):

$$\dot{Y} = \dot{N} + \dot{X}.$$  \hspace{1cm} (A3)

Let the subscripts on $F$ and $G$ refer to the marginal products with respect to the subscripted inputs. Taking total derivatives of (A2a and A2b), letting $I = K$ and substituting into (A3) yields:

$$\dot{Y} = F_K I_N + F_L I_N + F_X \dot{X} + G_K I_X + G_L \dot{L}_X.$$  \hspace{1cm} (A4)

Note that the partial derivative of $F$ with respect to $X$ ($F_X$) captures the sector-externality effect of exporting output.

Suppose that the respective marginal products in each sector are not equal. Specifically, let:

$$G_K = (1+\delta) F_K \text{ and } G_L = (1+\lambda) F_L.$$  \hspace{1cm} (A5)

Note that $\delta$ and $\lambda$ allow us to capture the productivity differentials or the factor-productivity effect due to exporting. Using (A5), (A4) becomes:

$$\dot{Y} = F_K I_N + F_L I_N + F_X \dot{X} + \delta F_K I_X + \lambda F_L \dot{L}_X.$$  \hspace{1cm} (A6)

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Combining terms, (A6) simplifies to:
\[ \dot{Y} = F_K I + F_L \dot{L} + F_X \dot{X} + \delta F_K I_X + \lambda F_L \dot{L}_X. \]  
(A7)

Data is readily available for the dependent variable and the first three RHS variables of (A7), but not for the last two RHS variables. Therefore an alternate expression for the last two terms in the equation above is derived. Start with the total differentiation of (A2b):
\[ \dot{X} = G_K I_X + G_L \dot{L}_X. \]  
(A8)

Substituting from (A5) into (A8) yields:
\[ \dot{X} = F_K I_X + F_L L_X + \delta F_K I_X + \lambda F_L \dot{L}_X. \]  
(A9)

Note that the last two terms of (A9) are the same as the last two terms of (A7). Now use (A5) and substitute back into the first two RHS terms of (A9).
\[ \dot{X} = G_K I_X / (1+\delta) + G_L I_X / (1+\lambda) + \delta F_K I_X + \lambda F_L \dot{L}_X. \]  
(A10)

Define \( \rho = G_K I_X / \dot{X} \), now (A8) can be rewritten as:
\[ X = G_K I_X + G_L L_X = \rho X + (1-\rho)X. \]  
(A11)

Substitute \( \rho \) into (A10):
\[ \dot{X} = \frac{\rho}{1+\delta} \dot{X} + \frac{1-\rho}{1+\lambda} \dot{X} + \delta F_K I_X + \lambda F_L \dot{L}_X. \]  
(A12)

Rearranging terms in (A12):
\[ \delta F_K I_X + \lambda F_L \dot{L}_X = \left( 1 - \frac{\rho}{1+\delta} - \frac{1-\rho}{1+\lambda} \right) \dot{X}. \]  
(A13)

Substitute (A13) in for the last two RHS terms in (A7) and simplify.
\[ \dot{Y} = F_K I + F_L \dot{L} + \left[ F_X + \left( 1 - \frac{\rho}{1+\delta} - \frac{1-\rho}{1+\lambda} \right) \dot{X} \right]. \]  
(A14)

Now let \( F_K = \alpha \) and \( F_L = \beta Y/L \)* and substitute these into (A14) and divide by \( Y \). This yields:

\[ \* As Feder (1983:62) notes, this suggests that there exists a linear relationship between the marginal product of labor in the export sector and the average output of labor in the economy. For supporting arguments see Bruno (1968). \]
\[ \dot{Y}/Y = \alpha (I/Y) + \beta (L/L) + \left[ F_X + \left( 1 - \frac{\rho}{1+\delta} - \frac{1-\rho}{1+\lambda} \right) (\dot{X}/Y) \right]. \quad (A15) \]

This is the equation used as the base for the first switching regression model, equations (2) in the text [where we let \( Y \) represent the entire bracketed expression preceding \( \dot{X}/Y \)]. If we let \( \lambda = \delta \) then (A15) collapses to Feder's equation (11). Note that the parameter estimated for the export variable \( \dot{X}/Y \) includes both a sector-externality effect \( (F_X) \) as well as the productivity differentials \( (\lambda \text{ and } \delta) \) or the factor-productivity effect. Ideally we want to be able to separately identify the factor-productivity effect and the sector-externality effect. To do this we let \( F \) have a specific separable form as follows:

\[ N = F(K_n, L_n, X) = X^\theta \Psi(K_n, L_n) \]. \quad (A16)

Now the partial derivative of \( F \) with respect to \( X \) is (using also that \( N = Y - X \)):

\[ F_X = \theta \frac{N}{X} = \theta \frac{Y}{X} - \theta. \quad (A17) \]

Substituting (A17) into (A15) and manipulating yields:

\[ \dot{Y}/Y = \alpha (I/Y) + \beta (L/L) + \left[ \left( 1 - \frac{\rho}{1+\delta} - \frac{1-\rho}{1+\lambda} \right) - \theta \right] (\dot{X}/Y) + \theta (\dot{X}/X). \quad (A18) \]

This is the equation used as the base for the second switching regression model, equations (3) in the text [where \( \Phi \) represents the entire bracketed expression preceding \( \dot{X}/Y \)]. If we let \( \lambda = \delta \) and define \( D = \lambda = \delta \) then (A18) collapses to Feder's equation (18) and we are able to separately identify \( D \) [equations (4) in the text]. Furthermore, as Feder (1982) points out, if one assumes that:

\[ \theta = \left( 1 - \frac{\rho}{1+\delta} - \frac{1-\rho}{1+\lambda} \right), \quad (A19) \]

then equation (A18) collapses into the form of the equation estimated in Michalopoulos and Jay (1973), Balassa (1978a), Tyler (1981), Kavonissi (1984), and Moschos (1989). Certainly a priori it would seem that the equality in (A19) is unlikely to hold, calling into question the results from estimations that implicitly impose this restriction.
A measure of the total marginal product of capital (which includes the sector-externality effect and the factor-productivity effect) can be calculated as:

\[ \text{TMPK}_x = \alpha[1+\theta(x/1 - 1)](1+D), \quad (A20) \]

where \( x \) is the export/GNP ratio and \( D \) is defined such that \( D=\lambda=\delta \) as above. This expression is derived in Feder (1982) and comes from his equation (19).
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