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Exporting Manufactures: Trade Policy  
or Human Resources?

ADRIAN WOOD AND  
KERSTI BERGE

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discussion and critical comment

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**EXPORTING MANUFACTURES: TRADE POLICY OR HUMAN RESOURCES?**

**Adrian Wood and Kersti Berge**

Institute of Development Studies, University of Sussex  
Brighton BN1 9RE, England  
Phone 0273 678777 Fax 0273 691647  
Email A.J.B.Wood@Sussex.ac.uk

**Abstract**

Whether a country exports manufactures or primary products is determined mainly by the skill level of its labour force, relative to the extent of its natural resources. This proposition is derived from a modified version of Heckscher-Ohlin theory, and strongly supported by econometric evidence. Variation in trade policies currently accounts for only a small part of the cross-country variation in the relative importance of manufactured exports. These findings have important implications for development strategy advice.

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Everyone agrees that East Asia's spectacular development success has been intimately associated with the export of manufactures. Most people also believe that these exports were caused by the trade policies pursued by the countries concerned (broadly defined to include trade-related macroeconomic and industrial policies).<sup>1</sup> This belief provides the basis of much official advice to other poor countries. As the World Bank (1993, p. 358) put it in a recent, widely-publicised report: "of the many interventions tried in East Asia, those associated with their export push hold the most promise for other developing economies". Thus for the past decade, in this spirit, trade policy reforms have been central to the structural adjustment programmes that the Bank and the IMF have promoted in many countries, most notably - and least successfully - in Sub-Saharan Africa (World Bank 1994).

This paper argues that the conventional interpretation and generalisation of East Asian export experience is misleading. Appropriate trade policies are a necessary condition for a country to export manufactures. But there is another necessary condition, namely that the resource endowments of the country concerned should give it a comparative advantage in manufacturing, and in practice this resource condition is far more important. There are now few countries where the main obstacle to manufactured exports is wrong trade policies: the usual obstacle is "wrong" resource endowments.<sup>2</sup>

In support of its argument, this paper will present (in Section I) a new variant of Heckscher-Ohlin (H-O) trade theory, and suggest (in Section II) a new approach to the econometric specification of H-O models. In Section III, it will be shown that a purely resource-based model can explain much of the cross-country pattern of trade in manufactures and primary products. Various measures of trade policy will then be introduced into the model in Section IV, but found to add little to its explanatory power. Section V summarises the conclusions, and discusses their implications for policy.

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1. Though there is vigorous dispute about which aspects of broadly-defined trade policy were most important. See e.g. Wade (1990), World Bank (1993), and Fishlow et al (1994).

2. Others who have argued explicitly, though in various contexts, that the pattern of trade depends more on resources than on policy include Winters (1987), Bruchmann (1989), and Saxonhouse (1993). Implicitly, the same is argued in the many studies which test Heckscher-Ohlin trade theory without including trade policy variables in their models: see Leamer (1992, 1993).

### I. A skill-and-land-only Heckscher-Ohlin model

The central question of this paper is what determines whether a country is an exporter mainly of manufactures or mainly of primary products (trade in services will also be dealt with, but not immediately). This question can be approached by harnessing the fundamental insight of Heckscher and Ohlin, namely that countries tend to export those goods which use intensively the factors of production with which they are relatively abundantly endowed.

In this perspective, one vital ingredient of the answer must be some basic difference in *factor proportions* between manufactures and primary products. To establish the nature of this difference, it is important to bear in mind that a factor is defined in this context as an input to production that is *internationally immobile*. Thus common sense and trade theory both tell us that the comparative advantage of particular countries cannot be governed by the availability of traded intermediate inputs such as ginned cotton or fertiliser. By extension of this logic, capital must also be disqualified as a factor: it is just too internationally mobile to be a basic influence on the commodity composition of trade (for a full statement and defence of this still somewhat controversial proposition, see Wood 1994b).<sup>3</sup>

The immobility criterion thus reduces the list of factors of production to natural resources and human resources (acknowledging, of course, that some part of the world's labour force, too, is internationally mobile). Within each of these groups there are many detailed factors of production: a wide variety of natural resources, and numerous sorts of workers, distinguished in particular by their types and levels of skill. However, we will assume for convenience here that all sorts of natural resources can be aggregated into something called *land* (labelled N), and that all sorts of skills can be aggregated into a single stock of *skill* (labelled H for human resources or human capital).

We can then write a production function for either manufactures or primary products as  $Q_i = f_i(N_i, H_i, L_i)$ , where L is the number of workers involved,

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3. Infrastructure is an important form of capital that is not mobile, and affects the level of trade via transport costs. Inter-country differences in infrastructure also influence the *composition* of trade (Wood 1994c, pp. 35-6), but are assumed in this paper to be of second-order importance.

and capital and intermediate inputs are omitted for the sake of simplicity. Assuming constant returns to scale (with due hesitation, but in line with other H-O models), we can rewrite both production functions in intensive form as:

$$q_m = f_m(n_m, h_m) \quad (1a)$$

$$q_p = f_p(n_p, h_p) \quad (1b)$$

where  $q$  is output per worker,  $n$  is land per worker,  $h$  is the average level of skill per worker, and the subscripts  $m$  and  $p$  refer to manufactures and primary products respectively.

The basic difference in factor proportions in our model is simply that the ratio of skill (per worker) to land (per worker) is higher for manufactures than for primary products. Formally, defining (for example)  $a_{nm}$  as  $n_m/q_m$ , we assume that at all sets of relative factor prices

$$a_{hm}/a_{nm} > a_{hp}/a_{np}. \quad (2)$$

The individual  $a_{ij}$  coefficients may vary with relative factor prices. In particular, the skill/land input ratios  $a_{hm}/a_{nm}$  and  $a_{hp}/a_{np}$ , which reflect the choice of technique (and the output mix) within each sector, will vary among countries and time periods with the relative cost of skill and land. But, as in other H-O models, there are assumed to be no "factor intensity reversals": the skill/land input ratio in manufacturing is always greater than in primary production.

This difference in factor proportions seems self-evident for manufacturing and primary production on average (although there may be pairs of specific manufacturing and primary activities for which inequality (2) is reversed). Manufacturing is clearly much more compact than agriculture - carried out on comparatively small sites and in cities, whereas agriculture needs big tracts of land. There is also a major difference in skill requirements: illiterate people can (and do, in large numbers) work as farmers, whereas even "unskilled" work in modern manufacturing requires a basic education (Wood 1994c, pp. 49, 95). Unlike agriculture, mineral extraction can be carried out on small sites, sometimes with a highly skilled labour force.

However, the relative cost structure of mining resembles that of farming, with a generally higher ratio of rent (for land or other natural resource use) to skilled wages than in manufacturing.

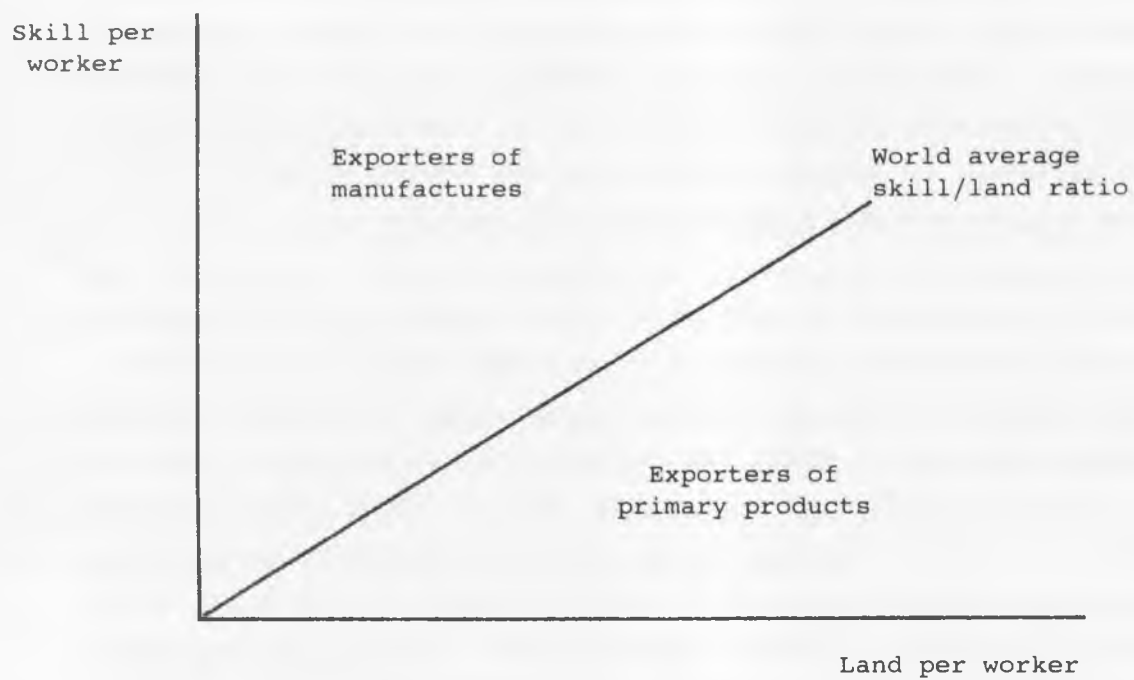
In addition to differences in factor proportions among goods, the second vital ingredient of all H-O models is differences in *resource endowments* among countries. And clearly, given the nature of the difference between manufactures and primary products, what is going to determine a country's comparative advantage as between manufactures and primary products in the present model is its relative endowments of skill and land.

The logic is so standard as to need only a brief summary. In the absence of trade, and of offsetting differences in consumer tastes and technology, the relative price of skill and land would vary among countries according to the relative supplies of these two factors. For example, in a country with a lot of natural resources, and little skilled labour, land would be cheap relative to skill. Because of the difference in factor proportions (inequality (2)), these variations in relative factor prices would cause corresponding variations in relative goods prices. So manufactures would cost more, relative to primary products, in a country with a low ratio of skill to land. Given the chance to trade, such a country would obviously tend to export primary products and import manufactures - and vice versa for a country with a high ratio of skill to land.

This is illustrated in Figure 1, whose axes measure the average levels of skill per worker and land per worker in each country (the total number of workers in each country, which may be thought of as a measure of country size, can be neglected because we are assuming constant returns to scale). Each country must lie on a ray from the origin, whose slope measures the ratio of its endowments of skill and land (the "per worker" denominators cancel out). Moreover, there must be one particular ray from the origin that measures the *world* average ratio of skill to land: and whether a country is a net exporter of manufactures or of primary products must depend on whether it lies above or below that ray.

A country's pattern of trade, incidentally, is not determined simply by whether it is rich or poor. Per capita income, insofar as it depends on resource availability, is measured in this figure by *distance from the*

Figure 1 Determinants of comparative advantage



*origin.* Thus countries with very different income levels may lie on the same ray: there are some rich exporters of primary commodities, and some poor exporters of manufactures. It is important to recognise, too, that a country's skill level can rise over time: the diagram can thus also be used to analyse dynamic comparative advantage (Wood 1994a, pp. 9-11).

The dividing line between manufactures and primary products has so far been taken for granted, neglecting the issue of how to treat the "primary processing" activities that are included in "manufacturing" in output and employment data, but excluded from it in trade data.<sup>4</sup> However, the model itself suggests that the division should depend on the transport costs of the raw materials used in an activity: where these are low enough for the materials to be widely traded, the activity belongs in manufacturing; but where bulk or weight make it necessary for the materials to be processed close to the natural resources from which they are obtained, the activity belongs in the primary category. Fortunately, moreover, this seems to be more or less how the line is drawn in practice in trade statistics, whose definitions of manufactures and primary products will simply be accepted for the rest of this paper.

A further advantage of this narrow definition of manufactures is that it allows the model to be extended to cover trade in services. For services resemble narrow manufactures (and differ from primary products) in having relatively high skill/land input ratios. In practice, the data on traded services are so limited that they are not included in the empirical work described below, but in theory, services can be accommodated in the model simply by broadening the definition of manufactures to include them. (Our model thus sheds no light, incidentally, on the developed-country debate about the relative merits of manufactured and service exports.)

It is also worth noting that the present model is one member of a larger family of skill-and-land-only H-O models. Another such model focusses on trade in manufactures (and services) of varying skill intensity, which it

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4. In trade data, manufacturing is usually defined as categories 5-8, less 68, of the Standard International Trade Classification. In production and employment data, manufacturing is the much broader category 3 of Revision 2 of the International Standard Industrial Classification (now division D of Revision 3), which also includes food, beverages and tobacco, refined oil, leather, lumber, pulp and paper, and non-ferrous metals.



explains in terms of inter-country differences in the relative numbers of workers in different skill categories (Wood 1994a, pp. 12-15, 1994c). In principle, a similar model might be focussed on trade in primary products of differing degrees of skill intensity. Thus although the present model is set up as if manufactures and primary products were homogeneous goods, it is important, in applying it empirically, to bear in mind that both of these categories are internally heterogeneous in skill intensity.

## II. Econometric specification

To make the model operational, we need to formulate it more precisely, and in particular to specify an equation that can be estimated using available cross-country data. The hypothesis is that the shares of manufactures and primary products in a country's trade are determined by its ratio of skill to land, making this ratio the obvious choice for the independent variable, subject to the practical problems involved in actually measuring it. The choice of dependent variable is not nearly so obvious, but we propose the *net export ratio*,  $x$ , defined as:

$$x = (X_m/X_p + M_p/M_m)/2 \quad (3)$$

where  $X$  and  $M$  are gross exports and imports respectively (the subscripts  $m$  and  $p$  referring as before to manufactured and primary products).

This specification of the dependent variable has several advantages. It has the same general form (a ratio) as the independent variable. It takes into account the composition of imports as well as of exports - H-O theory is ultimately about *net exports* - while allowing for the reality that all countries export and import both sorts of goods. Thus  $x$  is an increasing function both of the ratio of manufactured to primary exports, and of the ratio of *primary to manufactured* imports. Lastly, this specification is applicable regardless of whether trade is balanced ( $X_m + X_p = M_m + M_p$ ) or unbalanced (bearing in mind that imbalance in this sense might arise from omission of trade in services as well as from net capital flows).

A simple and flexible form for the relationship between the dependent and independent variable is

$$x = \Theta(H/N)^\alpha = \Theta(h/n)^\alpha \quad (4)$$

where  $H$  and  $N$  are the supplies of skill and land in each country,  $h$  and  $n$  skill and land per worker, and  $\Theta$  and  $\alpha$  are parameters. Indexing countries by  $i$ , and taking logs (denoted by  $\hat{\phantom{x}}$  over the variable), this equation can be estimated as

$$\hat{x}_i = a + b(\hat{h}/\hat{n})_i + u_i, \text{ or equivalently as} \quad (5a)$$

$$\hat{x}_i = a + c\hat{h}_i - d\hat{n}_i + u_i \quad (5b)$$

where  $a$  should be  $\hat{\Theta}$ ;  $b$ ,  $c$  and  $d$  should all be estimates of  $\alpha$ ; and  $u$  is the error term.

It is of considerable interest to compare the specification proposed here with the Heckscher-Ohlin-Vanek (HOV) formulation advocated and applied by Leamer (1984, 1992, 1993).<sup>5</sup> In general matrix form, the HOV equations

$$\mathbf{AT} = \mathbf{V} - s\mathbf{V}_w \quad (6)$$

relate the factor content of a country's trade,  $\mathbf{AT}$  (where  $\mathbf{A}$  is the matrix of factor input coefficients and  $\mathbf{T}$  its vector of net exports) to its factor endowments,  $\mathbf{V}$ , minus its domestic consumption of factors (assumed to be the product of its share of world income,  $s$ , and world factor endowments,  $\mathbf{V}_w$ ).<sup>6</sup> If  $\mathbf{A}$  is square (with equal numbers of goods and factors) and non-singular, equation (6) can be rewritten as

$$\mathbf{T} = \mathbf{A}^{-1}(\mathbf{V} - s\mathbf{V}_w), \quad (7)$$

a set of linear relationships between the net exports of each good and the country's factor endowments, which can be estimated econometrically.

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5. Though Leamer (1992, p. 14) also explicitly notes that the HOV equations are not the only possible way of modelling "the more basic Heckscher-Ohlin proposition .... that trade arises because of the unequal distribution of resources across countries".

6. In calculating  $s$ , one must adjust for imbalances in the country's trade, which would cause its share of world consumption to diverge from its share of world income.

For the present model, with two particular goods and factors, and taking advantage of the simplicity of the inverse of a 2x2 matrix, we can write the HOV equations (7) out in full in intensive (per-worker) form as

$$t_m = [a_{np}(h - sh_w) - a_{hp}(n - sn_w)] / (a_{hm}a_{np} - a_{nm}a_{hp}) \quad (8a)$$

$$t_p = [-a_{nm}(h - sh_w) + a_{hm}(n - sn_w)] / (a_{hm}a_{np} - a_{nm}a_{hp}) \quad (8b)$$

where  $t_m = T_m/L$  (net exports of manufactures per worker), likewise for  $t_p$ , and  $(a_{hm}a_{np} - a_{nm}a_{hp})$  is the determinant of  $\mathbf{A}$ . Furthermore, with only two goods, and given the overall balance of trade, we only need to consider one of these two equations, say the one for net exports of manufactures (8a).<sup>7</sup>

There are some general similarities between this equation and our equation (4) above. Each has some measure of net exports on the lhs, and resources on the rhs, and buried in both of them is an assumption that cross-country variations in consumption patterns are insufficient to offset the effects of variations in resource endowments. However, there are also substantial differences on both sides of the equations (which are discussed here only in an informal way - a full exploration of the algebraic linkages between these two equations, and of the differences in their econometric outcomes, would require a paper in itself).

Considering first the lhs,  $t_m$  is clearly a more "ambitious" variable than  $x$ . Our net export ratio measures only the *composition* of a country's trade (what sorts of goods it exports and imports), whereas  $t_m$  - the quantity of net exports of manufactures per worker - depends also on two other aspects of the economy concerned. One is how *productive* it is, as measured by its aggregate output per worker. The other is how *open* it is, as measured by trade as a share of aggregate output. Unsurprisingly, we find on the rhs of the HOV equation that we have to pay a price for the ambitions of its dependent variable, in the form of some strong additional assumptions.

First, we have to assume that given amounts of resources (skill and land) per worker always produce the same amount of output per worker, or, more

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7. Provided that we also specify the relative price of manufactures and primary products, since the balance of trade must be defined in terms of value flows rather than physical quantities.

formally, that the  $a_{ij}$  are the same in all countries. This requires not only that all countries have access to the same technology (which is not unreasonable, provided that "technology" is defined as knowledge embodied in traded producer goods - Wood 1994c, pp. 43-4), but also that they all have the same factor prices, and that no differences in efficiency arise from variations in infrastructure and institutions.

Second, we have to assume that openness depends exclusively on the degree of difference between each country's resource endowments and world average resource endowments. That the extent of this difference should determine the extent of trade is indeed one of the implications of H-O theory. But in practice, the openness of an economy is also powerfully influenced by its size, by its geographical location, and by the state of its transport system - not to mention its trade policies.

The point is not that these assumptions are too strong in some absolute sense, but just that they are unnecessarily strong for the purposes of the present paper (and perhaps also for many other applications of H-O theory). The less restrictive, albeit less ambitious, specification in equation (4) thus seems preferable here.

### III. Statistical results: resources

The model is estimated for the largest possible number of countries with populations over one million, in the most recent available year (results for earlier years are reported later). The trade data, mainly for 1989, are taken from the UNCTAD *Handbook of Trade and Development Statistics* (1991, table 4.1).<sup>8</sup> Skill per worker is measured by the average number of years of schooling of the adult (over 25) population in 1985 (from Barro and Lee 1993, supplemented in a few cases from the UNDP *Human Development Report*). Natural resources per worker are measured simply by total land area, divided by adult population.<sup>9</sup> The limitations of these measures of skill and natural resources are obvious, and are discussed further below.

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8. The data on Taiwan for all variables are from the *Statistical Yearbook of the Republic of China*.

9. The land area data are from the *World Development Report* (Indicators Table 1).

Referring to the summary of results in Table 1, the first regression is equation (5a), which relates the log of each country's net export ratio (manufactured/primary) to the log of its skill/land ratio. The scatter plot of the data is shown in panel (a) of Figure 2. The scatter and the regression both show a strong and highly significant association, in the predicted direction, between the two variables. The log-linear regression explains about half of the cross-country variation in the composition of trade. If allowance is made for the slight non-linearity apparent from the scatter and the diagnostic tests, by adding a cubic term,  $R^2$  rises to 0.59.

*(a) A closer look at the dependent variable*

In regressions (ii) and (iii) and in panels (b) and (c) of Figure 2, the net export ratio,  $(X_m/X_p + M_p/M_m)/2$ , is replaced as the dependent variable by its two constituents: the gross export ratio,  $X_m/X_p$ , and the gross import ratio,  $M_p/M_m$ . This decomposition reveals, most strikingly, that all the explanatory power of the first regression comes from the export side. In other words, the ratio of manufactured to primary gross exports is strongly related to the skill/land ratio, whereas the composition of imports (as between manufactures and primary products) seems unrelated to resource endowments.

Within the logical framework of a H-O model, as Leamer (1992, p. 29) notes, the most likely explanation for this asymmetry between exports and imports is that in reality there are more goods than factors, so that each country specialises in producing and exporting a few goods, and imports all other goods. Thus in the context of the present model, as mentioned above, one must recognise that the specific goods within our two broad categories of manufactures and primary products vary in skill intensity. For instance, within manufacturing, developed countries, because of their high levels of skill per worker, are specialised exporters of skill-intensive goods, and import goods of low and medium skill intensity from developing countries.

Moreover, going beyond the logic of the model, manufactures in each range of skill intensity are obviously highly differentiated in other ways, and (at this level of detail) subject to strong scale economies in production, which provides a powerful incentive for particular countries to specialise in exporting specific sorts of manufactures, and to import all other sorts.

Table 1 Summary of resources-only regression results

	Dependent variable	Constant term	Coefficients on independent variables					Number of countries	R-squared	Diagnostic tests
			h/n	n	h'/n	h	oil			
A. Most recent year (1989)										
(i)	NXR	0.53 ***	0.36 ***					112	0.49	F
(ii)	GXR	1.14 ***	0.73 ***					114	0.57	(N)
(iii)	GMR	-0.89 ***	-0.02					112	0.01	
(iv)	GXR	2.58 ***		-0.88 ***				111	0.45	(N)
(v)	GXR	2.74 ***			0.81 ***			111	0.53	(N)
(vi)	GXR	0.88 ***		-0.69 ***		0.81 ***		114	0.57	(FN)
(vii)	GXR	0.24		-0.64 ***		0.93 ***	-0.05 **	106	0.60	(F)
B. Comparison with earlier years										
1960	GXR	-0.07		-0.66 ***		0.59 ***		95	0.38	FN
1975	GXR	0.30		-0.65 ***		0.98 ***		95	0.53	FNH
1989	GXR	0.35		-0.69 ***		1.16 ***		95	0.60	(N)

Definitions (in the regressions, all estimated by OLS, all variables are in natural logs)

NXR = net export ratio =  $(X_m/X_p + M_p/M_m)/2$

GXR = gross export ratio =  $X_m/X_p$

GMR = gross import ratio =  $M_p/M_m$

h = average number of school years per worker

h' = proportion of literate workers

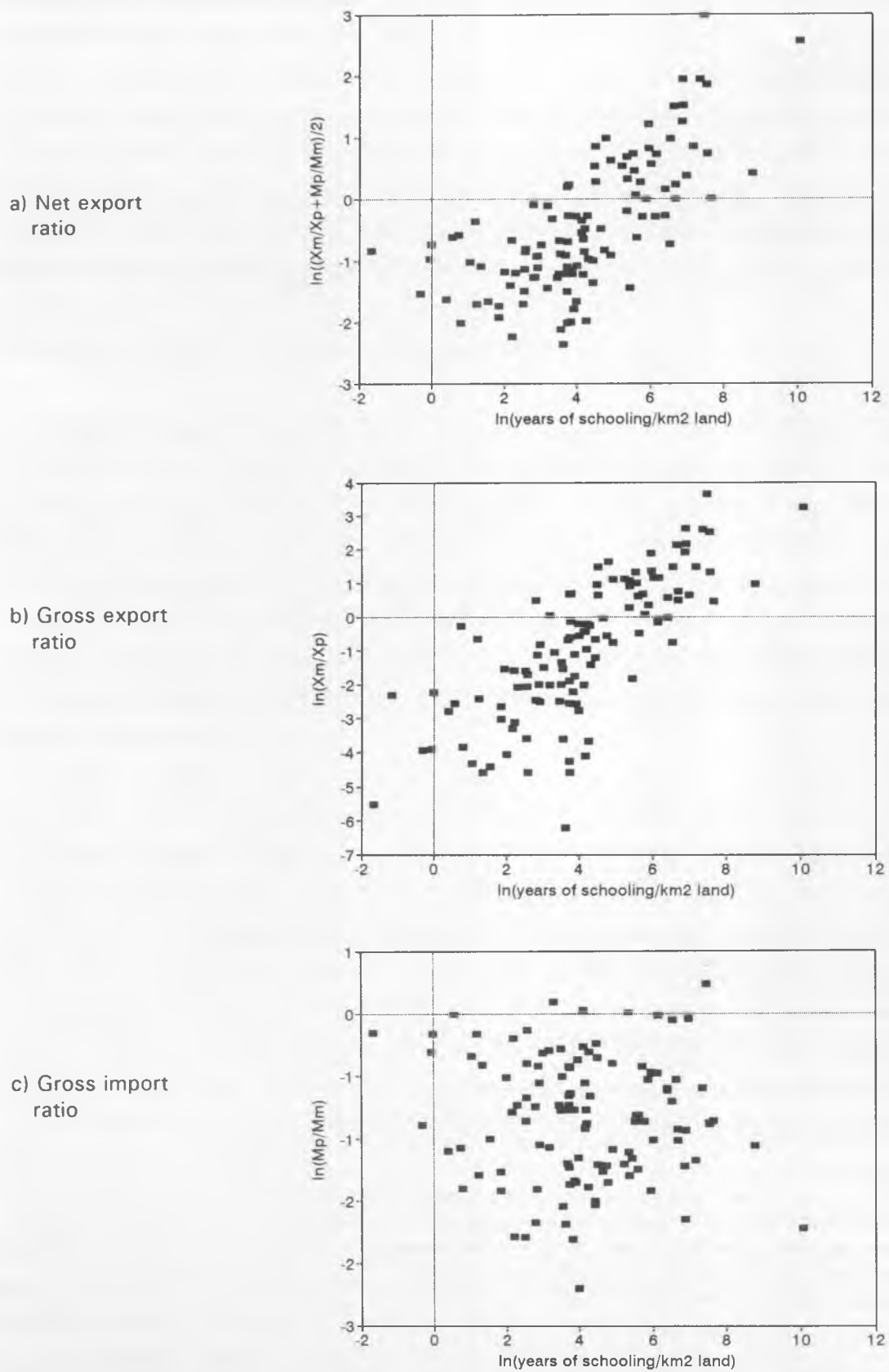
n = land area (thousand square kilometres) per worker

oil = value of oil and gas reserves (US\$ thousand million) per worker

\*, \*\*, \*\*\* = significant (2-tailed t-test) at 10%, 5% and 1% levels respectively

Diagnostic tests for: (1) functional form mis-specification, F, using Ramsey's RESET test; (2) heteroscedasticity, H, by regression of squared residuals on squared fitted values; and (3) non-normality, N, using the Jarque-Bera test. Where a letter appears in the last column, the regression failed the test concerned. Where the letters are in parentheses, the problem can be solved by excluding Iraq and Nigeria, two oil exporters with large negative residuals, which makes almost no difference to the size or significance of the coefficients, except that the oil coefficient in regression (vii) becomes insignificant and has to be excluded to avoid an F problem. The F problem in regression (i) can be solved by adding a cubed independent variable term, which is highly significant, and raises R<sup>2</sup> to 0.59. The 1960 and 1975 regressions improve if Iraq is excluded (Nigeria is not in the sample) and a squared independent variable term is added, but this still leaves the 1975 regression with H and N problems.

Figure 2 Alternative dependent variables



Note: independent variable re-scaled (x1000 or +6.91 in logs) by comparison with regressions in Table 1, to improve readability of the figure.

Finally, of course, land is heterogeneous: thus all but the few exporters of the commodities concerned import a wide range of primary and processed primary products - oil, coffee, rubber, timber, and so on

So from this point onwards in the paper, for clarity and convenience, we shall use the gross export ratio rather than the net export ratio as our dependent variable. This simplification, incidentally, resembles that of other studies which have followed Balassa (1979) in using the composition of gross exports as a measure of "revealed comparative advantage".<sup>10</sup>

*(b) A closer look at the independent variable*

It is also interesting to decompose the skill/land resource ratio into its constituent parts. Regression (iv) shows that quite a lot of variation in the manufactured/primary export ratio is explained simply by one of these constituents, namely the area of land per worker, whose inverse is closely related to a more familiar variable: population density. But the skills of the population also matter. The independent variable in regression (v) measures the number of *literate* workers (rather than the *total* number of workers) per unit of land area.<sup>11</sup> This modification improves the fit considerably ( $R^2$  up from 0.45 to 0.53), but still falls short of the  $R^2$  of 0.57 in regression (ii), which takes into account not only whether workers are literate or not, but how many years of schooling they have.

Regression (vi), based on equation (5b), introduces skill per worker and land per worker as two separate independent variables, rather than using their ratio.<sup>12</sup> The coefficients on both variables are highly significant, which confirms that the composition of a country's exports depends on the

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10. In his own later work, Balassa (1986) switched to a net-export-based measure. Moreover, his initial justification for using gross exports was different from those discussed above: he believed that the composition of imports would be distorted in many countries by trade barriers.

11. Using the 1985 literacy rate of the over-15 population, from the World Bank *Stars* disk. (The Barro and Lee data refer to the over-25 population.)

12. There is an inverse correlation ( $R = -0.38$ , in logs) between land per worker and average years of schooling per worker. One likely reason is the higher cost of providing good-quality schooling in more sparsely populated areas, but there are other possible reasons (economic and political) why countries with more natural resources might invest less in education.



educational level of its population and not merely on population density. Moreover, the coefficients on skill per worker and land per worker are not significantly different in absolute size, which is consistent with the hypothesis that the manufactured/primary export ratio depends simply on the ratio of skill to land.<sup>13</sup> (In other words, this result justifies specification (5a), which would be inappropriate if the true relationship in equation (4) were, for example,  $x = \Theta H^\alpha N^{-\phi}$ , with unequal  $\alpha$  and  $\phi$ .)

The measure of the skill/land ratio in regressions (i-iii) is just the total number of worker-years of schooling per thousand square kilometres of land in each country. Moreover, since  $H/N = hL/N$ , there are two very different ways in which a country (with a given land area,  $N$ ) might have a high  $H/N$ : by having a large workforce with a few years of schooling per worker (high  $L$ , low  $h$ ), or by having a small workforce with many years of schooling per worker (low  $L$ , high  $h$ ). These two combinations appear from our results to be equivalent in their effect on the manufactured/primary export ratio.<sup>14</sup> However, they must differ in their impact on the skill composition of these exports, particularly the manufactured ones.

In this connection, it is important to note that exports are measured in our trade data in terms of dollars. So one can rewrite  $X_m$  as  $Q_m P_m$  (where  $Q_m$  and  $P_m$  are the volume and average price, or unit value, of manufactured exports), and see immediately that there are also two very different ways in which a country might have a high  $X_m/X_p$ : by exporting a large volume of low-priced manufactures, or a small volume of high-priced ones. Moreover, since in the present model the main source of differences in the prices of manufactured exports is their skill intensity, inter-country variation in  $P_m$  is directly associated with variation in  $h$ , given  $X_m/X_p$  and  $H/N$ . (This association is the focus of the related model of trade in manufactures in Wood 1994a, 1994c - and of a similar model in Minford 1989.)

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13. The two coefficients are even more similar in size (-0.70 and 0.76) when the non-normality and functional form problems of equation (vi) are solved by omitting Iraq and Nigeria.

14. See the following footnote.

(c) *Limitations of our measures of land and skill*

As mentioned at the outset, our measures of land (i.e. natural resources) and skill have obvious limitations, which require some discussion. Total land area is an *unbiased* measure of natural resource availability, in the sense that what each country has, per square kilometre of its surface area, in terms of soil fertility, water resources, minerals, and so on, can be regarded as the outcome of a random draw. But it is clearly not an *ideal* indicator, since in principle it could be vastly improved by measuring the differences among countries in the composition and quality of their land.

We tried to do this, using data on various types of land (arable, pasture and forest), on water resources, and on metal, oil, gas and coal reserves, but with remarkably poor results (available in detail from the authors on request). The only improvement in the power of our regressions to explain cross-country variation in the manufactured/primary export ratio came from the addition of oil and gas reserves, and even this improvement was slight and dependent on the inclusion of two particular oil-exporting countries (see regression (vii) and the notes in Table 1). We believe that errors of measurement in the data for many countries are the main reason for the poor performance of the specific natural resource variables.

The use of years of schooling as a measure of skill has two defects. One is that it takes no account of cross-country differences in the *quality* of schooling - how much (and what) the student learned in the years concerned. The other defect is its neglect of all *sources of skill acquisition other than schooling*, which include not only formal classroom training, but also practical experience (or on-the-job training). Indeed, given that each of these defects is in principle extremely serious, it may seem extraordinary that years of schooling has so much explanatory power in our regressions.

The explanation is probably strong collinearity between years of schooling and these two excluded aspects of skill. (1) Considering the full range of cross-country differences in average years of schooling (say from Chad to Sweden), the number of years of schooling and the quality of that schooling must be positively correlated, despite quality differences among countries with similar years of schooling. (2) Schooling is known to enhance the capacity for subsequent learning from training and experience. Thus, for

example, in cross-section data within countries, the wages of more educated workers rise more steeply with age (e.g. Dougherty 1991, fig. 4). So there is probably a cross-country correlation between average years of schooling and the average level of skill acquired in other ways - despite variations in the degree to which the potential for post-school learning is realised.

*(d) Comparison with earlier studies*

There has been surprisingly little empirical work on the particular aspect of trade addressed in this paper - the extent of manufactured, relative to primary, exports. However, many of our results strongly resemble those of a remarkable paper by Keesing and Sherk (1971). Using data for 1965, they introduce population density into a (double-log) cross-country regression explaining the share of manufactures in gross exports, and interpret its significant coefficient as verifying a land/labour H-O model. Skill is not explicitly included, but the regression also contains per capita GDP, which is correlated with average years of schooling.<sup>15</sup> And like us, Keesing and Sherk discover an asymmetry between exports and imports: their regressions for the latter have no explanatory power.<sup>16</sup>

Syrquin and Chenery (e.g. 1989, Table 11) observe the ratio of manufactured exports to GDP to be higher, and the ratio of primary exports to GDP lower, in countries with higher per capita GDP (except in their "small primary" group), which again is consistent with our findings. Similarly, Bruchmann (1989), in work directed by one of us, found cross-country variation in the manufactured export/GDP ratio to be correlated positively with variation in the literacy rate and negatively with variation in arable land (and oil exports) per head. Auty (1994), in a much smaller sample of countries, likewise identifies arable land area per head as a negative influence on manufactured exports.

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15. Keesing and Sherk also include country size (measured by population) as an explanatory variable, hypothesising that economies of scale give large countries a comparative advantage in manufacturing, and find it to have a highly significant positive coefficient. We tried this in our regressions, and obtained a significant coefficient for 1960 (close to the year to which Keesing and Sherk's data refer), but not for 1975 or 1989.

16. This asymmetry was also found by Hufbauer (1970). Comparing countries with widely differing aggregate capital/labour ratios, he observed correspondingly wide variation in the capital/labour ratios of their exports, but little variation in those of their imports.

Leamer (1984, Table 6.7) explains cross-country variation in net exports of ten goods (six primary and four manufactured) in terms of variation in endowments of eleven resources (capital, three skill classes of labour, and seven natural resources). The influence of natural resources is consistent with our findings: exports of particular primary products are positively correlated with the extent of the corresponding natural resources (e.g. tropical products with tropical land area); and exports of all four of the manufactured goods are negatively correlated with all seven of the natural resources.<sup>17</sup> Leamer's results concerning the influence of skill supplies are less straightforward: they differ substantially between the two years he examines (1958 and 1975); and their interpretation is complicated by the inclusion of a capital variable which is highly correlated with GNP (and hence with years of schooling).<sup>18</sup>

(e) *Regional variation*

What light do our results shed on the dramatic differences in development performance among different regions in recent decades? To pursue this, we divide the world up into developed countries and the four main developing-country regions: Africa, Latin America, South Asia, and East Asia. Within East Asia, we distinguish the seven "high-performing" countries which were (with Japan) the subject of World Bank (1993). A sixth group contains all other countries, including those of the Middle East and Eastern Europe.

Table 2 shows average years of schooling per worker and average land area per worker in each of our five groups. Though there is also considerable variation within each group (as indicated by the standard deviations), the averages for the four developing regions lie more or less in the quadrants of a 2x2 matrix. Africa and South Asia both have low levels of schooling,

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17. An exception is coal in 1958, perhaps because it was then an important source of energy for industrial activity.

18. For a fuller discussion, see Wood (1994c, pp. 112-18). Leamer has more success (than us) with specific natural resource variables probably in part because he is explaining exports of *specific* primary products, rather than *total* exports of primary products, and in part because three of his natural resources (coal, minerals, and oil) are measured by the value of *production* rather than *reserves*. His later analysis in Bowen et al (1987), using only the same three land variables as us (and with the HOV specification of our equation (6), rather than (7), as in his 1984 book), yields worse results.

Table 2 Variation among country groups

	Number of countries	Group mean (standard deviation)		Coefficient on dummy variable (standard error)
		Average years of schooling	Square km of land per 100 workers	
Developed countries	19	8.9 (1.7)	11.2 (21.8)	1.18 *** (0.40)
Developing regions				
East Asia (total)	11	5.1 (2.0)	4.9 (9.7)	0.02 (0.49)
East Asia (high performing)	7	5.9 (1.5)	1.6 (1.8)	0.66 (0.58)
Latin America and Caribbean	21	4.7 (1.4)	10.8 (10.4)	-0.17 (0.37)
South Asia	6	2.4 (1.5)	3.0 (3.9)	0.94 (0.58)
Sub-Saharan Africa	34	1.8 (1.2)	24.8 (30.6)	-0.53 (0.35)

## Notes

1. Group means and standard deviations are unweighted.

2. This grouping of the 114 countries in regression (ii) in Table 1 is based on that of the World Bank's World Development Report 1993 (pp. 326-7). "Developed countries" are the high-income OECD countries. Non-OECD high-income countries are transferred to the relevant other groups. The "high-performing" East Asian economies, as defined in World Bank (1993), are Hong Kong, Indonesia, Korea, Malaysia, Singapore, Taiwan and Thailand. The "residual" group (not shown in this table) contains 23 countries.

3. The coefficients on all the dummy variables except that for East Asia (total) are based on an extension of regression (ii) in Table 1, in which the control group consists of the residual group plus the "non-high-performing" East Asian countries (China, Myanmar, Papua New Guinea and the Philippines). The coefficient on the dummy for East Asia (total) is based on a different regression in which the control group is simply the residual group.

4. The significance level of the coefficients on the dummy variables is indicated in the same way as in Table 1.

and Latin America and East Asia both have medium levels of schooling. The two Asian regions both have little land, and Africa and Latin America both have more land.

Figure 3 is a scatter plot of the regional averages of the dependent and independent variables of regression (ii) in Table 1, compared with the line of that regression. It reveals a remarkable cross-regional replication of the cross-country pattern shown in Figure 1 above. In other words, inter-regional differences in the manufactured/primary export ratio are strongly correlated with inter-regional differences in the skill/land ratio. The most notable contrast is between Africa and high-performing East Asia, at the two ends of the regression line.

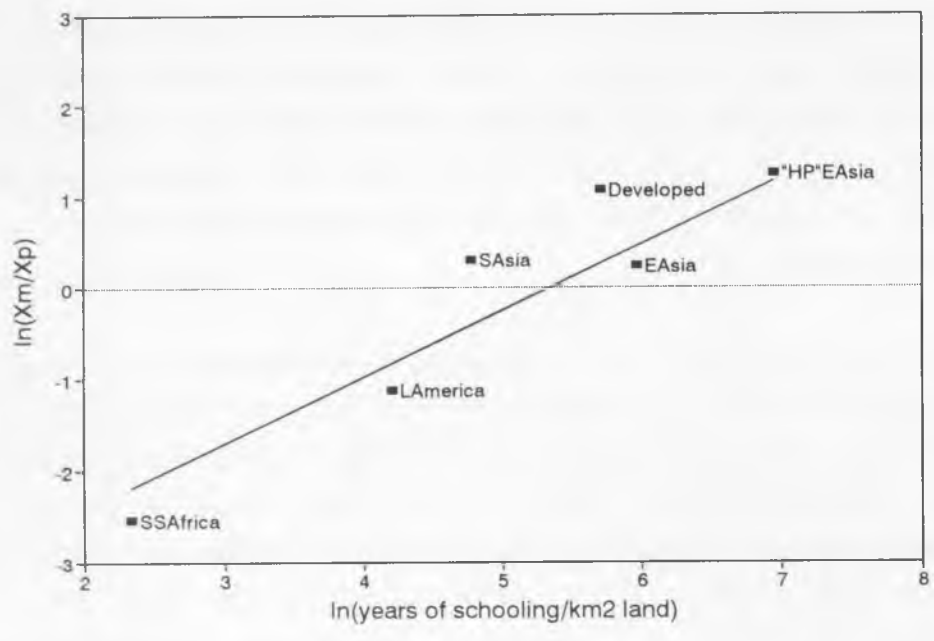
To discover whether there are significant inter-group differences, we reran regression (ii) with intercept dummies for each of our five groups (the control group being the sixth miscellaneous one, which luckily lies very close to the line). The results are reported in the last column of Table 2.<sup>19</sup> All the developing-region dummies are insignificant (though only just for both South Asia and Africa, which differ significantly from one another). So this test confirms the impression given by Figure 3, which is that developing regions differ chiefly in where they lie along this line: their deviations from the line are of second-order importance.

However, the developed countries are different, with a significantly higher manufactured/primary export ratio than would be predicted from their skill/land ratio. This could reflect better quality schooling than in developing countries, or greater acquisition of skills outside school. One important aspect of non-school skill acquisition is learning-by-doing in the process of manufacturing itself: it might just be the longer experience of manufacturing in developed countries that reinforces their comparative advantage.<sup>20</sup> To test this, we introduced the 1960 ratio of manufactured to primary exports as an additional explanatory variable (in the 1989 equation in panel B of Table 1). Its coefficient is highly significant, it has more explanatory power than a mere developed-country dummy, and its introduction

19. With the addition of the dummy variables, the  $R^2$  of the regression was 0.64 (up from 0.57). Starting from regression (vi), rather than regression (ii), in Table 1, made no substantial difference to the results.

20. This point was suggested to us by Hans Singer.

Fig. 3 Regional Pattern



does not reduce the significance of the resource coefficients. Comparative advantage in manufacturing thus appears to some extent self-perpetuating.

#### IV. Statistical results: trade policy

The central argument of this paper is that the influence of trade policies on the relative shares of manufactures and primary products in a country's exports is generally exaggerated, and the influence of resource endowments understated. The preceding section provides one piece of evidence that is consistent with this argument, namely that a resources-only model explains a lot of the cross-country variation in this aspect of trade. It remains, of course, to measure and compare the effects of trade policy.

##### *(a) Comparison with earlier years*

An initial approach (indirect, but interesting also for other reasons) is to compare our resources-only results, which refer to the most recent year available (1989), with similar regressions using data two or three decades old. The reason is that, over this period, many developing countries have adopted more open trade policies, which should have aligned the pattern of their trade more closely with their comparative advantage. We should thus expect the fit of the resources-only regression to improve over time.

The results in panel B of Table 1 show that this is indeed the case, with the  $R^2$  rising from 0.38 in 1960 to 0.53 in 1975 and 0.60 in 1989.<sup>21</sup> (These results for 1989 differ from regression (vi) in panel A because of the need to use a consistent sample in all years: this eliminates some of the least developed countries, and increases the coefficient on years of schooling.) There may well be other reasons for the improved fit, including reduction of transport costs and other natural barriers to trade, and improved data. But these results are certainly consistent with other evidence that trade policy changes have permitted many countries which formerly exported only primary products to realise a comparative advantage in manufacturing.

Some other aspects of the regressions in panel B deserve comment. Above all, the most basic features of the relationship - a significant positive

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21. This pattern emerges also when the regressions are modified to correct for the diagnostic test failures discussed in the notes to Table 1.



coefficient on skill per worker and a significant negative one on land per worker - emerge in both earlier years (although the regressions fail more of the diagnostic tests). The size of the land coefficient hardly alters. The intercept increases (though not significantly), which implies a uniform world-wide rise in the ratio of manufactured to primary exports, perhaps due to deteriorating terms of trade for primary products.

The coefficient on the skill variable increases significantly, implying a proportionally greater rise in the manufactured/primary export ratio for countries with higher levels of skill per worker. This could reflect the declining price of less skill-intensive, relative to more skill-intensive, manufactures, caused both by the initial transfer of less skill-intensive production from developed to developing countries, and by the later entry of ever more developing countries into this market (Wood 1994c, p. 332).

An obvious extension of these regressions, though one which lies outside the scope of this paper, would be to look more closely at changes over time (perhaps adding intervening years to create a panel data set). One could then, in principle, sort out the effects on changes in manufactured/primary export ratios of global causes, skill accumulation in individual countries, and changes in their trade policies, including an assessment of the extent to which the improvement of the fit of the resources-only regression is in fact a reflection of changed trade policies, as suggested above. The main practical obstacle at present is lack of time series data on trade policy.

*(b) Adding trade policy indicators*

What we would like to know more immediately, though, is how important the effects of trade policy are *now*. To assess this, we need to estimate (for the most recent year) a more general model that includes both resources and relevant measures of trade policy. Recalling that this paper is concerned with only one particular aspect of trade, namely the relative extent of manufactured and primary exports, it should also in principle be trying to measure only one particular aspect of each country's trade regime, namely the extent of its *bias* (if any) *against manufactured exports*.

The concept of bias is a familiar one (e.g. Krueger 1978), but is usually defined in relation to *total* exports. For example, a bias against exports

would be created by tariffs and/or quotas on imports (without compensating subsidies to exports), which would make it more profitable to produce for the home market than for the world market. We are concerned more narrowly with *sectoral differences in bias*, and in particular with circumstances in which there is *more bias against manufactured* than against *primary* exports. This would occur, for example, if there were tariffs on industrial imports, uncompensated by subsidies to industrial exports, with neither tariffs nor export subsidies for primary products.<sup>22</sup>

Most empirical studies of bias in specific countries have in fact focussed on the industrial trade regime. Unfortunately, though, accurate measures of bias (sectoral or total) are not available for large samples of countries. The most serious gaps relate to the restrictiveness (or tariff-equivalents) of quotas, and to the value of subsidies and other incentives to exporters. We are thus obliged, like earlier researchers, to rely on imperfect proxy variables. In particular, we experimented with most of the measures of trade policy that have been used in other cross-country studies. We also tried a variety of alternative specifications (including resurrection of the net export ratio as our dependent variable).

Table 3 contains a representative selection of results (more are available on request, as are further details of the data and sources). In the spirit of Hendry (Gilbert 1986), we assess the importance of trade policy by starting from the *general hypothesis* that both resources and trade policy affect export composition, and then checking whether omission of trade policy would be an *acceptable simplification* of this hypothesis, using an F test (columns headed "Simplification 1: resources only"). In addition, to gauge *how much* cross-country variation in export composition is currently due to variation in trade policies rather than in resources, we compare the adjusted  $R^2$  values of the general and the simplified models.

The first pair of measures in Table 3 are taken from the UNCTAD *Handbook of Trade Control Measures*, which permits comparisons between manufactured and primary imports of the level of tariffs and of the frequency of non-tariff

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22. In this case, the regime would be biased against exports in general, as well as against manufactured exports in particular. In principle, it would be possible to have a trade regime that was neutral for exports in total, but biased against manufactured exports (for instance, if there were tariffs on industrial imports and subsidies to primary exports).

Table 3 Selected results of trade policy tests

Trade policy indicator	Country sample		General hypothesis: resources + trade policy		Simplification 1: resources only		Simplification 2: trade policy only	
	Type	Number	Coefficient on trade policy	Adjusted R-squared	Accept? (Y or N)	Adjusted R-squared	Accept? (Y or N)	Adjusted R-squared
UNCTAD (manufactures - primary)								
Difference in tariff rates	LDC	71	0.021	0.45	Y	0.45	N ***	0.02
Difference in NTB frequency	LDC	71	-0.013	0.46	Y	0.45	N ***	0.02
Trade orientation (Greenaway)	LDC	41		0.66	Y	0.66	N ***	0.35
Moderately outward oriented		8	0.990					
Moderately inward oriented		16	0.367					
Strongly inward oriented		14	0.084					
Price distortion index (Dollar)	All	79		0.63	N **	0.60	N ***	0.25
Average level			-0.004			out		in
Variability			-3.651 **			out		in
[Terms of trade variability]			-6.187 **			in		out
Black exchange rate discount	All	88	-0.330 ***	0.62	N ***	0.59	N ***	0.22

## Notes

1. The trade policy indicators are described more fully in the text. In all cases they are specified so that a higher level of the indicator corresponds to more bias against manufactured exports (and hence the expected sign on the coefficient is negative). Notation of significance levels is as in Table 1.
2. "All" countries refers to the largest subset of the 114 countries in regression (vi) in Table 1 for which data on the trade policy indicator were available. "LDC" denotes samples containing developing countries only.
3. In each case, the "general hypothesis" was tested by running a regression of the same form as regression (vi) in Table 1, with the trade policy indicator as an additional independent variable. Simplification 1 was to re-run this regression on the same country sample without the trade policy indicator. Simplification 2 was to re-run it on the same country sample without the human and natural resource variables.
4. The acceptability of the simplifications was assessed by an F-test on the joint significance of the potentially excluded variables in the general specification. (Where the simplification involves the deletion of only one variable, this test is equivalent to a t-test of the coefficient concerned.) The results of these tests are indicated with the usual notation (the absence of asterisks signifies that the potentially excluded variables did not contribute even at the 10% significance level to the explanatory power of the general specification).

barriers (NTBs) in developing countries. Their main shortcomings are that the tariff measure refers to nominal, rather than to effective, protection (which is particularly important here because manufactures usually contain more imported intermediates than primary products), and that the frequency of NTBs is not closely related to their restrictiveness. The coefficients on both measures of trade policy are insignificant, implying that it would be an acceptable simplification to omit them from the model - but only just for NTBs, whose coefficient has the right sign and achieved significance (at the 10% level) in some of our experiments using alternative specifications and country samples.

The next measure in the table is Greenaway's (1986) classification of the 1973-85 trade regimes of developing countries into four groups: strongly outward-oriented (SO), moderately outward-oriented (MO), moderately inward-oriented (MI) and strongly inward-oriented (SI).<sup>23</sup> With SO as the control group, we insert dummy variables for the other three groups (1 = member of the group, 0 otherwise). If this classification accurately reflected bias against manufactured exports, all the coefficients would be negative, and their rank order would be MO > MI > SI. In fact, all of them are positive, and none is significantly different from zero - although their ranking is as expected (and with SI as the control group, the MO coefficient becomes significant at the 10% level).<sup>24</sup> It would be an acceptable simplification to omit this set of policy indicators from the model.

The third trade policy indicator is Dollar's (1992) price distortion index, which measures the excess of the domestic prices of traded goods over their border prices, taken as an indicator of the general level of protection.<sup>25</sup>

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23. The results in the table are based on the slightly modified version of the Greenaway classification in World Bank (1987, fig. 5.1). The results are much the same for both versions. Nor were they improved by our attempt to allow for changes in trade policies between 1985 and 1989 - the date to which our trade data refer.

24. The insignificance of the SO dummy is unsurprising, given that the SO group consists of three of the high-performing East Asian economies, which on average lie close to the resources-only regression line (see Figure 3).

25. It is calculated from the Summers and Heston data, and in particular from the deviation between the price in each country and the price in the US of a fixed consumption basket. These deviations are partly the result of differences in the price of *nontraded* goods, which Dollar controls for by regressing the deviations on per capita income and using the residuals from this regression as his index of (traded-good) price distortion. As

In principle, this is not necessarily related to the degree of bias against manufactured exports, but if, in practice, protection were mainly applied to manufactured rather than primary imports, it would generate such a bias. In his regressions (explaining growth of per capita GDP), Dollar includes both the average level of price distortion over the period 1976-85 and its variability (and uses the regression coefficients as weights to combine the two aspects of distortion into a single measure of "outward orientation").

We also included both the average level and the variability of the Dollar index in our regressions. However, we have serious reservations about the variability of this index as a measure of policy, particularly because it is strongly correlated across countries with the variability of their *terms of trade* ( $R = 0.44$ ). Such a correlation is to be expected, given (a) the economic linkages between terms of trade movements and real exchange rate movements (Edwards 1989, pp. 37-9, 140), and (b) the similarities between the Dollar index and a real exchange rate index.<sup>26</sup> And for most countries, most terms of trade movements are unrelated to trade (or other) policies. So to isolate the policy-related components of Dollar's index, we included terms of trade variability as an additional independent variable in both our general and our simplified (resources-only) specifications.<sup>27</sup>

Even with this control, the coefficient on the price distortion variability measure is significant (although that on the average level of distortion is not). It is thus not an acceptable simplification to exclude the Dollar variables from the general hypothesis. However, comparison of the adjusted  $R^2$  of the general and simplified specifications - a difference of 0.03 -

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Rodrik (1994, p. 49) notes, the assumed relationship between traded-goods prices and the level of protection depends on the absence of export taxes.

26. Dollar himself often refers to his index as a real exchange rate index. The similarity is stressed by Rodrik (1994, p. 36), who also (p. 53) has doubts about the variability of the Dollar index as a measure of policy.

27. Terms of trade variability is measured over the same period (1976-85), and using the same indicator (the coefficient of variation), as the Dollar index, with data from the World Bank Stars disk. Unsurprisingly, there is a strong cross-country correlation between terms of trade variability (TCV) and the manufactured/primary export ratio. When included in the resources-only regression, TCV has a highly significant (negative) coefficient, and raises the adjusted  $R^2$  from 0.53 to 0.60. Had we not controlled for terms of trade variability, the impact of the Dollar variables would have seemed greater: the adjusted  $R^2$  of the general specification would have been 0.09 (rather than 0.03) higher than that of the simplified specification.

suggests that the (policy-related components of the) Dollar variables can explain only a little of the cross-country variation in export composition. Nor would this conclusion be altered by limiting the sample to developing countries (where the assumption of more protection of manufacturing than of agriculture is more plausible than in most developed countries).

The last trade policy measure is the discount of the black market exchange rate below the official exchange rate (taking an average of the five years around 1989).<sup>28</sup> In principle, this is a remote proxy: the gap between the black and the official exchange rates might not be related to trade policy at all, let alone to bias against manufactured exports. But in practice, high protection, especially of manufacturing, is often associated with active black exchange rate markets, and the coefficient on this variable in Table 3 is significant, with the expected (negative) sign. Again, however, there is only a small gap (0.03) between the adjusted  $R^2$  of the general and the (unacceptable) simplified specifications.

*(c) Methodological qualifications*

In summary, these results suggest that variation in trade policies may have explained part of the cross-country variation in the ratio of manufactured to primary exports in the late 1980s. However, neither of the two direct measures of trade policy (UNCTAD and Greenaway) is significant. Moreover, the two indirect measures, though statistically significant, explain only a small fraction of the variation in export composition, and in particular a much smaller fraction than variation in resources. This finding is subject to two potentially important qualifications.

The first is that, as emphasised above, our indicators of trade policy are imperfect. In other words, it is possible that, if we had really accurate measures of bias against manufactured exports in each country, they would explain more of the residual variance of our resources-only regressions.

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28. These exchange rate data were kindly provided by Michael Hee of the World Bank. They update the 1960-84 series in Wood (1988), and invert the definition of the discount in that earlier paper. The black rate discount is mildly correlated with the average level of the Dollar price distortion index ( $R = 0.23$  in the sample of 69 countries for which both variables are available). Rodrik (1994, pp. 36-8) discovers a much stronger association between the two Dollar variables and the average level and variability of the black rate discount over the longer period 1960-89.

This residual variance is indeed large (about 40% of the total), but much of it probably arises from the deficiencies of our measures of land and skill, and from our omission of many other variables (e.g. infrastructure) that in practice affect this export ratio. It thus seems unlikely that the incremental contribution to explained variance of even an ideal measure of trade policy would approach that of resource endowments.

The second qualification, though, is that this "incremental" approach may not be a valid way of comparing the explanatory power of trade policy and resources, because these two variables are causally related to each other, rather than being independent. This would not matter if causality flowed from resources to policy, with countries choosing the trade policies that made best use of their endowments (Ranis 1991). For then, with policy as an intervening variable, our method of testing would be appropriate.

The problem arises if causality flows the other way, from trade policy to resources, which evidently would make our incremental method underestimate the true influence of trade policy. And in the case of skill, there is an obvious theoretical linkage: trade policies that are less biased against manufactured exports raise the demand for (and price of) skill relative to land, and thus, if there is any elasticity of relative supply, stimulate a greater skill supply and so increase the skill/land ratio. Moreover, there is a clear cross-country correlation between our trade policy variables and skill per worker. For example, with the average level of the Dollar index,  $R = -0.36$ , suggesting quite a strong tendency for countries with less price distortion also to have more years of schooling per worker.

This correlation need not imply, of course, that there is a strong causal linkage from trade policy to the skill supply. It might reflect causation from resources to policy, or arise from the causal influence of some third variable (such as "good government") on both variables. In principle, this issue could be resolved by further research, using a simultaneous-equations specification which treated skill as an endogenous variable. For the time being, though, the best we can do is to estimate the upper bound of the bias of our incremental method, by re-running our regressions with trade policy as the sole independent variable, and interpreting the results as an indication of the maximum possible explanatory power of trade policy.

In the last two columns of Table 3, the trade-policy-only specification is thus presented as an alternative simplification of the more general model. In all cases, it is an *unacceptable* simplification, given the significance of the resource variables, and with the UNCTAD policy measures it has little explanatory power. For the other three measures, however, the upper-bound estimates of the influence of trade policy implied by the adjusted  $R^2$  far exceed the lower-bound estimates suggested by our earlier comparisons between the adjusted  $R^2$  of the general specification and the resources-only simplification. The discrepancy is largest for the Greenaway measure (because the three high-performing East Asian economies that make up his SO group have high skill/land ratios), but is substantial also for the Dollar and black discount measures.<sup>29</sup>

In arriving at an interim judgement about whether the true effect of trade policy is closer to the lower-bound or to the upper-bound estimate, we can appeal to general knowledge about the causes of differences in educational performance among countries. In this regard, it seems to us (and we would expect to most people) that the effects of differences in trade policy are small in comparison to other causes, including differences in other sorts of policies - particularly educational policies. On this basis, and while acknowledging the need for more statistical investigation, we suggest that the truth is much closer to our lower-bound estimates.

## V. Conclusions and policy implications

The question addressed in this paper is: why are some countries exporters mainly of manufactures and others mainly of primary products? The answer that emerges from our analysis is: principally because they have different resource endowments, and more specifically because of differences in their ratios of human skills to natural resources (or "land"). Countries with a high skill/land ratio have a comparative advantage in manufacturing, those with a low skill/land ratio a comparative advantage in primary production. So, contrary to widespread pessimism about the explanatory power of factor proportions theory, and at least in this dimension of international trade, Heckscher and Ohlin rule!

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29. Controlling for terms of trade variability (TCV) reduces the influence of the Dollar variables: the adjusted  $R^2$  of a regression including both the Dollar variables and TCV exceeds that of a regression on TCV by only 0.095.



Variation in trade policies among countries now explains only a small part of the variation in manufactured/primary export ratios. Over the past few decades, *changes* in trade policy - towards more open trade regimes - have enabled a series of developing countries, notably in East Asia, to realise a previously stifled comparative advantage in manufacturing. However, the scope for further progress of this sort seems limited: the big differences in export composition that still exist between East Asia and other regions, particularly Latin America and Sub-Saharan Africa, are overwhelmingly due to differences in resource endowments, not differences in trade policies.

The limited scope of these conclusions should be emphasised. We are not saying that *trade policy in general* is unimportant, but just that it is now rarely a major influence on the ratio of manufactured to primary exports. For other aspects of trade - the overall level of exports, the composition of both manufactured and primary exports, the choice of trading partners - trade policy may well be more important. Thus, for example, a country such as India with a fairly high manufactured/primary export ratio could still gain from changes in policy that raised its ratio of total exports to GDP.

Even less are we saying that *other sorts of policy* are unimportant. On the contrary, our results imply that policies which influence skill acquisition (including, but not limited to, educational policies) have a powerful effect on the ratio of manufactured to primary exports.

What, then, are the specific lessons for development policy that might be drawn from our findings? One obvious negative lesson is that is a mistake to design, and evaluate the results of, trade policy reforms without first looking at the skill/land ratio of the country concerned. Too much of the advice that has been given to Latin America and to Africa, and too much of the disappointment about the poor results of implementing this advice, has been based on the false premiss that East Asian trade *policies* will yield East Asian trade *outcomes*, regardless of resource endowments.

A positive lesson (which in this case reinforces part of the conventional wisdom of development policy advice) is that education and other means of skill acquisition - or, more broadly, human resource development - are of great importance for many aspects of economic performance. In particular, this paper suggests that the only way in which most of the countries that

now mainly export primary products could become exporters of manufactures would be to raise the skill levels of their labour forces.

It must also be recognised, however, that not everyone can be an exporter of manufactures: some countries, particularly those with large amounts of natural resources per worker, are bound to remain net exporters of primary products. Moreover, the process of skill accumulation is inevitably slow, meaning that it may be decades before some countries with moderate amounts of land per worker and initially low levels of education and training will acquire a comparative advantage in manufacturing. More thought thus needs to be given to the choice of development strategy for countries which now have low skill/land ratios.

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