Sectoral composition of global trade *

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We explore, theoretically and empirically, two claims regarding the sectoral composition of trade between primaries and non-primaries. First, in the long run, the comparative advantage in one good or the other is driven by the TFP differential in both sectors rather than by the relative capital endowment. Our first claim explains the fact that less developed countries tend to export primaries even though it is not clear that primaries are less capital intensive. Second, this dynamic comparative advantage, together with non-homothetic preferences, implies that, as the global economy develops, fewer and fewer countries export only or mostly primaries.

1 Introduction

This paper explores the notion that, as the global economy develops, we should witness a shift in global production and, consequently, a shift in global trade away from primaries towards manufactured goods and services. This hypothesized change in the sectoral composition of global trade implies a change in individual country trade patterns. Thus this paper also explores whether countries are moving in the direction of a decline in the share of primary commodity trade.

The first point this paper makes is that, although in the short run other factors may be more important, in the long run, the comparative advantage in one good or the other is driven by the total factor productivity (TFP) differential in both sectors rather than by the relative capital endowment. In much of the trade literature it is commonly assumed that primary production is labour-intensive when compared to manufacturing and industry. This "popular belief" has its roots in the empirical regularity of developed countries, abundant in capital per worker, traditionally exporting non-primaries and importing primaries. Hayami and Ruttan (1971, pp. 92-93) and Echevarria (1998) are examples that show agriculture being less labour intensive and, even when accounting for land intensiveness, more capital intensive than manufactures and industry. That the dynamic comparative advantage is driven by the TFP differential, rather than by the relative factor endowment, explains the fact that less developed countries tend to export primaries, even though it is not clear that primaries are less capital intensive.

As countries progress in a technical sense, TFP grows in both sectors: primaries and non-primaries. However, progress is more rapid in the non-primaries sector (see, for instance, Echevarria 1997). This means that, as time goes by, the difference—the wedge—between productivity in both sectors increases. Likewise, more advanced countries use resources more productively in both sectors but the productivity differential is larger for the non-primaries sector. This "scissors" effect is a source of comparative advantage in non-primaries for more technically advanced countries that in the long run proves to be more important than relative factor endowments.

A large number of developing economies are moving away from agricultural production and trade toward the export of manufactured goods. The most prominent examples are in Asia, and some in Latin America and in the Middle East. In terms of the increasing number of industries in East Asia competing with traditionally "Western" exports, there has been consid-

erable debate on the role of changing comparative advantage. Explanations for the rapid industrialization of these countries and competitiveness in technology intensive sectors emphasize the role of technology transfer (Edwards 1991), innovation (Romer 1986, 1990), and accumulation of human capital (Lucas 1988). Our explanation relates to these three arguments. The increasing numbers of developing countries competing in manufactured goods lends support to the notion of a "product cycle".[1] This paper emphasizes the role that nonhomothetic preferences play in this cycle: as the world becomes richer, global consumption of primaries falls in proportional terms which makes countries move away from production and export of primaries.

Nonhomothetic preferences have been proved (Echevarria 1997, Laitner 2000) to be behind the process known as "structural change", documented as early as 1940 by Clark, that typically accompanies economic growth. This structural change is characterized by a shift away from agricultural production towards manufacturing and services. The relative change in the contribution of each sector to total output is a consequence of Engel's law, where aggregate consumption of agriculture rises less that proportionally with growth in per capita income. Kuznets' (1973) compiles three decades of research on the topic in what are know as Kuznets' facts.

There are fewer inquiries, like this one, into how this uneven or "unbalanced" development path has affected the composition of global trade in general and country trade patterns in particular. In the long view, the dominant pattern of global consumption, production and trade has undergone a quite noticeable change. The extensive empirical studies conducted by Chenery and Syrquin (1975, 1986) noted a gradual shift in the composition of both global production and exports in many developing countries that closely parallels Kuznets' facts.

Trade has for some time been viewed as critical to the pace of development. Matsuyama (1992) and Echevarria (1995, 2000) show that economies specializing in agriculture will enjoy lower rates of economic growth than those specializing in non-agricultural goods. Echevarria, using a small open economy, shows that at the steady state a country would specialize in primaries if the autarchic relative price of primaries is lower than the global price. She takes the global price as given. This model employed here gener-

[1]This paper uses just a composite good: non-primaries. Obviously, there are many different non-primaries and the "product cycle" may take a different form for each good: the transfer of production to the "South" may take a long time for some commodity groups, and in other industries there may not be a shift in comparative advantage at all.

ates the same patterns of specialization where the price in autarchy is lower, but in this paper steady state prices are endogenously determined in a dynamic general equilibrium framework. Therefore, the model endogenously determines which economies specialize in primaries or non-primaries. The model makes simplifying assumptions that result in complete specialization. When comparing the theoretical results to the data, we need to take into account that complete specialization is rarely witnessed for many and different reasons.

One implication of this model is that, although the "structural change" is a universal fact of development, the level of income per capita at which the change in the sectoral composition of trade occurs depends on the relative technological level: the more advanced technological countries start "industrializing" at lower levels of per capita income; the late comers go through this process at much higher levels of income—the level of income per capita of Britain in the mid-19th century was probably lower than that of many today's primaries exporters. This is because the level of income per capita at which the country starts industrializing depends on the relation between the autarchic price and the global price but the global price depends on global income; i.e., other countries' income and technical level. In this sense, each "structural change" is unique. These conclusions are taken to be a refinement, rather than a departure, from the ideas espoused in Chenery and Syrquin (1975), Chenery and Taylor (1968) and Kuznets (1973), among others.

This study is an extension of recent research into the relationships between economic growth and sectoral composition. Drawing upon previous work in the issue by, mostly, Echevarria (1997) and Kongsamut, Rebelo and Xie (2001), the model adopted to explain the dynamic pattern of global trade is simple: we assume identical non-homothetic preferences; two non-sector-specific factors of production that are immobile; no borrowing or lending; and different production functions and different rates of technical progress in each sector. Finally, we assume the existence of only two tradable consumption goods: primaries and non-primaries; and the existence of a minimum of consumption, consisting of primaries, to replicate Engel's facts. We assume away the existence of non-tradables for the sake of simplicity. Although non-primaries in the model does not necessarily refer to manufactures—we are aware that more and more services are internationally trade—we often refer to non-primaries as manufactures. It is true that services used to be mostly non-tradable but this is not the case anymore. However, the statistics we use

concern only primaries and manufactures. Hence the reason for our equating non-primaries to manufactures throughout the text. Capital goods are produced in the non-primaries sector.

Our main contribution at the theoretical level is to extend Kongsamut, Rebelo and Xie's definition of an unbalanced growth path to an open economy. We define an unbalanced growth path as a situation in which there exists a global return to capital that remains constant, using Trefler's (1993) results about a weak form of factor-price equalization that allows for international productivity differences being consistent with observed variation in factor prices across countries.

Our empirical analysis extends in various ways Chenery and Syrquin's (1975) analysis of world development and trade patterns for the 1950-1970 period, although the present study benefits from more extensive country coverage and more detailed data on resource endowments. It replicates some of the important findings in their analysis, as the tendency for most countries to move towards greater manufactured commodity trade.

This analysis explores the importance of nonhomothetic preferences in explaining the sectoral composition of trade. In this we follow Markusen (1986), Hunter (1991) and Bergoeing and Kehoe (2001) which have demonstrated in a static framework that nonhomothetic preferences have significant potential to account for the direction of trade between developed and developing countries.

The rest of the paper is organized as follows: in the next section we use a model with homothetic preferences to show how, in the long run, specialization is driven by the TFP differential in both sectors. Sector 3 uses the same model with nonhomothetic preferences to explain the fact that fewer and fewer countries export only or mainly primaries. Section 4 is an empirical investigation of the sectoral composition of global trade that shows the data generally conforming to the predictions of the model. Section 5 concludes the paper.

2 Specialization and TFP differential

There are two tradable goods—primaries and non-primaries; for the sake of simplicity we assume away the existence of non-tradables.

We refer to primaries (or agriculture) as the first sector and non-primaries (often referred to as manufactures, as explained in the Introduction) as the

second sector. There exist two non-sector-specific factors of production, capital and labour, assumed to be immobile. Finally, we assume that there is no international borrowing or lending.

There exists a continuum of countries $i \in [0,1]$. For each country i the production function for primaries is

$$A_i K_{i1t}^{\theta} L_{i1t}^{1-\theta}$$

and for non-primaries is

$$B_i \lambda^{(1-\gamma)t} K_{i2t}^{\gamma} L_{i2t}^{1-\gamma},$$

where K_{ijt} denotes capital in sector $j = 1,2$ in period t; L_{ijt} labour in sector j in year t; and A_i and B_i are the initial efficiency parameters. We assume A_i (normalized to 1) to be the same for all countries and $B_i = B(i)$ ($B_0 = \underline{B}, B_1 = \bar{B}$) to be a strictly increasing function of i; i.e., we order countries according to their productivity in manufactures).

Our assumptions about TFP imply two things: first, we assume that the technological gap between the most and the least technologically advanced countries remains basically constant across time—using a train analogy, the most advanced countries, the engine of growth, pull the least advanced so they all go ahead at the same speed, the distance between the engine and the caboose constant.[2]

Second, assuming technical progress to be larger in the second sector than in the first (as Echevarria 1997 shows) and assuming the rate of technical progress to be the same in all countries, the wedge between TFP in the first and the second sector is greater the more technically advanced the country is. Thus, by normalizing A_i to 1, B_i measures the TFP differential in country i. By the same token, $\lambda^{(1-\gamma)}$ refers to the difference in TFP growth in both sectors.

Capital intensities in the two sectors ($0 < \theta, \gamma < 1$) are different. In each country a representative consumer (there is no population growth) owns the factors of production and decides their distribution between the alternative uses. We normalize the total amount of labour in each period to 1.

Both goods are consumption goods, although manufactures can be used as an investment good as well; i.e., capital is produced in the second sector.

[2]This assumption is consistent with the stylized fact that the "width" of the global income distribution across countries has neither decreased nor increased in over four decades (see, for instance, Jones, 1998, p. 65)

The utility function for each period satisfies the Inada conditions. Capital accumulation is subject to the usual condition

$$K_{i,t+1} = (1-\delta)K_{it} + I_{it}$$

where K_{it} refers to total capital of country i at period t, δ is the depreciation rate, and I_{it} denotes investment in country i at period t.

Appendix **A** shows that, in a closed economy, the relative price of primaries in the steady state p_i is a positive function of B_i—the more technically advanced the country, the higher the autarchic relative price of primaries in the steady state. As a consequence, p_i is an increasing function of i.[3]

Since there is no borrowing and lending, an equilibrium is a list of functions of i $(C_{i1t}, C_{i2t}, p_t, I_{it}, q_{i1t}, q_{i2t}, K_{it}, K_{i1t}, K_{i2t}, L_{i1t}, L_{i2t})$ for $t = 1, 2, ...$ such that

1. the representative consumer of each country maximizes the intertemporal utility function

   $$\sum_{t=1}^{\infty} \beta^t U(C_{i1t}, C_{i2t})$$

   subject to the following intratemporal constraints:

   $$\begin{aligned} p_t C_{i1t} + C_{i2t} + I_{it} &= p_t q_{i1t} + q_{i2t}, \\ q_{i1t} &= K_{i1t}^{\theta} L_{i1t}^{1-\theta}, \\ q_{i2t} &= B_i \lambda^{(1-\gamma)t} K_{i2t}^{\gamma} L_{i2t}^{1-\gamma}, \\ K_{i1t} + K_{i2t} &= K_{it}, \\ L_{i1t} + L_{i2t} &= 1, \end{aligned}$$

   and the intertemporal constraint, $K_{i,t+1} = (1-\delta)K_{it} + I_{it}$; and

2. the market clearing conditions,

   $$\begin{aligned} \int_0^1 C_{i1t} di &= \int_0^1 q_{i1t} di \text{ and} \\ \int_0^1 (C_{i2t} + I_{it})\, di &= \int_0^1 q_{i2t} di, \end{aligned}$$

   are satisfied every period.

[3]By not normalizing TFP in the first sector to 1, it can be shown that the relative price of primaries in the steady state of a closed economy is a positive function of B_i and a negative function of A_i.

We drop time subindexes to indicate "detrended" steady state values. In all countries, and in either a closed or an open economy, the return to capital, r, in the steady state equals $\lambda/\beta' - (1-\delta)$ where $\beta' = \beta\lambda^{\theta\alpha+1-\alpha}$. In a closed economy, the return to capital implies a capital/labour ratio in the second sector k_2^*, and this ratio in turn implies a wage. The relation between the remuneration of the inputs implies a capital/labour ratio in the first sector, k_1^*. These two ratios result in a relative prices for primaries in terms of non-primaries (see Appendix **A)**.

In an open economy, capital market equilibrium requires

$$\begin{aligned} p\theta k_{i1}^{\theta-1} &\leq r \\ \gamma B_i k_{i2}^{\gamma-1} &\leq r \end{aligned}$$

where k_{ij} denotes the capital/labour ratio in sector j. Given B_i, the return to capital ties the capital/labour ratio in the second sector k_{i2}^* if manufactures are to be produced. If both goods are to be produced, equilibrium in the capital and labour market requires the capital/labour in the first sector to be at a certain level k_{i1}^* as well. Calling p_i the autarchic relative price of primaries in country i,

$$p_i\theta\left(k_{i1}^*\right)^{\theta-1} = \gamma B_i\left(k_{i2}^*\right)^{\gamma-1} = r$$

If the equilibrium relative price in the steady state is smaller than the autarchic relative price for country i, $p < p_i$,

$$p\theta\left(k_1^*\right)^{\theta-1} < p_i\theta\left(k_1^*\right)^{\theta-1} = \gamma B_i\left(k_2^*\right)^{\gamma-1} = r$$

and the country specializes in manufactures: $q_{i1} = 0, q_{i2} > 0$. A similar argument shows that if $p > p_i$, the country specializes in agriculture: $q_{i1} > 0, q_{i2} = 0$. Since p_i is an increasing function of i, more technically advanced countries specialize in manufactures while less technically advanced countries specialize in primaries. The comparative advantage is driven by the TFP differential rather than by the relative capital endowment since in the long run capital per worker can be accumulated.

Market clearing, together with the Inada conditions, guarantee that there exists a country $\psi, 0 < \psi < 1$ such that

$$\int_0^1 C_{1i}di = \int_0^\psi q_{1i}di.$$

For such a country $p_\psi = p$ since for $i < \psi$, $p_i < p$ and for $i > \psi$, $p_i > p$.

Assuming the utility function for each period to be homothetic and calling α the parameter indicating the proportion of income spent in primaries, the steady state is characterized by the following equations:

$$\begin{aligned}
pC_{i1} &= \alpha\left[pq_{i1} + q_{i2} - (\lambda - 1 + \delta)K_i\right] \text{ for } i \in (0,1);\\
C_{i2} &= (1-\alpha)([pq_{i1} + qi_2 - (\lambda - 1 + \delta)\,K_i] \text{ for } i \in (0,1);\\
q_{i1} &= K_i^{\theta} \text{ for } i \in (0,\psi);\\
q_{i1} &= 0 \text{ for } i \in (0,\psi);\\
q_{i2} &= 0 \text{ for } i \in (\psi,1);\\
q_{i2} &= B_i K_i^{\gamma} \text{ for } i \in (\psi,1);\\
\int_0^1 C_{1i}di &= \int_0^{\psi} q_{1i}di;\\
p\theta K_i^{\theta-1} &= r \text{ for } i \in (0,\psi);\\
\gamma B_i K_i^{\gamma-1} &= r \text{ for } i \in (\psi,1);\\
p(1-\theta)K_i^{\theta} &= w \text{ for } i \in (0,\psi); \text{ and}\\
(1-\gamma)B_i K_i^{\gamma} &= w \text{ for } i \in (\psi,1).
\end{aligned}$$

From now onward we will refer to the modified depreciation rate as $\delta' = \lambda - 1 + \delta$.

The steady state level of capital K_i for all countries is as follows:

$$\begin{aligned}
K_i &= \left(\frac{p\theta}{r}\right)^{\frac{1}{1-\theta}} = K_1 \text{ for } i \in (0,\psi), \text{ and}\\
K_i &= \left(\frac{\gamma B_i}{r}\right)^{\frac{1}{1-\gamma}} \text{ for } i \in (\psi,1).
\end{aligned}$$

(The fact that capital is the same for all countries specializing in primaries follows from our assumption of equal TFP across countries in the first sector.)

Substituting production levels into consumption functions and these into the market clearing condition yields

$$\int_{i\in(0,\psi)} \frac{\alpha}{p}(pK_1^{\theta} - \delta' K_1)di + \int_{i\in(\psi,1)} \frac{\alpha}{p}\left(B_i K_i^{\gamma} - \delta' K_i\right)di = \int_{i\in(0,\psi)} K_1^{\theta} di. \quad (1)$$

Substituting countries' steady state levels of capital into equation (1), we obtain

$$\Phi\left(\bar{B}^{\frac{1}{1-\gamma}} - B_{\psi}^{\frac{1}{1-\gamma}}\right) = p^{\frac{1}{1-\theta}}\Omega\psi, \tag{2}$$

where Ω and Φ are parametric forms such that

$$\Omega = (1-\alpha)\left(\frac{\theta}{r}\right)^{\frac{\theta}{1-\theta}} + \alpha\delta'\left(\frac{\theta}{r}\right)^{\frac{1}{1-\theta}} > 0,$$

and

$$\Phi = \alpha\left(\left(\frac{\gamma}{r}\right)^{\frac{\gamma}{1-\gamma}} - \delta'\left(\frac{\gamma}{r}\right)^{\frac{1}{1-\gamma}}\right) > 0.$$

According to equation (2) p is a negative function of ψ.

The cutting point for the specialization, ψ, is the country for which the autarchic price and the global price coincide, or

$$p = \Psi B_{\psi}^{\frac{1-\theta}{1-\gamma}} \tag{3}$$

where Ψ is another parametric form, $\Psi > 0$ (see appendix **A**). According to equation (3), p is a positive function of ψ. Equations (2) and (3) yield the global price and the cutting point of specialization. These two variables are enough to characterize the steady state.

In the steady state of this model, for each country capital, investment and consumption of non-primaries grow at the factor λ. Consumption of primaries grow at the factor λ^{θ}. Output in countries producing non-primaries grows at the rate $\lambda - 1$ while in primaries producing countries grows at the rate $\lambda^{\theta} - 1$.

Since the cutting point of specialization ψ is constant, the number of countries producing either primaries or non-primaries is constant. Thus, global production of the second good grows at the factor λ while production of the first good grows at the factor λ^{θ}. The relative price of primaries, p, grows at the factor $\lambda^{1-\theta}$. That is, although in physical terms output grows faster in industrialized countries, in value terms output of both industrialized and non-industrialized countries grows at the same factor λ—the same factor than in a closed economy. Therefore, in value terms, global production of both primaries and non-primaries grows at the rate λ.

In value, global trade also grows at the rate λ. That means that the quantity traded of the second good grows at this rate and the quantity trade of the first good grows at the factor λ^{θ}.[4]

3 A product cycle

The above model reproduces what we consider to be important trends about the sectoral composition of global trade but, since ψ is constant, it misses one important fact: fewer and fewer countries are exporting only or mostly primaries. Thus, at this point we modify the model to introduce nonhomothetic preferences; more specifically, we assume the intratemporal utility function to be of the Stone-Geary form, $U(C_{1t}, C_{2t}) = \alpha \ln(C_{1t} - \eta) + (1 - \alpha) \ln C_{2t}$, with η denoting the minimum of primaries consumption.

"Detrending" the variables by the growth factors mentioned in the previous section, we can write the objective function in the following form $U(C^*_{1t}, C^*_{2t}) = \alpha \ln(C^*_{1t} - \eta^*_t) + (1 - \alpha) \ln C^*_{2t}$. The detrended consumption minimum, η^*_t, $\lim_{t\to\infty} \eta^*_t = 0$, is now time dependent: its value decreases constantly reflecting the smaller role played by the minimum of consumption as the economy develops. For a closed economy, we define a "steady state" (or an unbalanced growth path) as a situation in which the return to capital, r, remains constant, as in Kongsamut, Rebelo and Xie (2001).

For an open economy, we define an unbalanced growth path as a in situation in which there is a global return to capital r that remains constant; i.e., we maintain the Kongsamut, Rebelo and Xie's capital return constancy and add the condition that in detrended terms, wages and return to capital are the same across countries. Trefler (1993) shows that a weak form of Samuelson's factor price equalization theorem that allows for TFP differences across countries is consistent with observed cross-country variation in factor prices. Thus, we use Trefler's results to define the unbalanced growth path of an open economy. Moreover, we assume the constant rate of return to be the same as the rate of return in a closed economy. Our rationale is that the world as such, even if consisting of open economies, is a closed economy and therefore certain variables should behave as generated by a closed economy. Notice that our definition of an unbalanced growth path preserves

[4]Since when looking at data series we use constant US dollars and, therefore, constant relative prices, we would expect to see the value of primaries exports to grow at the factor λ^{θ} and the value of manufactures exports to grow at the factor λ.

three characteristics that we observe in the steady state of an open economy with homothetic differences—namely, **1)** that there exists a global rate of return (same for all countries); **2)** that this global rate of return is constant; and **3)** that the steady state rate of return is the same for a closed or an open economy: steady state global and autarchic returns are the same—even though with nonhomothetic preferences none of these three conditions is imposed. Our approach here is similar to Kongsamut, Rebelo and Xie (2001). It also resembles Ventura's (1997).

Appendix **B** shows that this steady state (more properly, an unbalanced growth path) exists for a closed economy with many of the detrended variables being time dependent: the detrended value of primaries production decreases while the detrended value of non-primaries production increases. In other words, production of manufactures grows at a factor greater than λ and production of primaries grows at a factor smaller than λ^{θ}, since these are the factors by which we detrend the variables. The proportion, in value terms, of the two goods is not constant since the relative price is growing at the factor $\lambda^{1-\theta}$.

From the rest of the section we drop the asterisks to denote detrended variables. Likewise, we drop the subindex t to denote unbalanced growth variables that are not time dependent although we will maintain it for variables that are time dependent at the unbalanced growth path.

Given the definition of an unbalanced growth path in an open economy, the above arguments about specialization in the steady state are still valid: more technically advanced countries specialize in manufactures while less technically advanced countries specialize in primaries; and there exists a country ψ for which the global price of primaries equals the relative price primaries would convey in autarchy. Thus, level of capital and production for countries specializing in primaries and non-primaries are as above. However, the representative consumer in each country consumes according to the following equations:

$$\begin{aligned} p_t C_{i1t} &= \alpha(p_t q_{i1} + q_{i2} - \delta' K_i) + p_t(1-\alpha)\eta_t, \text{ and} \\ C_{i2t} &= (1-\alpha)(p_t q_{i1} + q_{i2} - \delta' K_i) - (1-\alpha)p_t\eta_t. \end{aligned}$$

Once again, we substitute production levels into consumption functions and these into the market clearing condition. We further substitute countries' steady state levels of capital into the market clearing condition to obtain

$$\Phi\left(B^{-\frac{1}{1-\gamma}} - B_{\psi_t}^{\frac{1}{1-\gamma}}\right) + (1-\alpha)p_t\eta_t = p_t^{\frac{1}{1-\theta}}\Omega\psi_t. \tag{4}$$

According to equation (4), p_t is not always a negative function of ψ_t.

As before, the cutting point for the specialization, ψ, is the country for which the autarchic price and the global price coincide, or

$$p_t = \Psi B_{\psi_t}^{\frac{1-\theta}{1-\gamma}}. \tag{5}$$

According to equation (5), p_t is a positive function of ψ_t. Equations (4) and (5) constitute an implicit system that determines the global price and the cutting point of specialization which, since they depend on η_t, will be time dependant as well. Because the only difference between this system and the one in the previous section is the term $(1-\alpha)p_t\eta_t$ in equation (4) and this term goes to zero as time goes by, the system tends to the one in the previous section: p_t and ψ_t tend to p and ψ in the previous section.

As time goes ψ_t decreases (i.e., it tends to ψ from above).[5] Thus, the measure of countries specializing in primaries ψ decreases as the importance of the minimum of consumption decreases. Equation (5) shows that, unlike in the closed economy case, the detrended price of primaries decreases as well; i.e., the relative price of primaries grows at a factor lower than $\lambda^{1-\theta}$ since this is the factor by which we detrend the relative price.

In an open economy, unlike in a closed economy, the detrended value of production within each country remains constant or within each country physical output grows at a steady rate: this rate is $\lambda - 1$ for manufacturing exporters and $\lambda^{\theta} - 1$ for primaries exporters. The global economy adjusts quantities by adjusting the measure of countries producing one or the other good; thus, at a global level, production and consumption of manufactures grows faster than λ and production and consumption of primaries grows slower than λ^{θ}—same as production of a closed economy—and, once again, proportion of the two goods, even in value terms, is not constant.

For the primaries exporting countries, not only physical production grows at a lower rate than that of non-primaries exporters, but the same can be said of production growth in value terms since the relative price grows at a factor lower than $\lambda^{1-\theta}$. It should be emphasized that, although higher growth usually implies higher welfare in a closed economy, this is not necessarily the

[5] To prove the claim, and since equation (5) is increasing, one only needs to show that a decrease in η_t shifts curve (4) inwards. Suppose, by way of contradiction, that for each fixed p_t in (4), a decrease in η_t increases ψ_t: the right-hand side of (4) increases but the left hand side decreases, which violates equation (4). Therefore, the curve (4) shifts inwards for a decrease in η_t resulting in a decrease in both p_t and ψ_t.

case in an open economy: Echevarria (2000) shows how their period-by-period "gains from trade" more than compensate for a lower growth rate.

4 Sectoral composition of global trade

According to the model, economic growth, along with non-homothetic preferences, leads to a decreasing importance of primaries in global trade: as the global economy becomes richer, world consumption moves towards manufactured goods. This section constitutes an empirical investigation of this relationship, exploring the degree to which observed trade patterns are consistent with the model.

A few words must be added in linking the empirical results presented in this section to the theoretical results of the previous section. The model, with two homogenous tradable goods, implies that the country exports only that good which is comparatively advantageous to produce. Therefore, a primaries-oriented country refers to a country exporting exclusively non-manufactured goods, when indeed no such country can be found. Our simple model provides no explanation for the large amount of trade in differentiated products within the two extremely broad categories used. Trade orientation in the above analysis is meant to reflect the relative importance of each sector in actual trade. In this section, we use the relative shares that the two aggregates represent in total exports as a criterium for a country's trade orientation.

Likewise, the model hypothesizes a relationship between trade specialization and the relative technological level. Since growth models posit a relation between technological level and per capita income,[6] we use per capita income as a proxy for technical level.

4.1 The data

The following examination of global trade patterns draws upon data taken from WBEA, an electronic database published by Statistics Canada which converts world data from the original SITC classification to an industry-based classification system making use of the categories created by the Bureau of

[6]The relation between technical level and income in this model is incomplete (all primaries-exporters enjoy the same income) because of our normalizing TFP in the first sector to 1.

Economic Analysis (BEA) of the US Department of Commerce. The data set spans over 22 years, and consists of bilateral trade data for 165 countries. The WBEA trade statistics are organized according to 34 manufacturing sectors and a 35th "non-manufacturing" group, which more or less corresponds to primary exports, but not entirely so.

4.2 Global trends

Trends in the total value of trade (measured in constant 1995 US dollars) for manufactures and primary commodities are presented in Figure 1. As might be expected, the value of total world trade has risen rather dramatically over the 1970-92 period. Save for a short period of decline during the 1982-85 period, the steady climb in world trade has meant a near fourfold increase in its total value, from $1.1 Trillion to $4.1 Trillion. This is compared to a more modest rise in world production, measured in terms of aggregate GDP (World Bank 2001), rising from $13.2 Trillion to $27.1 Trillion. Thus exports account for an increasing proportion of overall production and income, rising from approximately 8% of global income in 1970 to 15% in 1992.

This increase in the proportion of trade in overall income, however, can be attributed almost entirely to rising production and trade of manufactures. World primary commodity exports have more than doubled in absolute terms (from $336 Billion to $695 Billion), while its relative share in total exports has declined. Similarly, aggregate value-added in agriculture as a share of total world GDP has declined in similar proportions over this period. What one finds is that manufactures make up a rising proportion of overall trade (Figure 2). The precise shares of manufacturing in total trade over the past few decades will vary depending on how the category is defined (i.e. whether processed agricultural goods are included), but the observed trend is unaffected. (for more details, see Hajzler 2003).

The model predicts that the relative price of primaries should be growing. If the world were at a steady state, according to section 2, the global relative price of primaries should grow at the rate $\lambda^{1-\theta} - 1$, where θ is the capital share of income in the first sector. We use Echevarria's (1997) productivity growth estimates for 13 OECD countries to form loose predictions regarding the trend in the relative price of primaries. Given productivity growth in each sector of 1.4% and 0% (corresponding to a $\lambda = 1.023$ in our model), the expected rise in the relative price of primaries is an annual 1.3%.

We attempt to verify this prediction using United Nations producer price

Figure 1: Patterns of Global Trade – Value of Exports (constant 1995 US dollars)

Figure 2: Sector Shares in Global Exports

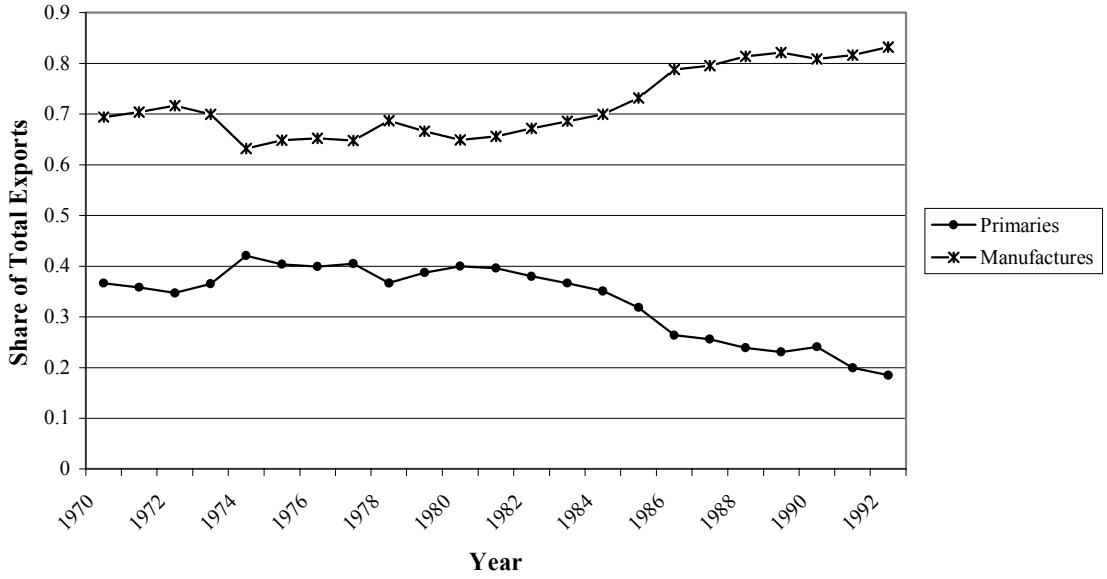


Figure 3: Relative Price of Primaries (1990 = 100)

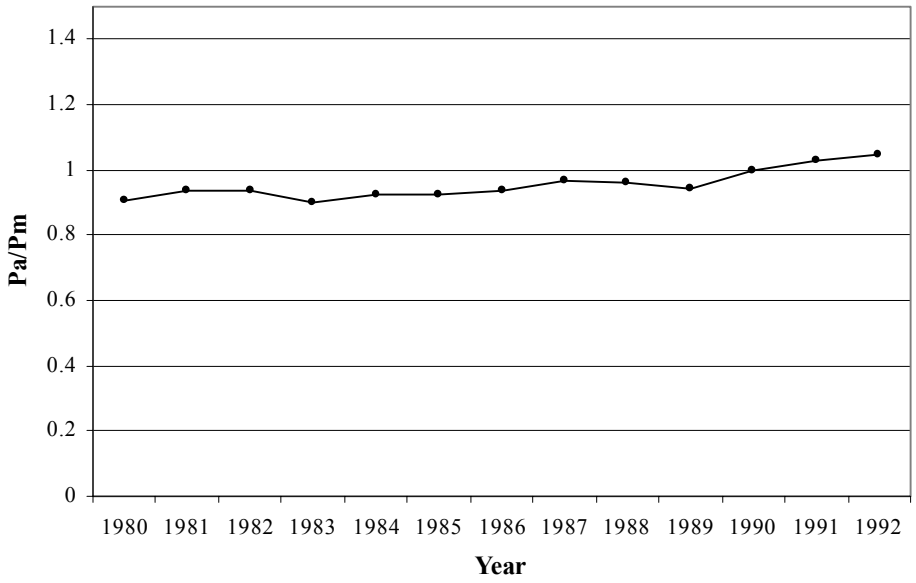
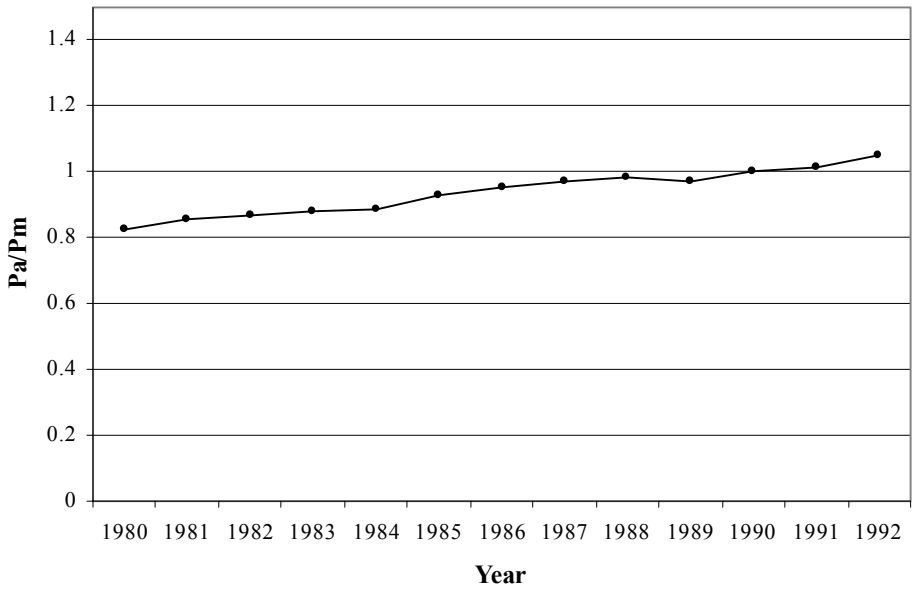


Figure 4: Relative Price of Primaries (OECD)



index statistics for 24 countries, the trend in the relative price of primaries in terms of manufactures presented in Figure 3. It is worthwhile to note that the predicted and actual global price movements, apart from corresponding to different time periods, are based on a different sample of countries. To attempt to correct for the discrepancy in cross-sectional data, averages are calculated again restricting the sample to nine OECD countries, which do not include Denmark, Finland, France, and Norway. The resulting relative price trend is presented in Figure 4.

These figures indicate that the relative rise in the producer price is more pronounced for OECD countries. A comparison of the estimated average annual growth rates for the two sample groups, 1.2% for all 24 countries and 2.0% for the OECD sample, reveals that our predicted growth rate in the relative price of primaries lies within the estimated rates of increase.

4.3 Countries trends

The objective of this subsection is to conduct an examination of export trends at the country level and to explore some of the underlying characteristics that explain the observed differences in trade orientation. A survey of world trade data shows that there exists a number of countries whose exports consist almost exclusively of primary products throughout the sample period. Based on the preceding analysis of the rising share of manufactured goods in global trade, it is evident that such countries are few in number and combined size in comparison to the overwhelming number of countries gradually shifting away from primary trade. However, there exits a handful of countries moving away from manufactures exports into more specialized primary commodity trade. Such trends are interesting from the point of view of the contrasting global patterns of development and trade conjectured above. Finally, there are also those countries that can be classified as predominantly manufactured commodity exporters at the beginning of the 1970-92 period and whose composition of exports has not significantly changed.

4.3.1 Countries' Classification

Of the 163 countries for which WBEA trade data is available, 71 or 44% were primaries exporters (the share of primaries in the total value of exports exceeds 50%) in 1992 and 92 or 56% were manufactures exporters. In sorting

the sample of countries, it is desirable to not only distinguish between manufacturing and non-manufacturing oriented countries but between those that are characterized by increasing or decreasing relative importance of manufactures in total trade. We separate countries according to **a**) whether they have "switched" from being predominantly primary commodity exporters in 1970 to exporting mostly manufactured goods in 1992, **b**) whether they have moved in the opposite direction, **c**) whether they export predominantly primaries at the beginning and end of the period, and **d**) whether they remain relatively specialized in manufactured commodity trade. The corresponding list of countries according to this classification is given in Table A1 of the appendix. Of the 163 countries, 67 or 41% were primaries exporters all throughout the period; 32 or 20% were manufactures exporters during the whole period; 37% switched from being mainly primary exporters to being mainly manufactures exporters; and only 4 or 2% switched from being manufacturing exporters to being primary commodities exporters.

This method is a rather crude generalization of actual trade trends since countries with relative trade shares above or below the 50% threshold during the whole period are lumped into the "primaries to primaries" or "manufactures to manufactures" categories even when they show a significant increase or decrease in the share of primaries. Therefore, we try an alternative approach to classify country trade trends. For each of the countries in the sample, we fit a linear trend in the share of primary commodities in total exports and test for statistical significance at the 5% level. Those countries with a statistically significant positive trend are labeled as MP (Manufactures to Primaries), indicating the direction of specialization over time; and those with a negative trend are labeled as PM (Primaries to Manufactures) countries. The remaining countries—without any observed trend—are divided as before into two groups corresponding to trade orientation at the beginning of the period: countries whose share of primaries in total exports exceeds 50% in 1970 are classified as PP (Primaries to Primaries) and those characterized by less that 50% in 1970 are MM (Manufactures to Manufactures) countries. The alternative country grouping is given in Table A2 of the appendix, and the corresponding regression estimates are provided in Table A3.

The trade of a country small in size may represent an insignificant amount of global trade. In such circumstances small movements in world prices for traded goods could conceivably generate large fluctuations in the relative shares of total exports that each commodity group represents. Following Chenery and Syrquin (1975), we avoid the potential bias in aggregate esti-

mates caused by such variation by simply omitting small "splinter countries" from the analysis. The criterion used to identify this group of countries is those countries with a labour force of less than one million workers in 1990, as reported by the World Bank (2001).

We omit a second group of countries on the basis of the relative importance of petroleum products in total exports. The WBEA database includes petroleum in the non-manufacturing commodity category, and as a result long-run dependence on oil production and trade will be reflected in a large share of primaries in total exports. The reason for excluding this group from the analysis is twofold: **i**) production and exports of OPEC members is largely controlled by coordinated government decision making, and **ii**) unlike most agricultural products, the country at which petroleum is produced is entirely determined by geographical circumstances, and therefore changes in global demand for oil will be reflected almost entirely in the exports of the relatively small groups of countries where production is most highly concentrated. Because this study is not directly concerned with the isolated patterns of petroleum trade, countries excluded include OPEC members and other net petroleum exporters.[7]

Each country omitted from the initial sample (splinter countries and net oil exporters) is identified by category in Table A2. Note that this omission leaves 142 countries in the sample.

The new classification identifies the overwhelming number of countries that conform to the conjectured pattern of increased manufactured commodity trade: 75 out of 142 (53%). Among the 13 (9%) countries characterized by the opposite trend in the composition of exports, the most marked rise in the share of primary commodity exports has occurred in Bolivia and Chile (see Table A3 in the appendix), countries that went through an important trade policy reform during the period considered. The remaining countries in this group have displayed a much more modest increase in the primary share, and in some cases the large variation in annual sectoral shares casts some doubt on whether they show any long-run trend. For countries that display gradual movement toward manufacturing trade, however, the trend is generally much more pronounced, and significant inter-period fluctuations are only a concern in a few cases such as Gambia and Nepal. Of the remaining 54 countries which show no trend, 33 (23%) were primaries exporters

[7]OPEC and net petroleum exporters are as listed in the Energy Information Administration (2001)

throughout the period and 21 (15%) were manufacturing exporters during the period.

The average shares of primary commodities in total exports for each country group and five sub-periods are presented in Table 1. The upper portion of the table is based on averages for the entire sample, which varies in size depending on availability of data in each period.[8] The lower segment, listing averages derived from only those countries for which data is available over the entire 1970-92 period, is included since these averages provide a more accurate description of inter-period differences.

Table 1

Share of Primaries in Total Exports: Entire Sample					
Period	1970-74	1975-79	1980-84	1985-89	1990-92
Sample	[119]	[119]	[130]	[130]	[130]
Primaries-Primaries	0.829	0.833	0.849	0.828	0.794
Primaries-Manufactures	0.618	0.603	0.551	0.464	0.360
Manufactures-Primaries	0.603	0.640	0.697	0.719	0.705
Manufactures-Manufactures	0.424	0.387	0.436	0.418	0.280
Share of Primaries in Total Exports: Compatible Sample					
Period	1970-74	1975-79	1980-84	1985-89	1990-92
Sample	[119]	[119]	[119]	[119]	[119]
Primaries-Primaries	0.829	0.843	0.860	0.837	0.805
Primaries-Manufactures	0.618	0.590	0.523	0.436	0.342
Manufactures-Primaries	0.603	0.640	0.697	0.719	0.705
Manufactures-Manufactures	0.424	0.384	0.422	0.404	0.273

The table shows the expected result of relatively higher composition of primaries in total exports for the PP group in each sub-period when compared to the other groups, while the opposite is true of the manufactures oriented countries. The PM group is characterized by a rapid decline in the share of primaries, falling to less than 60 percent of its initial 1970-74 level by the end of the sample period. Beginning with a roughly equal share of primaries in total exports, the MP group is characterized by a much more gradual increase in this share, and indicates a slight drop in the share of primaries in the final sub-period. This drop in the relative share of primary exports for the 1990-92 period is noted in the first country category as well, and

[8]The sample size listed for each sub-period refers to number of countries at the beginning of the period.

reflected in the relatively sharp decline in the primary export share among the manufactures oriented countries

4.3.2 Resource Endowments

Availability of resources is an important determinant of a country's comparative advantage. While accumulation of physical and human capital is related to the process of economic growth and development, natural resources cannot be accumulated and different countries vary in the availability of natural resources. Although for the sake of simplicity the theoretical model does not include natural resources, we feel the need to account for the difference in natural resources endowments in the empirical test of the model—a country rich in natural resources would arguably export more primaries than other country at comparable level of development but poorer in natural resources.

The data set used was constructed by Maskus and Penubarti (used in their 1995 article) and contains factor endowment data for all the countries in the *Penn World Tables* from 1970 to 1990. Arable land and the area of forests and woodland, measured in thousands of hectares, are taken from the FAO Production Yearbook. The standard approach to comparing relative endowments is to consider factor ratios; i.e. hectares of arable land and forests and woodland per worker. Measures of endowments are presented here as ratios over the total number of workers reported by the World Bank (2001). Tables 2 and 3 report average factor endowment ratios for each group and sub-period. Table 2 uses the entire sample while Table 3 refers to a compatible sample.

Comparing group averages provides weak evidence that trade in primaries is driven by a country's stock of arable land, while the evidence is somewhat stronger for forest and woodland resources. It is interesting to note the particularly rapid decline in forest area per worker, representing the relatively non-renewable resource, especially among the PP and MP groups. This suggests that a large volume of trade in primaries is achieved through the intensive use of resources that are relatively fixed in supply.

Table 2

Factor Endowments: Entire Sample						
Arable Land/Worker	Period	1970-74	1975-79	1980-84	1985-89	1990
	Sample	[51]	[61]	[60]	[62]	[63]
Primaries-Primaries		1.07	0.97	0.86	0.78	0.69
Primaries-Manufactures		1.22	1.13	1.05	0.96	0.87
Manufactures-Primaries		0.87	0.89	0.86	0.81	0.67
Manufactures-Manufactures		0.67	0.64	0.60	0.57	0.46

Forest Area/Worker	Period	1970-74	1975-79	1980-84	1985-89	1990-92
	Sample	[59]	[61]	[62]	[62]	[63]
Primaries-Primaries		3.47	2.79	2.24	1.86	1.63
Primaries-Manufactures		4.25	3.52	3.09	2.57	2.49
Manufactures-Primaries		10.81	8.80	7.60	6.45	5.45
Manufactures-Manufactures		1.54	1.46	1.39	1.34	1.30

Table 3

Factor Endowments: Compatible Sample						
Arable Land/Worker	Period	1970-74	1975-79	1980-84	1985-89	1990
	Sample	[52]	[52]	[52]	[52]	[52]
Primaries-Primaries		1.06	0.95	0.85	0.77	0.72
Primaries-Manufactures		1.22	1.11	1.02	0.95	0.86
Manufactures-Primaries		0.87	0.89	0.86	0.81	0.67
Manufactures-Manufactures		0.67	0.64	0.60	0.57	0.46

Forest Area/Worker	Period	1970-74	1975-79	1980-84	1985-89	1990-92
	Sample	[57]	[57]	[57]	[57]	[57]
Primaries-Primaries		3.53	2.80	2.33	1.94	1.68
Primaries-Manufactures		4.25	3.57	3.12	2.64	2.58
Manufactures-Primaries		10.46	8.80	7.60	6.45	5.45
Manufactures-Manufactures		1.54	1.46	1.39	1.34	1.30

4.4 Growth and trade composition

This sub-section examines how the level of development affects the composition of trade and, conversely, how trade orientation affects growth in income. Measures of annual GDP growth and average per capita GDP in each group

are presented in Tables 4.6 and 4.7, based on entire sample and compatible sample estimates respectively. At the outset, one notes highest average annual growth for the PP group in the first period, while falling below that of the PM category in later periods. Annual per capita GDP growth for the MM group follows close behind the PP countries in the earlier periods. However, the higher average growth in the primaries-oriented group is not sustained over the entire period. These findings, together with the fact that lowest average growth is experienced by the MP countries in almost every sub-period, are roughly consistent with the implications of the model concerning lower growth rates for primaries-exporting countries.

Table 4

Average Annual Growth in Real GDP per Capita (1995 US dollars)					
Period	1970-74	1975-79	1980-84	1985-89	1990
Sample	[111]	[111]	[132]	[132]	[132]
Primaries-Primaries	3.268	2.149	0.387	0.598	0.247
Primaries-Manufactures	2.507	2.895	0.894	1.919	0.633
Manufactures-Primaries	2.007	1.822	-2.104	-0.375	1.479
Manufactures-Manufactures	3.094	1.282	0.645	1.767	-0.962
Average - All Groups	2.708	2.446	0.484	1.400	0.427
Average GDP per Capita (1995 US dollars)					
Period	1970-74	1975-79	1980-84	1985-89	1990-92
Sample	[111]	[111]	[132]	[132]	[132]
Primaries-Primaries	1,797	2,145	2,373	2,297	2,371
Primaries-Manufactures	6,316	7,145	7,053	7,288	7,904
Manufactures-Primaries	915	981	929	918	1,055
Manufactures-Manufactures	9,462	10,409	11,449	11,547	10,863
Average - All Groups	5,315	6,006	6,019	6,172	6,455

Consistent with the model, each group of countries can also be roughly categorized according to different stages of development on the basis of per capita income. Countries specialized or moving toward increased specialization in primaries represent the lowest income groups, while countries specialized or moving towards increased manufactured commodity trade are those with relatively high per capita incomes.

Table 5

Average Annual Growth in Real GDP per Capita (1995 US dollars)					
Period	1970-74	1975-79	1980-84	1985-89	1990
Sample	[89]	[89]	[89]	[89]	[89]
Primaries-Primaries	3.507	2.308	0.434	0.598	0.511
Primaries-Manufactures	2.500	2.378	0.798	2.132	1.094
Manufactures-Primaries	2.041	1.584	-2.133	0.373	-0.427
Manufactures-Manufactures	3.094	1.282	0.645	1.712	-1.334
Average - All Groups	2.769	2.145	0.458	1.589	0.506
Average GDP per Capita (1995 US dollars)					
Period	1970-74	1975-79	1980-84	1985-89	1990-92
Sample	[89]	[89]	[89]	[89]	[89]
Primaries-Primaries	1,880	2,247	2,271	2,370	2,561
Primaries-Manufactures	6,182	6,849	7,466	8,311	9,037
Manufactures-Primaries	968	1,026	1,065	1,052	1,141
Manufactures-Manufactures	10,090	11,098	12,448	13,777	13,743
Average - All Groups	5,398	6,001	6,550	7,234	7,675

4.5 Estimations

In this section a more accurate depiction of global trade patterns is gained from a series of regression equations. The model hypothesizes a relationship between trade specialization and the relative technological level. To capture the hypothesized relationship, we regress composition of trade on per capita income, denoted by $ln(y)$. The net effect of rising per capita income on the primaries share is expected to be negative. We estimate this relationship using panel data.

As explained above, we expect natural resources endowments to partially account for the observed differences in the "development timing" (understood in this context as level of per capita income) of the change in the sectoral composition of trade. Thus, we estimate the following log-linear regression:

$$S_{pit} = \alpha_i + \beta_1 \ln y_{it} + \psi_1 \ln(arable_{it}) + \psi_2 \ln(forest_{it}) \tag{6}$$

where $i = 1, ..., N$ refers to the number of countries in the sample, and $t = 1, ..., T$ is a given year between 1970 and 1992. The variables Sp, y, $arable$

and $forest$ represent the primaries share in total exports, per capita income, arable land per worker, and forest area per worker respectively. We also allow for non-linearity of relation between trade composition and income by running a second regression which incorporates a quadratic term in income,

$$S_{pit} = \alpha_i + \beta_1 \ln y_{it} + \beta_2 (\ln y_{it})^2 + \psi_1 \ln(arable_{it}) + \psi_2 \ln(forest_{it}). \quad (7)$$

We allow each country to have a separate intercept, α_i, because the theoretical model implies that the level of income at which the change in the sectoral composition of trade occurs depends on the relative technological level: the more advanced technological countries start "industrializing" at lower levels of per capita income; the late comers go through this process at much higher levels of income (if at all).[9]

The the composition of exports is affected by the interrelation between domestic income and global income affects and, thus, we should add world income as an explanatory variable. Yet one would expect problems due to the close association between individual countries' and world's income movements. However, if due to nonhomothetic preferences, global demand for primaries is declining relative to manufactures and in turn affecting the structure of trade, one would expect the average share of primaries in trade to be lower in later periods for any given level of development. We add a time trend to capture the effect of changing global demand on the composition of exports. The modified regression equation becomes

$$S_{pit} = \alpha_i + \beta_1 \ln y_{it} + \beta_2 (\ln y_{it}) + \psi_1 \ln(arable_{it}) + \psi_2 \ln(forest_{it}) + \phi t. \quad (8)$$

The results of the regressions are reported in Table 6.

There is not much difference between the results of the log-linear regression and the one with a quadratic term. The estimated coefficients with a quadratic term indicate an sharper decline in the primary export share at low levels of income, with the positive effect of the squared term capturing the tendency of the primary share to taper off as income rises.

[9]For the purpose of comparison, we run a regression restricting the constant α to be the same for all countries. As expected, the common coefficient model does not perform especially well, suggesting that while countries will on average move towards trade in manufactured goods, the "development timing" of this movement will indeed differ across countries.

Table 6

	Regression 1	Regression 2	Regression3
$\ln y$	-0.1077**	-0.3540**	-0.3307**
$(\ln y)^2$		0.0159*	0.0184**
$\ln(arable)$	0.1256**	0.1376**	0.0910**
$\ln(forest)$	0.0308**	0.0305**	0.0013
t			-0.0044**
Adjusted R^2	0.916	0.917	0.919
Cross-sectional observations	53	53	53

* indicates significance at the 0.05 level.

** indicates significance at the 0.01 level.

Both resource variables influence positively and quite significantly the primaries export share. When the time trend is added, however, $forest$ shows no apparent effect on trade orientation. This result is not unusual in light of our previous observation that forest area per worker, despite its positive effect on primaries trade, is being diminished on average with time (see Tables 2 and 3). Since a declining average endowment of forest area per worker implies a relative fall in primary exports over time, the negative time trend coefficient is now capturing much of this correlation.

The time trend is highly significant and has the expected sign. Another important implication of including the time trend is the change in the significance and magnitude of the income coefficients. With the inclusion of the time trend the income estimates are even more highly significant, yet the estimated negative relationship is dampened slightly as a result of the expected correlations between per capita income and time, on one hand, and time and the relative demand for primaries, on the other.

5 Conclusions

The main purpose of this study has been to explore the interrelations between economic growth and the changing composition of global trade. By studying patterns of development for over 140 countries, the analysis has attempted to explain observed patterns in the respective shares of manufactured and non-manufactured commodity trade in the context of a dynamic perspective of comparative advantage.

In general, growth in agricultural and raw-material exports has not kept pace with the massive rise in manufactured commodity trade over the 22 year period examined. At the global level, the relative share of primaries in world exports has declined from near 40 percent in 1970 to a mere 20 percent of total trade, with exports from the manufacturing sectors accounting for the remaining volume of global trade. Underlying this shift in the composition of world trade is an overwhelming number of individual countries moving towards increased exports of manufacturing goods; this trend is observed almost universally across countries, irrespective of the initial trade orientation, as the economy develops. In fact, the peculiar tendency of some countries to either move in a direction opposite to the world average or to sustain relatively high shares of primary exports in the time-series data can be explained in terms of low or negative growth in many countries, although a few countries prevailed in showing an upward trend explained by a change in trade policy.

This gradual transformation in the composition of global trade is explained in part by the fact that as incomes rise internationally, world consumption demand for manufactured goods increases relative to that of primary products.

During the period considered trade, in percentage terms, almost doubled from representing 8% to 15% of global GDP. Part of the increase has been due to a movement towards a more open trading system at the global level. However, this movement has not been unbiased—trade liberalization has been strongest concerning non-agricultural products, especially on the side of industrialized countries. The question that arises is how this bias affects the results of this paper concerning the sectoral transformation of global trade. The other factor probably affecting the sectoral composition of trade is that product differentiation may conceivably be more important in non-primaries than in primaries.

APPENDIX

A A closed economy with homothetic preferences

In a closed economy, the representative consumer maximizes

$$\sum_{t=1}^{\infty} \beta^t U(C_{i1t}, C_{i2t})$$

subject to

$$\begin{aligned} C_{i1t} &= K_{i1t}^{\theta} L_{i1t}^{1-\theta}, \\ C_{i2t} + I_{it} &= B_i \lambda^{(1-\gamma)t} K_{i2t}^{\gamma} L_{i2t}^{1-\gamma}, \\ K_{i1t} + K_{i2t} &= K_{it}, \\ L_{i1t} + L_{i2t} &= 1, \text{ and} \\ K_{i,t+1} &= (1-\delta) K_{it} + I_{it}. \end{aligned}$$

At the steady state, the return to capital r should equal $\lambda/\beta - (1-\delta)$.

Equilibrium in the capital and labour markets requires

$$\frac{1-\theta}{\theta} k_{i1} = \frac{1-\gamma}{\gamma} k_{i2}$$

where $k_{ij}, j = 1, 2$, refers to the capital/labour ratio in each sector. The condition that the marginal product of capital be equal to r in the second sector yields a value for the capital/labor ratio in the second sector

$$k_{i2} = \left(\frac{B_i \gamma}{r} \right)^{\frac{1}{1-\gamma}}.$$

Therefore,

$$k_{i1} = \frac{\theta}{1-\theta} \frac{1-\gamma}{\gamma} \left(\frac{B_i \gamma}{r} \right)^{\frac{1}{1-\gamma}};$$

i.e., the capital/labour ratio in both sectors depends positively on the TFP in the second sector, B_i. The condition that the marginal product of capital be equal to r in the first sector shows that the relative price at the steady state in a closed economy p_i

$$p_i = \frac{r}{\theta} k_{i1}^{1-\theta}$$

is a positive function of B_i.

Assuming B_i to be a strictly increasing function of i, p_i is a strictly increasing function of i,

$$p_i = \frac{r^{\frac{\theta-\gamma}{1-\gamma}}}{\theta^{\theta}} \left(\frac{(1-\gamma)}{1-\theta} \gamma^{\gamma/(1-\gamma)} \right)^{1-\theta} B_i^{\frac{1-\theta}{1-\gamma}} = \Psi B_i^{\frac{1-\theta}{1-\gamma}},$$

where $\Psi > 0$. The autarchic relative price of primaries is higher the higher the TFP in the second sector—the autarchic relative price is higher for more technically advanced countries. These are "detrended" prices: autarchic relative prices grow at the factor $\lambda^{1-\theta}$; but at each period the price is higher for more advanced countries.

Substituting equation (3) into equation (2) in the text we obtain an implicit equation for the value of ψ,

$$f(\psi, \alpha) = \Phi(\bar{B}^{1/(1-\gamma)} - B_{\psi}^{1/(1-\gamma)}) - \Psi^{1/(1-\theta)} B_{\psi}^{1/(1-\gamma)} \Omega\psi = 0.$$

This implicit equation shows that the cutting point for specialization ψ depends only on parameters and, therefore, is constant—it does not change with the level of technology. Since $d\Phi/d\alpha > 0, d\Omega/d\alpha < 0$ and $d\Psi/d\alpha = 0, \delta f/\delta\alpha > 0$. Therefore, according to the implicit function theorem and since $\delta f/\delta\psi < 0$.

$$\frac{d\psi}{d\alpha} = -\frac{\delta f/\delta\alpha}{\delta f/\delta\psi} > 0;$$

i.e., in the steady state , the larger the proportion of consumer' budget spent in primaries the larger the measure (or proportion) of countries that specialize in primaries and the larger the (detrended) relative price of primaries.

B A closed economy with nonhomothetic preferences

The variables in this section refer to variables detrended by the growth factors, as explained in the text.

As stated in the text, we define a steady state as a constant r as in Kongsamut, Rebelo and Xie (2001). A constant return of capital, as in the previous section, determines a non-time-dependent capital/labour ratio in both sectors, $k_j, j = 1, 2..$ The capital/labour ratios, together with the return to capital, determine a relative price p_i, also non-time-dependent. As in the previous section, the higher the technical level of the country, B_i, the higher the autarchic detrended price.

With the posed nonhomothetic preferences, at each period,

$$C_{i1t} = \frac{\alpha}{1-\alpha}\frac{1}{p_i} C_{i2t} + \eta_t = \varepsilon_i C_{i2t} + \eta_t$$

Thus, the unbalanced growth path is characterized by the following system:

$$\begin{aligned}
\varepsilon_i C_{2it} + \eta_t &= k_1^\theta L_{i1t}, \\
C_{i2t} + \delta' K_{it} &= B_i k_2^\gamma L_{i2t}, \\
L_{i1t} + L_{i2t} &= 1, \text{ and} \\
k_1 L_{i1t} + k_2 L_{i2t} &= K_{it}.
\end{aligned}$$

The system reduces to

$$\begin{aligned}
K_{it} &= k_1 - (k_1 - k_2) L_{i2t}, \text{ and} \\
\delta' K_{it} &= \eta_t/\varepsilon_i - k_1^\theta/\varepsilon_i + (B_i k_2^\gamma + k_1^\theta/\varepsilon_i) L_{i2t}.
\end{aligned}$$

The first equation states that K_{it} is a negative function of L_{i2t}, provided that primaries are more capital intensive than manufactures (see Hayami and Ruttan 1971 pp. 92-93 or Echevarria 1998). According to the second equation, K_{it} is a positive function of L_{i2t}. It is easily verifiable that a solution exists at each period of time. The solution changes with time—the whole system is time dependent because of η_t: L_{i2t} and, consequently C_{2it}, increase as time goes by. This means that L_{i1t}, and therefore C_{i1t} decrease. The level of capital K_{it} decreases, reflecting the fact that resources are moving toward the less capital intensive sector.

Since the variables are in detrended terms, in this unbalanced growth path, capital grows at a factor lower than λ, non-primaries grow at a factor higher than λ and primaries grow at a factor lower than λ^θ.

Because η_t tends to zero, the system tends to the system with homothetic preferences: a consequence of the Stone-Geary type of preferences by which the consumer behaves as one with homothetic preferences at high enough levels of income.

C Tables

Table 1: Countries' Classification

Group 1 (total =67)

Primaries - Primaries

Afghanistan	Kenya
Albania	Lybia
Algeria	Madagascar
Angola	Malawi
Argentina	Mali
Australia	Mauritania
Bahrain	Mongolia
Benin	Mozambique
Bolivia	Netherland Antilles
Br. Ind. Oc. Tr.	Nicaragua
Brunei	Nigeria
Burkina Faso	Paraguay
Burundi	Qatar
Cameroon	Reunion
Chad	Rwanda
Colombia	Saudi Arabia
Comoros	Senegal
Congo	Seychelles
Costa Rica	Somalia
Cote d'Ivoire	St. Helena
Cuba	St. Kitts Nevis
Ecuador	St. Pierre Miq
Egypt	Sudan
Ethiopia	Syrian Arab Rep
Gabon	Tanzania
Ghana	Togo
Greenland	Trinidad-Tobago
Guadeloupe	Uganda
Guatemala	United Arab Emirates
Guinea-Bissau	USSR (former)
Honduras	Vietnam
Iran	Western Sahara
Iraq	Yemen
	Zimbabwe

Group 3 (total = 4)

Manufactures - Primaries

Djibouti	Guyana
Lebanon	Norway

Group 2 (total = 60)

Primaries - Manufactures

Bahamas	Gibraltar	New Zealand
Bangladesh	Greece	Niger
Barbados	Haiti	Oman
Belize	Iceland	Panama
Bhutan	Indonesia	Papua New Guinea
Brazil	Ireland	Peru
Bulgaria	Jordan	Philippines'
Cambodia	Kiribati	Poland
Cayman Islands	Korea, DPR	Romania
Central African Rep	Kuwait	Sierra Leone
China	Laos	Singapore
Cyprus	Liberia	Solomon Islands
Czechoslovakia	Malaysia	South Africa
Dominican Republic	Maldives	Sri Lanka
El Salvador	Mauritius	Thailand
Eq. Guinea	Mexico	Tunisia
Falkland Isl	Morocco	Turkey
Fiji	Myanmar	Turks Caicos Isl
French Guiana	Nepal	Uruguay
Gambia	New Cledonia	Venezuela

Group 4 (total = 32)

Manufactures - Manufactures

Austria	Hong Kong	Portugal
Belgium-Luxembourg	Hungary	Spain
Bermuda	India	Suriname
Canada	Isreal	Sweden
Chile	Italy	Switzerland
Denmark	Jamaica	Taiwan
Finland	Japan	United Kingdom
France	Korea, Republic	United States
Germany	Malta	Yugoslavia (former)
Guinea	Netherlands	Zambia
	Pakistan	Zaire

SECTORAL COMPOSITION OF GLOBAL TRADE

Table 2: Country Groups by Trade Trends

Group 1 (total =34)
Primaries - Primaries

Western Sahara	Togo
Egypt	Burkina Faso
Cameroon	Greenland
Chad	St. Pierre Miq
Congo	Colombia
Gabon	Ecuador
Br. Ind. Oc. Tr.	Guatemala
Burundi	Honduras
Comoros	Nicaragua
Benin	Netherland Antilles
Kenya	Guyana
Mali	Bahrain
Nigeria*	Iran*
Guinea-Bissau	Syrian Arab Rep
St. Helena	Yemen
Senegal	Mongolia
Seychelles	Vietnam
Somalia	

Group 2 (total = 88)
Primaries - Manufactures

Lybia*	Dominican Republic	Singapore
Morocco	Guadeloupe	Thailand
Sudan	Haiti	Taiwan
Tunisia	St. Kitts Nevis	China
Eq. Guinea	Trinidad-Tobago	Denmark
Ethiopia	Turks Caicos Isl	France
Gambia**	Falkland Isl	Germany
Ghana	Panama**	Greece
Guinea	Isreal	Ireland
Liberia**	Japan	Italy
Madagascar	Cyprus**	Portugal
Mauritius**	Jordan	Spain
Mozambique	Oman**	Austria
Niger	Qatar*	Sweden
Reunion	Saudi Arabia*	Gibraltar
Rwanda	United Arab Emirates*	Malta
Zimbabwe	Turkey	Albania
Tanzania	Bangladesh	Bulgaria
Canada	Bhutan	Poland
United States	Brunei	Romania
Bermuda	Myanmar	Former Yugoslavia
Argentina	Sri Lanka	Former USSR*
Brazil	India	Australia
Peru	Indonesia*	New Zealand
Uruguay	Korea, Republic of	Solomon Islands
Venezuela*	Malaysia	Fiji
Costa Rica	Maldives	New Cledonia
Bahamas	Nepal	Papua New Guinea
Barbados	Pakistan	
Cuba	Philippines	

Group 3 (total = 16)
Manufactures - Primaries

Algeria*	Bolivia
Angola	Chile
Djibouti	Paraguay
Cote d'Ivoire	Suriname
Malawi	Iraq*
Mauritania	Lebanon
Uganda	Afghanistan
Zambia	Norway*

Group 4 (total = 24)
Manufactures - Manufactures

South Africa	Belize	Netherlands
Central African Rep	French Guiana	United Kingdom
Zaire	Kuwait*	Finland
Sierra Leone	Cambodia	Iceland
Mexico*	Hong Kong	Switzerland
El Salvador	Laos	Czechoslovakia
Cayman Islands**	Korea, DPR	Hungary
Jamaica	Belgium-Luxembourg	Kiribati

* indicates OPEC members and net petroleum exporters
** indicates countries with fewer than 1 million workers in 1990

Table 3: Regression Results for Country Trends – Share of Primaries in Total Exports Over Time (1970-90)

Primaries - Primaries				Primaries - Manufactures			
Country	Coefficien	T-statistic	P-value	Country	Coefficient	T-statistic	P-value
Bahrain	-0.0031	-1.539	0.139	Albania	-0.0031	-2.822	0.010
Benin	0.0018	0.511	0.615	Argentina	-0.0064	-4.436	0.000
Br. Ind. Oc. Tr.	0.0244	1.684	0.116	Australia	-0.0051	-4.021	0.001
Burkina Faso	-0.0072	-1.370	0.194	Austria	-0.0031	-9.564	0.000
Burundi	-0.0101	-2.133	0.053	Bahamas	-0.0172	-2.202	0.040
Cameroon	0.0010	0.394	0.698	Bangladesh	-0.0215	-6.822	0.000
Chad	0.0006	0.291	0.776	Barbados	-0.0132	-3.873	0.001
Colombia	-0.0031	-1.783	0.089	Bermuda	-0.0141	-2.383	0.027
Comoros	0.0002	0.037	0.971	Bhutan	-0.0259	-2.216	0.047
Congo	-0.0096	-1.860	0.088	Brazil	-0.0228	-24.277	0.000
Ecuador	-0.0028	-0.958	0.349	Brunei	-0.0105	-4.544	0.001
Egypt	-0.0021	-0.572	0.574	Bulgaria	-0.0308	-6.179	0.000
Gabon	0.0069	2.061	0.052	Canada	-0.0045	-3.887	0.001
Greenland	-0.0003	-0.281	0.782	China	-0.0166	-7.311	0.000
Guatemala	-0.0015	-0.903	0.377	Costa Rica	-0.0053	-4.693	0.000
Guinea-Bissau	-0.0021	-1.274	0.217	Cuba	-0.0086	-6.560	0.000
Guyana	0.0016	0.884	0.387	Cyprus**	-0.0250	-9.591	0.000
Honduras	0.0019	1.110	0.280	Denmark	-0.0043	-2.687	0.014
Iran*	-0.0006	-0.886	0.386	Dominican Republic	-0.0350	-9.217	0.000
Kenya	-0.0025	-1.716	0.101	Eq. Guinea	-0.0314	-7.431	0.000
Mali	0.0044	1.586	0.128	Ethiopia	-0.0045	-3.157	0.005
Mongolia	-0.0086	-1.651	0.123	Falkland Isl	-0.0233	-4.537	0.000
Netherland Antilles	-0.0010	-1.747	0.095	Fiji	-0.0167	-7.946	0.000
Nicaragua	-0.0028	-1.018	0.320	France	-0.0041	-6.985	0.000
Nigeria*	0.0004	1.183	0.250	Gambia**	-0.0206	-6.805	0.000
Senegal	-0.0004	-0.204	0.841	Germany	-0.0016	-3.727	0.001
Seychelles	-0.0018	-0.855	0.402	Ghana	-0.0122	-3.856	0.001
Somalia	0.0004	0.898	0.380	Gibraltar	-0.0318	-4.988	0.000
St. Helena	0.0253	2.138	0.052	Greece	-0.0100	-8.859	0.000
St. Pierre Miq	0.0068	1.830	0.081	Guadeloupe	-0.0087	-7.956	0.000
Syrian Arab Rep	-0.0063	-1.803	0.086	Guinea	-0.0057	-3.941	0.001
Togo	0.0002	0.118	0.907	Haiti	-0.0258	-14.011	0.000
Vietnam	-0.0009	-0.340	0.737	India	-0.0089	-4.531	0.000
Western Sahara	0.0021	0.110	0.914	Indonesia*	-0.0140	-4.725	0.000
Yemen	0.0023	0.651	0.528	Ireland	-0.0193	-16.139	0.000
				Isreal	-0.0084	-18.273	0.000
				Italy	-0.0038	-9.522	0.000
				Japan	-0.0042	-5.898	0.000
				Jordan	-0.0104	-5.360	0.000
				Korea, Republic of	-0.0085	-13.590	0.000
				Liberia**	-0.0349	-6.404	0.000

* indicates OPEC members and net petroleum exporters

** indicates countries with fewer than 1 million workers in 1990

Table 3: Cont.

Primaries - Manufactures Continued			
Country	Coefficien	T-statistic	P-value
Lybia*	-0.0024	-7.411	0.000
Madagascar	-0.0038	-4.128	0.000
Malaysia	-0.0143	-5.877	0.000
Maldives	-0.0327	-2.524	0.027
Malta	-0.0067	-9.101	0.000
Mauritius**	-0.0335	-23.641	0.000
Morocco	-0.0228	-18.529	0.000
Mozambique	-0.0181	-6.524	0.000
Myanmar	-0.0166	-5.643	0.000
Nepal	-0.0385	-12.085	0.000
New Cledonia	-0.0092	-2.578	0.018
New Zealand	-0.0150	-5.241	0.000
Niger	-0.0767	-5.325	0.000
Oman**	-0.0023	-3.081	0.006
Pakistan	-0.0086	-4.191	0.000
Panama**	-0.0165	-6.342	0.000
Papua New Guinea	-0.0107	-3.273	0.004
Peru	-0.0082	-3.263	0.004
Philippines	-0.0135	-4.552	0.000
Poland	-0.0292	-6.994	0.000
Portugal	-0.0062	-11.129	0.000
Qatar*	-0.0096	-3.937	0.001
Reunion	-0.0043	-3.969	0.002
Romania	-0.0173	-3.640	0.002
Rwanda	-0.0078	-3.665	0.003
Saudi Arabia*	-0.0096	-2.898	0.009
Singapore	-0.0195	-11.997	0.000
Solomon Islands	-0.0209	-2.662	0.021
Spain	-0.0073	-6.350	0.000
Sri Lanka	-0.0282	-16.818	0.000
St. Kitts Nevis	-0.0147	-5.444	0.000
Sudan	-0.0024	-4.530	0.000
Sweden	-0.0027	-7.273	0.000
Taiwan	-0.0086	-16.498	0.000
Tanzania	-0.0039	-2.830	0.010
Thailand	-0.0241	-10.863	0.000
Trinidad-Tobago	-0.0127	-6.529	0.000
Tunisia	-0.0245	-13.481	0.000
Turkey	-0.0327	-18.531	0.000
Turks Caicos Isl	-0.0398	-2.918	0.013
United Arab Emirates*	-0.0034	-6.065	0.000
United States	-0.0074	-11.077	0.000
Uruguay	-0.0136	-4.146	0.001
USSR (former)*	-0.0069	-5.127	0.000
Venezuela*	-0.0103	-7.827	0.000
Yugoslavia (former)	-0.0047	-9.725	0.000
Zimbabwe	-0.0224	-10.315	0.000

Manufactures - Primaries			
Country	Coefficient	T-statistic	P-value
Afghanistan	0.0038	3.632	0.002
Algeria*	0.0041	3.202	0.004
Angola	0.0067	4.149	0.000
Bolivia	0.0128	5.908	0.000
Chile	0.0151	7.000	0.000
Cote d'Ivoire	0.0080	6.518	0.000
Djibouti	0.0281	3.764	0.003
Iraq*	0.0061	2.652	0.015
Lebanon	0.0111	3.989	0.001
Malawi	0.0017	2.914	0.008
Mauritania	0.0012	2.888	0.009
Norway*	0.0177	6.320	0.000
Paraguay	0.0044	2.658	0.015
Suriname	0.0075	4.205	0.000
Uganda	0.0029	3.339	0.003
Zambia	0.0034	2.377	0.028

Manufactures - Manufactures			
Country	Coefficient	T-statistic	P-value
Belgium-Luxembourg	-0.0011	-1.049	0.306
Belize	-0.0048	-1.450	0.163
Cambodia	-0.0051	-1.016	0.322
Cayman Islands**	-0.0218	-1.463	0.169
Central African Rep	-0.0111	-1.661	0.123
Czechoslovakia	-0.0054	-0.767	0.452
El Salvador	-0.0035	-1.374	0.185
Finland	-0.0001	-0.180	0.859
French Guiana	-0.0093	-1.615	0.122
Hong Kong	-0.0003	-0.914	0.372
Hungary	0.0001	0.094	0.926
Iceland	-0.0109	-2.059	0.053
Jamaica	-0.0019	-1.345	0.194
Kiribati	0.0010	0.457	0.653
Korea, DPR	-0.0025	-0.807	0.429
Kuwait*	-0.0103	-1.663	0.112
Laos	0.0074	0.512	0.618
Mexico*	-0.0017	-0.398	0.695
Netherlands	-0.0026	-1.802	0.087
Sierra Leone	-0.0065	-1.244	0.228
South Africa	-0.0030	-0.912	0.373
Switzerland	-0.0001	-0.257	0.800
United Kingdom	0.0035	1.870	0.076
Zaire	-0.0017	-0.497	0.624

* indicates OPEC members and net petroleum exporters

** indicates countries with fewer than 1 million workers in 1990

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