The rise of China and India and the commodity boom: economic and environmental implications for low-income countries

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Abstract
The rapid growth of China and, more recently, of India, is having major effects on every facet of the global economy, including the environment, and this influence is projected to continue to expand in the foreseeable future. The growth of these two 'giants' in the developing world has produced a massive surge in manufacturing and services exports as well as in imports of both intermediates and primary commodities.

In manufactures, even as competitive pressures have sharpened in labor-intensive export sectors, new growth opportunities have emerged for complementary expansion. Benefiting from trade and investment liberalization, international production networks closely tied to FDI and multinational enterprises have thrived. They have enhanced intra-regional trade and intensified Asian regional integration. The other dramatic impact on global markets has been the current commodity price boom, a product of huge increase in demand for energy, minerals and other commodities. The commodity boom, too, has had particularly strong effects on resource-rich Asian economies.

What are the implications for developing economies of the growth of these new 'giants' in the context of new patterns of production and trade? We provide a sketch of a trade-theoretic model that highlights key economic forces operating on resource-rich economies. We show analytically how the growth of the 'giants' generates adjustment pressures on either side of the factor-intensity spectrum of their own factor endowment range. We discuss how differences in relative factor endowments can produce different outcomes in the face of new challenges to pre-existing patterns of comparative advantage. We then use insights from the model to explore the effects on production, trade, environment and prospects for future growth.

Commodity extraction and production in particular has strong environmental impacts, particularly in the context of weak institutions and other market failure, and may have serious growth and equity consequences. Hence concerns are being raised about the national and global environmental implications of the commodity boom. In Southeast Asia, for example, intensified deforestation to expand oil palm cultivation plantations is being linked directly to high commodity prices.

The paper concludes with a brief survey of the developmental implications and policy issues, emphasizing the premium being placed on policy and institutions.
1. Introduction

The rapid growth of the two Asian ‘giants’—China and India, the world’s most populous countries—is transforming the global economic and political landscape. Their emergence as major economic powers, forcing other countries to ‘dance with the giants’ (Yusuf and Winters 2007) has already led to major changes in trade and investment patterns in Asia, producing an intensification of intra-regional trade and integration. In many ways, the direction of this evolution has highlighted the complementarities among Asian economies, rather than pit them as competitors. When China first began to attract large scale foreign investments and expand export-oriented labor intensive manufacturing industries, fears were expressed that China would be major threat to continuing economic growth of the developing Asian economies. In fact, facilitated by ongoing trade and investment liberalization, production networks—typically established by multinational enterprises—were able to profitably exploit underlying complementarities based on location and factor cost differences within the region to engage in FDI, expand production, intensify regional integration and enhance economic growth. The subsequent emergence of India as a dynamic trading economy, following the Chinese example, has only served to strengthen the trend towards greater integration. Production fragmentation and associated patterns of intra-firm, intra-regional and inter-regional trade reflect this profound transformation in the nature of global manufacturing processes.

Intra-regional trade in Asia has been growing much faster than global trade. It doubled during 1995-2004, and has reached levels comparable to that within EU (ADB, 2007). In this process, the role of China has been pivotal. China has attracted massive amounts of FDI on a global scale and sourced numerous intermediate goods (components, commodities etc.) for finally assembly operations destined for export. Within that same period, its total trade grew at an average 14% per year, and its trade with countries in the region tripled. It is important to note that within the region China is a net importer; given its large overall trade surplus, this means that it had become, indirectly, a key export outlet from the Asian region to the rest of the world. The resulting impact on Southeast Asian countries has been twofold: on the one hand, they have experienced competitive pressures in external markets, particularly in labor-intensive

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1 “..the growth of these giant economies will affect not only goods markets but also the flows of savings, investment, and even people around the world, and will place heavy demands on the global commons, such as the oceans and the atmosphere” (Winters and Yusuf, 2007: p. 1). The size of these economies and the implications of their growth remain large even after incorporating the recent downward adjustments to their size done by the ICP project (World Bank, 2007).

2 For detailed descriptions and analysis of the nature of product fragmentation and trade patterns in Asia, see, for example, Ando (2006), Athukorala and Yamashita (2006), Kimura and Ando (2005).
manufactured goods destined for markets such as US and Japan; on the other, Chinese growth has attracted their exports, enabling them to benefit from complementarities with the growing Chinese economy.  

Production growth in China (and India) demands not only components for manufacturing operations. Demand for all types of primary commodities (fuel, metals, agricultural commodities etc.) has also increased very rapidly. China is now the world’s largest consumer of most of the main metals (accounting for a quarter or more), and a major consumer of energy and many other minerals and primary commodities. It is the largest consumer of a wide range of agricultural commodities: wheat, rice, palm oil, cotton and rubber; and the second largest in soybeans, soy oil and tea. India – arriving later on the fast growth path and yet to embark on Chinese-style industrialization – is fifth in overall energy use (third largest in coal), 7th or 8th in many of the main metals, and a large consumer of agricultural commodities (largest in sugar and tea, second largest in wheat, rice, palm oil and cotton). Between 1990 and 2003, Chinese demand for major metals grew at an average of 14.7% per year; since 1999, it has grown at over 17 percent and absorbed around two thirds of incremental global output. Chinese demand in particular has been the primary causal factor driving the commodity price boom so far; if India were to emulate the Chinese growth path, it is not difficult to imagine the impact there will be on global commodity demand and prices.

The growing demand for commodities from China (and India) has led to a global search for suppliers. China in particular, has been reaching out not only to neighboring resource-rich countries but also to supply sources in both Africa and Latin America. For example, Brazil’s exports to China have grown by 800 percent in value terms during 2000-2004, while the value of its imports from China has more than tripled, making it Brazil’s third most important export destination and its fourth most important import source. Chinese imports from Brazil are concentrated on a narrow range of primary commodities, with iron ore, soy beans, crude oil, wood pulp and bovine leather accounting for over 80 percent of imports (Willenbockel 2007). China, which signed an FTA with Chile in 2005, is now that country’s second most important

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3 See, for example, Roland-Holst and Weiss (2005).
4 Chinese demand for primary commodities has been a far more dominant factor than Indian demand in global commodity markets both because of its larger scale and because of the nature of Chinese growth, with its much stronger emphasis on manufacturing industry.
6 We do not wish to enter the debate about the sustainability of the current commodity boom, except to point out that while global economic conditions (business cycles) would undoubtedly have a major impact on prices – after all China is still a major exporter to the rest of the world – commodity prices can be significantly lower over the medium term only in the event of a major slowdown of Chinese and Indian growth (see UNCTAD 2007, Ch 3 for a discussion).
trading partner after the US, with Chinese imports dominated by copper, followed by wood pulp and fishmeal. China has also started to invest in Latin America, and half of its global FDI stock is now located in Latin America. A similar development can be seen in the case of Africa, with China and, to a lesser extent, India, emerging as major trading partners (Broadman 2007).\(^7\)

Though small as a share of total Asian imports, African exports to Asia—dominated by oil, metals and agricultural raw materials—have been growing rapidly in recent years, accelerating from an average annual growth rate of 15% during 1990-1995 to 20% in 2000-2005. In 2005 Asia’s share of African exports (27%) was roughly equal to that of the EU (32%) or the US (29%). Asian exports to Africa have also been growing rapidly, by an average 18% per year during 2000-2005. These trade links have been leading to stronger investment links; Chinese and Indian FDI into Africa, particularly targeting extractive industries, has been growing and the Chinese FDI stock in Africa is now estimated to exceed $1.1 billion.

In this context, it seems important (and reasonable) to consider the impact of China-India growth on the manufacturing sectors and the commodity sectors of other developing countries in rather different ways. The manufacturing process lends itself to finer divisions along the value chain through product fragmentation, and the growth of China and India can generate both competitive and complementary pressures on the (potentially ‘fragmentable’) manufacturing sectors of other developing countries. In contrast, natural resource extraction and processing typically involves fewer stages of processing, so comparative costs are more likely to be determined by location-specific characteristics such as the availability of mineral deposits, soils and climate. We need to bear this difference in mind when approaching the analysis of the economic and environmental impacts of Chinese (and Indian) growth on poor but resource-rich countries.

Until very recently, the trade, growth and environmental implications of the commodity had been subjected only to limited analysis. Willenbockel (2007) refers to concerns in Brazil about the dynamic long term implications for Brazil related to negative Dutch Disease pressures on manufacturing. Winters and Yusuf (2007) raise the issue of environmental impacts of the ‘growth of the giants’, but do so only in terms of the likely impact of growth-related domestic environmental degradation in China and India on the global environment. That is certainly of importance and interest. But we wish to focus on the overall economic impact and trade-

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\(^7\) Broadman (2007: p.10) points to the complementarities driving this trade: “Africa has growing demand for Asia’s manufactured goods and machinery, and demand in Asia’s developing economies is growing for Africa’s natural resources, and increasingly for labor-intensive goods. Factor endowments and other economic resources will likely continue to yield these strong country-level African-Asian complementarities….”
environmental implications on those relatively resource rich developing countries whose trade is now much more closely aligned with the fortunes of the ‘giants’. These are almost by definition countries which, on the one hand, will seem to have direct benefits from the commodity boom but may well suffer not only because of competitive pressures on labor intensive manufacturing. They are also countries where excessive rates of environmental degradation are more likely, given market and government failures and weak institutions. But it is also important to distinguish between different types of resource-rich countries. Thus Malaysia and Indonesia (and, to a lesser extent, Thailand) are often loosely described as resource-rich, but they obviously differ very significantly in relative endowments of skills, infrastructure etc. This is partly due to previous investments and policy regimes. These factors influence how such countries now respond to the twin pressures of ‘threats and opportunities’ emerging from Chinese and Indian growth. In resource-rich developing countries, net changes in welfare depend on both the growth of manufacturing, and on changes within the commodity and natural resource sectors, and the intersectoral links between these two. These interactions have been largely neglected in the recent literature on fragmentation and economic growth.

2 Theory

The foregoing empirical discussion links changes in trade, such as those resulting from growth of the Chinese and Indian economies, to changes in the scale and structure of production in developing economies. How do these links operate, and how does the structure of production alter in response, in the short and long run? To explore this, it is important first to establish the determinants of changing patterns of trade in a multi-country context. Deardorff (1987) develops a two-factor, n-good, m-country model in which the pattern of trade is determined by comparative costs and transport costs (or equivalent trade barriers). In the model, manufactured goods (z) range over a Dornbusch-Fisher-Samuelson continuum (0,1) and are ranked by the capital intensity of their production processes. In each country, define the relative factor price $v = w/r$. Then cost-minimizing unit input requirements are determined by $a_i(z) = a_i(z; v)$ for $i = K, L$, and

$$k(z; v) = a_k(z; v)/a_L(z; v)$$

is strictly increasing in $z$. Equilibrium factor prices in each country are determined as part of the global trading equilibrium, and need not be equal across economies due to specialization in production (if two countries had identical factor endowments, then for analytical purposes they could be combined and treated as a single entity). The pattern of trade in the absence of transport

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8 The model abstracts from scale economies, imperfect competition, and existing distortionary policies.
costs is determined by comparative production costs, where unit cost for each good in each country is:

\[ c(z; v) = w_{AL}(z; v) + r_{AK}(z; v). \]

In equilibrium, each country produces a range of goods that are contiguous in terms of capital intensity. If preferences are the same in all countries and trade is unimpeded, then no good is produced in more than one country—the so-called ‘neutral’ case. This is shown for the case of three countries (labeled A to C) in Figure 1 (simplified from Deardorff), where by assumption, \( \nu^A < \nu^B < \nu^C \), which yields the unit cost curves \( c^A, \ldots, c^C \). Then A produces the most labor-intensive set of goods, \( X_1 \), B the next most labor-intensive set \( X_2 \), and C the most capital-intensive set \( X_3 \).

The table beneath the figure shows the pattern of trade that results; the width of each column in the table corresponds to the segment of \( z \) along (0,1) occupied by each set.

The factor endowment ranking corresponds inversely to a per-capita income ranking, so we can think of A as a low-income country, B as lower-middle income, and so on. In the neutral case, the poorest countries export the most labor-intensive goods, and the most capital-intensive goods are exported by the richest country. In this model, each good is produced and traded only by one country, that in which unit costs are lowest.

The model generates somewhat more realistic outcomes once transport costs or equivalent trade restrictions are included. Suppose that transport costs take an iceberg form, so that only a fraction \( g (0 < g < 1) \) of each good exported arrives at its destination. (For simplicity, assume also that transport costs are the same for all goods and countries). Then a country will import a specific product only if the landed price is less than the domestic cost of production; or (for importer \( i \) and exporter \( j \)) if \( gc_i(z; v_i) > c_j(z; v_j) \). Comparative cost is now no longer the sole determinant of propensity to produce and export, and as a result, some countries produce some goods solely for home market consumption. This is illustrated in Figure 2, where dashed lines labeled \( gc^A, gc^B \) and \( gc^C \) show the transport-inclusive import unit costs faced by countries A, B, and C. The pattern of production and trade is again shown in a table below the figure. In this example each good, other than \( X_4 \) and those at each extreme of factor-intensity, is produced in two countries. One country is the sole exporter of that good, while the other produces only for its own domestic market. Production for the home market only occurs for goods at either end of a country’s capital-intensity range. Thus, for example, country B imports goods in the sets \( X_1 \) and \( X_7 \), and exports those in \( X_3 - X_5 \). It also produces \( X_2 \) and \( X_6 \), though its production costs are higher.

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\(^9\) This requires that \( n > m \), a condition easily satisfied by the continuum of goods structure.
than in countries $A$ and $C$ respectively. Once transport costs are included, however, $B$ can source these goods more cheaply from its own producers.\footnote{The results of the transport cost model depend on the assumption of identical homothetic preferences in all countries, as Deardorff has pointed out (1987: 8-10).}

The transport cost model is analytically useful for two reasons. First, we can mimic the effects of global market liberalization or reductions in other frictional barriers to trade by reducing or removing transport costs. Second, we can simulate the effects of \textit{ceteris paribus} productivity growth (or of policy reforms that have productivity-increasing effects) in just one country, by exogenously lowering its unit production costs relative to those in other countries. The model will then predict the resulting changes in the pattern of production and trade by each country. Lowering production costs in one country, holding others constant, expands the range of goods that the growing country produces and in the model, alters the pattern of its exports and imports in predictable ways. It continues to export all goods that it previously exported; but now it adds to its exports those ‘marginal’ goods that it previously produced only for home consumption—and possibly also other goods that it did not previously produce at all. In doing so, it captures a larger share of global trade at the expense of countries adjacent to it in terms of factor endowments.

This is a comparative static analysis of how enhanced productivity in a country can impact on its trading partners. But we can use the intuition to understand the consequences of fast(er) growth in such an economy. In the example of growth in China relative to its trading partners, this model suggests that such growth would cause China to begin exporting new products at \textit{both} the labor-intensive and the capital-intensive ends of the range of goods that it produced in the initial equilibrium.\footnote{This is in contrast to the more conventional growth case in which an economy moves to the right along $z$, acquiring comparative advantage at the capital-intensive end of its endowment range but losing it at the labor-intensive end (e.g. Krueger 1977).} Moreover, China’s import demand for adjacent ‘marginal’ goods produced in other countries would also diminish as its own domestic industries’ unit costs fell. Meanwhile, a country that is slightly more labor- (capital-) abundant than China will lose global market share at the capital- (labor-) intensive end of its range of exports, as China both expands the range of its own exports and also reduces its own import demand.

This experiment is illustrated in Figure 3, which shows the effects of a uniform \textit{ceteris paribus} lowering of production costs in country $B$. Country $B$’s new unit cost curve is $c_B'$; its trading partners face unit costs of imports from $B$ as shown by the line labeled $gc_B'$. The pattern of specialization is again shown in the table beneath the figure; the reader is invited to compare the width of columns in this table with those beneath figure 2. There it can be seen that the range
of $z$ covered by $X'_1$ is both smaller and less capital-intensive than $X_1$ in figure 2; the range $X_3-X_5$ exported by $B$ expands to $X'_3-X'_5$, and so on. If China is equivalent to country $B$, then its growth relative to other economies results in a loss to low-income economy $A$ of its most capital-intensive exports, and a loss to $C$ of its most labor-intensive exports. However, China’s imports of goods outside of the range of its comparative would increase (we assume that trade must be balanced both before and after any exogenous change). Increased exports from other countries to China could include intermediate products—parts and components trade—as well as final goods. Thus, a country that is slightly more capital-abundant than China—country $C$, for example—will lose export market share in its most labor-intensive goods, and at the same time see increased export demand for those more capital-intensive goods where it has retained comparative advantage.

For the purpose of analyzing developing countries, Deardorff’s model is limited in that its input side is restricted to two factors of production, while the issues with which we are concerned involve land or other natural resource stocks in addition to labor and capital. As in Krueger (1977), we can augment the basic continuum of goods model, in which manufacturing industries produce a range of goods of differing capital-intensity, by the addition of a resource sector ($r$). Focusing now on the case of a single price-taking country, the specific factors model (Jones 1971) provides a convenient starting-point for thinking through the structural implications of trade shocks. Jones’ model divides capital into two sector-specific stocks, with labor used in each sector and freely mobile between them. For our purposes, one sector produces the resource good, and the capital in that sector can be thought of as a composite made up of an underlying natural resource stock (e.g. soils, forests, fisheries or mineral-laden land) together with the plant and equipment required to exploit or extract it. The other sector uses labor and its own endowment of specific capital to produce some subset of manufactured goods ($z$) along the $(0,1)$ continuum. The exact subset of $z$ produced will depend on the economy’s factor endowments, the scale of production in the resources sector, and international prices. So long as production technologies exhibit constant returns to all factors and diminishing returns to each factor, $w/r$ (where $r$ refers to the return on capital in the manufacturing sector) will reflect the availability of labor relative to capital in manufacturing and will determine the subset of $z$ that is produced.

Assuming a flexible wage such that full employment of labor prevails, or $L = L_y + L_z$, we can immediately begin to distinguish a taxonomy of country types based on factor endowments. Countries with relatively small endowments of manufacturing sector capital will tend to export mainly resource products and to import manufactures; since aggregate capital-labor ratios and per capita incomes are correlated, these are mainly low-income economies. Other low-income
countries may have relatively sparse natural resource stocks as well as low capital stocks in relation to labor; they are likely to have low w/r and to produce mainly labor-intensive (i.e. low z-value) manufactures. Resource-poor middle-income economies will have higher w/r and will produce little y, but higher z-value commodities. Resource-rich middle-income economies will initially produce some mix of resource products and more capital-intensive, or skill-intensive products.

An important observation about this structure is that for given international prices, the structure of manufacturing production depends not only on comparative costs in z, but also on conditions in the resource sector, since these influence w/r through intersectoral competition in the labor market. A rise in the price of the resource sector’s output\(^{12}\) will raise the value marginal product of labor in that sector, and labor mobility will cause w/r to rise and \(L_z/K_z = (L - L_y)/K_z\) in manufacturing to fall. In response to a shock of this kind, a country previously producing manufactures at the lowest end of the capital-intensity continuum might initiate production of a slightly more capital-intensive good, and could even cease production of the most labor-intensive good altogether. Further increases in resource prices (or endowments of resource sector capital) may spur continued movement up the scale of capital-intensity in manufacturing—with corresponding changes in the pattern of trade (Krueger 1977). Thus a resource-rich, wealthy (i.e. capital-abundant) economy, with high w/r, will export a mix of resource products and capital-intensive manufactures, and import labor-intensive manufactures (Norway and the United States are examples). As in the earlier exposition, the range of manufactures produced will depend in part on transport costs, which inhibit specialization.

We now return to the story of unequal rates of economic growth across countries. In a world of many countries, ceteris paribus changes in a single economy that lower its production costs across the board will expand its z-sector production at both the labor-intensive and the capital-intensive ends of its factor endowment range, as already described. The range of manufactures that it exports will increase, and with positive transport costs, the range that it produces for home consumption will also change. This expansion will be fueled by increased imports of manufactures in which other countries have comparative advantage. In the case of growth in a labor-abundant country like China, the additional imports will tend to be more capital-intensive than that country’s own endowments. The expansion will also increase the country’s demand for imports of y from resource-rich countries. This will occur both because of the higher overall activity level in the expanding country, and also because growth in its production of z will reduce the amount of labor available domestically to produce y. The massive

\(^{12}\) Or some equivalent shock, such as an increase in the stock of resource sector-specific capital.
growth in product fragmentation—facilitated by trade and FDI liberalization—has allowed China to benefit enormously from a surge of FDI to expand the range of its labor-intensive operations from relatively low technology manufactures such as clothing, garments and footwear to the labor-intensive final assembly segment of much more sophisticated final goods. Thus China has emerged as ‘the world’s factory,’ producing and exporting a variety of manufactures that ranges from highly labor-intensive to moderately skill-intensive. This has been accompanied by huge increases in its imports of capital goods and skill-intensive parts and components from richer countries, and of energy, metals, timber, paper, rubber, vegetable oils, and other natural resources from resource-abundant countries.

What of the effects of this growth on other low or middle income economies? If the expanding economy is a ‘giant’ (that is, if it is large enough to influence global prices) then its growth will have effects on relative prices and resource allocation in global markets. From the foregoing it can now be seen that in the short run, its ‘boom’ affects the structure of trade and production in other countries through two distinct channels, \( z \) and \( y \). In those countries, these two effects also interact.

Consider first a middle-income economy with a somewhat higher capital-labor endowment ratio relative to the ‘giant’ economy. Growth in the ‘giant’ economy results in the loss to the adjacent more capital-abundant economy of its most labor-intensive exports, and also generates an increase in demand for its exports of the resource good, \( y \). Within an economy so affected, some labor is reallocated to \( y \) production. Increased intersectoral competition for labor reduces \( L_z/K_z \), the factor endowment ratio faced by the manufacturing sector. As a result, the capital-intensity of \( z \) production increases. At the same time, this economy faces increased demand from the ‘giant’ for its more capital-intensive products. Both effects work in the same direction: the structure of production and trade should shift toward higher GDP and export shares of resource goods and capital-intensive manufactures alike. Production and export of its most labor-intensive manufactures will decline.

What remains unknown in this case is whether \( w/r \) will rise or fall. The resource sector’s expansion will tend to raise \( w \), while increased demand for capital-intensive exports will raise \( r \), the return on manufacturing sector capital. There are two potentially interesting stories. First, in economies where the \( y \) sector is relatively small, the latter effect will dominate. If the definition of ‘capital’ includes human capital so that \( v \) is correlated with a measure of the skill premium in the domestic labor market, then this premium will rise and along with it, the returns on acquisition of education and skills will also increase.
A second possibility is that the economy will respond by opening its factor markets. If the resource boom increases intersectoral competition for labor and the resulting rise in $w/r$ would threaten to limit expansion in manufacturing, then it may be rational to open the borders to inflows of unskilled workers.\textsuperscript{13}

In Southeast Asia, Thailand and Malaysia—two middle-income developing countries—exhibit recent trends of industrial structure and trade that correspond very closely with the predictions just made. In the past decade, their exports of skill-intensive manufactures have grown much faster than those of the labor-intensive manufactures that drove their growth in previous decades. The expansion of relatively capita/skill-intensive sectors is the manifestation of their responses both to pressures on their more labor intensive manufacturing sectors emanating from the rapid expansion of China’s labor intensive exports, and also the increased Chinese demand for higher capital/skill intensive intermediates as vertical unbundling has led to a massive expansion of labor-intensive assembly operations in China. The positive effects of Chinese growth are not confined to the more capital/skill intensive intermediates. Both countries have also increased their exports of resource-intensive products, including energy, rubber, processed foods and edible oils, to meet the increased demand for labor intensive assembly operations and higher consumption demands from rapid income growth. Both countries, in addition, now play host to large stocks of unskilled workers from neighboring countries: Burmese in Thailand, and Indonesians in Malaysia (Manning and Bhatnegar 2004). These ‘labor imports’ have clearly helped dampen cost growth in the most labor-intensive industries, including food crops, plantation agriculture and fisheries, thus slowing the rate of their decline (Kulkolkarn et al 2007).

Now consider the case of a country with a somewhat lower capital-labor endowment ratio relative to the ‘giant’. As the ‘giant’ expands, the poorer economy loses an export market for its most capital-intensive manufactures, and also faces more intense competition for the same exports in global markets. This shift in comparative advantage is accompanied by increased demand for its natural resource exports. The expansion of its $y$ sector draws out labor from $z$, raising the wage-rental ratio and lowering the $z$ sector’s labor-capital endowment, $L_z/K_z$. Consequently, its most labor-intensive manufactures will become less profitable, and some goods at the most labor-intensive end of its range might no longer be produced. But—and here, the similarities with the previous case of a more capital-abundant economy end—the possibilities of expansion at the more capital-intensive range of manufactures in the poorer economy are

\textsuperscript{13} In some low-income countries there may be sufficient slack in the labor market that intersectoral competition is not an important feature of adjustment to altered global market conditions. Others may exhibit forms of labor market segmentation that inhibit adjustment.
bounded by the expansion that has occurred in the ‘giant,’ whose unit costs for the poorer economy’s most capital-intensive manufactures have fallen. Whereas growth in the ‘giant’ created complementaries with the manufacturing sectors of richer economies, in the case of the poorer economy it creates competition. Moreover, whereas in richer economies the giant’s expanded import demand for $y$ is complementary with their shift toward more capital-intensive manufacturing, in the poorer economy the same change induces intersectoral competition for labor in its most labor-intensive manufacturing industries. Labor costs rise, but there is no offsetting mechanism to raise returns on manufacturing sector capital or skills. The manufacturing sector of the poorer economy faces a growth trap.

Indonesia, along with some sub-Saharan African countries, appears to fit this description. With a large resource sector and relatively poorly developed skill-intensive manufacturing, Indonesian manufacturing industry as a whole is squeezed between increasingly intense competition from China, and the Dutch disease effects of a sustained commodity price boom, itself driven in large part by growth in Chinese and Indian demand.

To clarify the role played in this process by the resource sector, it is helpful to consider the case in which the poor economy has little or no tradable $y$ production. In this case, growth of the ‘giant’ economy again results in attenuation of the more capital-intensive industries. If, however, there is no corresponding increase in labor demand from the resources sector, then $w/r$ must fall and the resource-poor, labor-abundant economy will specialize in the least capital-intensive goods along the manufacturing spectrum. Bangladesh or Cambodia (prior to its very recent oil strikes) are representative of countries that fit this variant of the model. Each country earns approximately 80% of its export revenues from garments and closely related labor-intensive production activities, and these industries employ the largest fraction of the non-farm labor force.

3 Some country case studies

It is instructive to look at how the NIEs and other developing Asian economies have evolved during the last decade or so of Chinese and Indian growth. The changing composition of exports from selected Southeast Asian countries is shown in Figures 4-7. These provide some indications about the way countries have adjusted. Causation, however, is not established in these data; other changes besides the growth of trade with China (and to a much lesser extent, India) have of course occurred during this period. Nevertheless, the data suggest a surprising degree of consistency with our theoretical predictions, at least as far as the composition of exports is concerned.
Trends in Thai export data (Figure 4) appear strongly consistent with our predictions. In the early 1990s, labor-intensive manufactures (SITC 8) and capital/skill intensive manufactures (SITC 7) each accounted for about one-fourth of Thai merchandise exports. Over the subsequent fifteen years, skill-intensive exports rose to 45% of the total, while labor-intensive exports fell to about 10%. Heavy industry exports (SITC 5), which are also capital-intensive, also rose, from less than 2% of exports to about 8%. The most labor-intensive resource-based sectors—agriculture and fisheries—experienced declining export shares, but less labor-intensive resource sectors (SITC 3 and 4) held steady, or rose slightly. These trends coincide with the rise of China in world trade and as a trading partner for Thailand (Coxhead 2007), though of course it would be highly misleading to suggest that this phenomenon alone accounts for the observed export share changes.

In a similar case, Malaysian export share trends are dominated in the 1990s by the relative rise of SITC 7 exports (Figure 5). The recent commodity price boom has presumably been important in the rise of fuel exports (SITC 3). Malaysia’s labor-intensive manufacturing exports (SITC 8) have grown no faster or slower than total exports, maintaining a share of about 8%. Both Thailand and Malaysia have been prominent beneficiaries of China’s growth through the expansion of complementary, high-tech and high-skill industries (Coxhead 2007; Eichengreen et al. 2004).

In contrast with Thailand and Malaysia, Indonesian export shares reveal a much less clear pattern (Figure 6). The share of labor-intensive manufactures in total exports diminished slightly since the early 1990s, and that of skill-intensive exports rose—until 2000, after which it too experienced a significant decline, from 17% of total exports to 14%. Non-oil resource sectors (SITC 2 and 4) have risen, while oil and gas (SITC 3) has held roughly constant since the late 1990s. Resource processing and heavy industry (SITC 5 and 6) have remained roughly constant, with a joint share of about 22% of exports. Among developing economies, and even within Southeast Asia, Indonesia and Thailand share fairly similar histories of educational attainment, FDI/GDP, and other indicators of potential productivity growth. Yet it seems that Indonesia has made far less progress toward greater sophistication in manufacturing (in the language of our theoretical model, rightwards along the z axis) than Thailand and its other regional neighbors (Coxhead and Li 2008). Indonesia appears to be an example of a country ‘on the cusp’ in the sense of having resource wealth as well as considerable tradable manufacturing capacity. Thus the Indonesian case is an inherently interesting one, and raises large questions about optimal (or at least desirable) development strategy.
Finally, Cambodia (Figure 7) is representative of the resource-poor low-income country case. Its exports are overwhelmingly dominated by low-tech manufactures (in practice, by garments), and there have been little variation in export shares through time (albeit we have data for only a few years). The economy has little or no comparative advantage in resource-based exports, and has thus far failed to develop any measurable export capacity in tradable capital-intensive or skills-based (SITC 7) industries.

4. Environmental and economic growth consequences

As far as a resource-rich developing economy is concerned, our model posits that an exogenous shock in the form of expansion in a large trading partner will undercut its most labor-intensive exports, but promote growth in the production and export of resource-based goods and more capital or skill intensive manufactures. Overall, to the extent that the positive income effects of the resource boom are larger, the country should experience a net welfare gain. However, it is possible that even a resource boom that generates such positive income effects (at least as directly measured) may have adverse long term developmental consequences. This can be important, but does not emerge in our model because it omits a variety of phenomena associated with specific types of market failures, rigidities and externalities that are likely to be important in a developing country context. The literature on Dutch disease and the ‘curse’ of natural resources considers a great number of these (e.g. Humphreys et al. 2007). In the remainder of this section we address three that seem to be of particular importance in the Southeast Asian and African context.

First, the growth of manufacturing in general, and of specific sectors within manufacturing, is argued to generate dynamic productivity gains through a variety of mechanisms. These include learning-by-doing effects, interindustry spillovers of skills and knowledge, and scale-related phenomena leading to endogenous increases in the marginal product of factors employed in manufacturing. The expansion of a resource-intensive sector such as oil or forestry, to the extent that it has an impact on production costs or investment incentives in manufacturing, reduces the potential for these dynamic productivity gains. Thus long-run economic growth may be negatively affected, but more specifically, the economy’s future structure will also reflect lower returns to capital (outside resource sectors) and reduce investments in human capital. In van Wijnbergen 1984, for example, the level of activity in manufacturing raises factor productivity in the future through learning-by-doing effects. A resource boom reduces manufacturing sector output through the familiar Dutch disease mechanisms, and this in turn lowers the potential for endogenous manufacturing sector

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14 See, for example, Grossman and Helpman 1991.
productivity growth in the future. The economy’s capacity for diversification away from dependence on natural resources is reduced. This effect is enhanced to the extent that resource sector profitability is boosted above its social profitability if any negative social externalities generated by resource sector activities – such as adverse environmental and ecological impacts of deforestation or extractive industries - are not fully reflected in private costs. The resulting overspecialization can be important from a welfare point of view when natural resources are subject to increasing extraction costs or outright exhaustion, since in that case the economy’s level of specialization in natural resource sectors cannot be sustained in the long run.\textsuperscript{15} The capacity of a developing country to implement policies that fully internalize costs of resource sector expansion is often limited by weak institutions and poor governance.

A second possible consequence of the economy’s response to higher resource prices and diminished manufacturing export opportunities is that it becomes more vulnerable to trade-based shocks. Because primary commodities usually have low price elasticities of supply, their world prices have much higher variance than do manufacturing prices, which creates volatility in export earnings for price-taking exporters. Volatility is exacerbated by Dutch disease effects that reduce the size of non-resource tradable sectors and increase that of non-tradable sectors, since changes in demand for the latter are resolved in large part by price adjustments rather than through the intersectoral movement of factors. If investors are risk-averse, this real exchange rate volatility may lead to inefficient specialization; investment in non-resource tradables sectors will be reduced by the higher capital costs needed to cover additional risk (Hausmann and Rigobon 2002; Chen and Rogoff 2002).

Finally, a higher share of income from resource rents is associated with higher inequality (except in cases where ownership of the resource stock is widely distributed; see Deininger and Squire 1996) and weak or corrupt institutions (Mauro 1995; Auty 2001). Greater inequality need not be the source of inefficiency or reduced growth opportunities. However, the concentration of incomes may be indicative of a deeper problem, in which the allocation of resources to rent-seeking rather than to productive activities widens the gap in returns between the two, and so creates an undesirable equilibrium characterized by high returns to rent-seeking and low returns to productive activities and innovation (Murphy et al. 1993). In this equilibrium, entrepreneurial

\textsuperscript{15} This analysis is a precursor to endogenous growth models in which expansion of high-skill industries has positive productivity spillovers, which raise returns to skilled labor and induce additional investments in human capital. But human capital investments are financed by profits earned from production in lower-skill industries. So faster growth in lower-skill industries accelerates growth along with structural change (expansion of higher-skill output); conversely, lower world prices for lower-skill manufactures reduce profits, and thus reduce the rate of growth and structural change.
activity is limited to rent-seeking activities, highlighting an interaction effect between resource rents and sectoral allocations of investment and effort that arises when institutions are not robust enough to tax resource rents or to prevent corrupt behavior.

In each of these cases, the effect of Dutch disease or related mechanisms is to over-reduce – from a long term welfare point of view - returns on investments in the tradable manufacturing sector. They are longer-term consequences of a resource boom in a typical developing economy. In general, in the longer run the distribution of investment across sectors will shift to match the changing pattern of comparative advantage, falling in z as a whole and rising in y. Capital will seek to move into y, increasing its output and the corresponding rate of depletion of the underlying natural resource stock. Whether increased activity in the y sector raises or lowers welfare in the long run depends on the rate of exploitation, potential for exhaustion, and the uses to which the revenue stream is put. At the same time, the resource boom contributes in more than one way to reduced investment growth in non-resource sectors, an additional source of foregone growth opportunity.

Some of these issues can be illustrated by considering the case of oil palm. Southeast Asia is the world’s largest by far producer and exporter of palm oil, a product whose price has risen to record highs in recent years, in part due to rapid growth of demand from traditional sources (food processors, for example) and in part because of the burgeoning demand for non-fossil fuel energy sources (palm oil is a key ingredient to production of biodiesel). Since early 1980s oil palm area and production have grown tremendously in Malaysia and Indonesia, which now account for bulk of the world’s commercial oil palm production (Figures 8-9). Malaysia’s oil palm area covers one-eighth of the nation’s land area, and its expansion has been claimed to be the cause for 87% of deforestation in that country from 1985-2000 (Wakker 2005). The area of oil palm planted in Indonesia exceeds that in Malaysia, and is expanding much more rapidly (FAOSTAT); it has grown from 295,000 hectares in 1980 to 4,926,000 in 2003 (Zen, Barlow and Gondowarsito, 2005) . This boom has been driven by long-term rises in palm oil prices, recently stimulated by a number of demand shocks including the switch from trans-fats in food preparation, the rapid growth of consumer demand for processed foods, particularly emanating from China and India, and most recently, the global demand for biodiesel as an alternative energy source to fossil fuels.\(^1\) Concern about the national and global environmental effects of oil palm

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\(^1\) China is the world’s largest importer of palm oil, and India is the third largest importer just behind EU. Chinese and Indian imports have increased sharply from 1,291,000 MT and 209,000 Mt in 1990 to 4,500,000 MT and 3,800,000 MT respectively by 2005.
expansion is now widespread. An ongoing boom in palm oil price is likely to place even greater pressures on the capacity of these countries, particularly Indonesia, to balance the environmental consequences and the pressures from private plantation owners for further expansion.

In an early contribution to the fragmentation literature, Jones and Kierzkowski (2001) predicted that vertical unbundling would lead to losses for countries that are ‘all-rounders’ in integrated production processes but which lack comparative advantage in either skill-intensive production or labor-intensive assembly. In Southeast Asia, middle-income economies like Malaysia and Thailand have, by contrast, flourished from fragmentation trade. Some of their neighbors, however, have not—and Indonesia is the leading example. Indonesia, like other resource exporters, has done well (in trade terms) out of the recent commodity boom. But its manufactured exports—or more specifically, its more skill-intensive exports—have suffered. Perhaps it is countries of the Indonesian type—resource rich but not abundant in human capital or other inputs to skill-intensive production—that are likely to be the real losers from vertically unbundled trade, especially if their resource stocks are vulnerable to overexploitation and exhaustion.

The discussion in the recent World Investment Report (UNCTAD 2007:xxv) on extractive industries can be readily extended more broadly to resource sectors in general:

“The quality of government policies and institutions is a determining factor for ensuring sustainable development gains from resource extraction, with or without TNC involvement. The management of a mineral-based economy is complex, and requires a well-developed governance system and well-considered national development objectives. In some mineral-rich developing countries, however, government policy-making may be aimed at short term gains rather than long-term development objectives. Furthermore, the distribution and use of a host country’s share of mineral revenues may be determined with little attention to development.”

But as demonstrated not only by countries such as Australia, Canada, and Nordic countries, but also by Botswana in more recent times, resource booms can have not only immediate positive effects but, with the right policies, can also pave the way for long term development. Thus the growth of China and India offer developing countries both adjustment challenges—in some cases quite severe—and opportunities for growth. Whether the development opportunities are exploited or wasted will depend critically on the policy responses and quality of institutions.

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17 Environmental research groups assert that deforestation and land conversion for oil palm expansion is a significant contributor to greenhouse gas emissions. Peat swamp draining and burning for plantation establishment in Indonesia are held responsible for 660 million tones and 1.5 billion tons, respectively, of carbon release, equivalent to 8% of the global carbon emissions due to burning of fossil fuels (NYT 2007; 2008). Nor are concerns limited to the environmental implications of oil palm expansion; the effects on the poor of rising food and vegetable oil prices have also attracted substantial attention, with a leading UN official describing the diversion of land to oil palm as a “crime against humanity” (http://news.bbc.co.uk/2/hi/americas/7065061.stm).
References


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Figure 1: Patterns of specialization with no transport costs: three-country case
(Source: Deardorff 1987)
Figure 2: Patterns of specialization with transport costs, three-country case
(Source: Deardorff 1987)
Figure 3: Effects of growth in country B on specialization and trade

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Figure 4: Thailand: composition of exports by SITC division

Figure 5: Malaysia: composition of exports by SITC division
Figure 6: Indonesia: composition of exports by SITC division

Figure 7: Cambodia: composition of exports by SITC division
Figure 8: Oil palm area harvested, Southeast Asia, 1980-2005 (Source: FAO).

Figure 9: Country shares in global palm kernel production, 1970-2004 (Source: FAO).