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Specialization dynamics and natural resources abundance

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Abstract This paper uses a large sample of countries for the last four decades to document how specialization dynamics differ depending on the abundance of natural resources. We show interesting stylized facts on two main issues. First, we do not find evidence that comparative advantage in resource-intensive products is necessarily more persistent than comparative advantage in manufactured goods. Second, we analyze the interaction between specialization in manufacturing and natural resources abundance. Though it is less likely that resource-rich countries have comparative advantage in manufactured goods, the abundance of natural resources does not inhibit significant changes in specialization for these countries.

Keywords Comparative advantage · Natural resources abundance · Industrialization

JEL Classification F100 · O140

1 Introduction

Theoretical models in international trade aim to understand which factors determine a country's comparative advantage. One interesting empirical issue is to study how comparative advantage evolves over time and which factors are responsible for these changes. The neoclassical trade model generates predictions, but few empirical papers have analyzed these implications. Leamer (1987) has extended

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the neoclassical model to consider a third production factor—natural resources—in a model with *n* goods, but the empirical part of his work only exploits cross-country differences in factor endowments. Schott (2003) has analyzed the existence of different diversification cones, i.e., countries specializing in different product mixes, but his work also only considers a cross-section of countries. These cross-section analyses are useful for understanding how a labor-abundant country, for example, China, changes its specialization patterns once it reaches similar endowments as a capital-rich country, such as Germany. However, there is little evidence for which countries have actually changed their specialization patterns in that direction. How likely are these changes to take place? In what types of goods? How important is natural resources abundance for specialization dynamics? Does the type of natural resources abundance matter?

These and other similar questions have received little attention in the empirical trade literature. Some exceptions have been Proudman and Redding (2000) and Redding (2002), which analyze trade specialization dynamics. These two works, however, have not analyzed an important issue, the role of natural resources abundance in driving or retarding changes in comparative advantage. In this paper we are particularly interested in studying how resources abundance affects the chances of gaining comparative advantage in manufacturing. This is in line with Leamer (1987), which shows that it could be particularly difficult for resource-abundant countries to achieve a comparative advantage in manufactured goods. We contribute to this literature by distinguishing among three types of resources abundance: mineral, forest, and agricultural. Previous works on this area have used a narrow definition of resource-abundance by focusing only on differences in arable or other forms of land (Leamer 1987; Schott 2003).

Our focus on manufactured goods and natural resources abundance is motivated by several concerns regarding the bad performance of resource-abundant countries. One very influential idea on this issue was initially proposed by Singer (1950) and Prebisch (1950) which argued that the negative consequences of commodity specialization was because of the secular deterioration in the international prices of these goods. More recently, the so-called *natural resources curse* has revived the debate on the negative consequences of natural resources abundance on economic growth (Sachs and Warner 1995; Sachs and Warner 2001; Gylfason 2001; Kronenberg 2004).[1]

A country's amount of natural resources has been indicated as not only harmful for economic growth, but also as having negative consequences for income distribution. Leamer et al. (1999), for example, have shown that natural resource-rich countries may exhibit a specialization pattern that increases income inequality. They argue that natural resource-intensive sectors absorb the scarce capital in these economies, delaying industrialization. The absence of incentives to accumulate

[1] The issue, however, remains in dispute. Some authors have analyzed the robustness of these results to alternative econometric techniques, while others have focused on explaining what are the factors underlying this negative relationship (Rodriguez and Sachs 1999; Leite and Weidmann 2002; Lederman and Maloney 2007; Hausmann and Rigobon 2003; Mehlum et al. 2006; Hodler 2005).

human capital increases inequality and delays the surge of manufacturing industries that require skilled labor.[2]

The objective of this paper is twofold. First, we highlight the main facts of the dynamics of specialization for different products. Second, we study how natural resources abundance can impede gaining a comparative advantage in manufactured goods. In general, the results suggest that mobility tends to be different for different types of products, but we do not find evidence that a comparative advantage in resource-intensive goods is necessarily more persistent than one in manufactured goods. In addition, though it is less likely that resource-rich countries have comparative advantage in manufactured goods, the abundance of natural resources does not inhibit significant changes in specialization for these countries.

This paper is structured as follows. In Sect. 2, we discuss the conceptual framework for studying specialization patterns. In Sect. 3, we describe the data. In Sect. 4 we show our main evidence on specialization dynamics. Finally, in Sect. 5 we summarize the main results.

2 Specialization dynamics in the neoclassical model

In this section, we discuss the main implications for specialization in an economy rich in natural resources. The theoretical approach is based on the Heckscher–Ohlin model that explains production and trade patterns by differences in countries' factor endowments. This model predicts that a country has comparative advantages in those goods that more intensively use its more abundant productive factor.

Leamer (1987) extends the traditional model to a case with three factors and n goods. In this context, it is possible to analyze how countries with different endowments experience dissimilar development paths.[3] One interesting feature of this model is that the economies are located in different diversification cones, as defined by the mix of products in which the economy specializes. This model predicts different development paths depending on natural resources abundance. By contrast, the 2-factors and n-goods model indicates that all countries follow the same development path. With only two factors, capital accumulation changes the output mix from labor-intensive goods to more capital-intensive goods.

By introducing a third factor, Leamer (1987) has shown that development paths will be different depending on the relative abundance of natural resources. The output mix of resource-rich economies will be different from that of resource-poor economies. Consequently, capital accumulation will generate transitions to different cones of diversification across countries. Moreover, factor price equalization will only hold within each triangle of diversification.

[2] Other important research on this issue is on the impact of factor endowments on institutions and growth (Engerman and Sokoloff 1997, 2002; Acemoglu and Robinson 2001).

[3] Leamer (1987) defines path of development as the effect of capital accumulation on the production mix and factors returns.

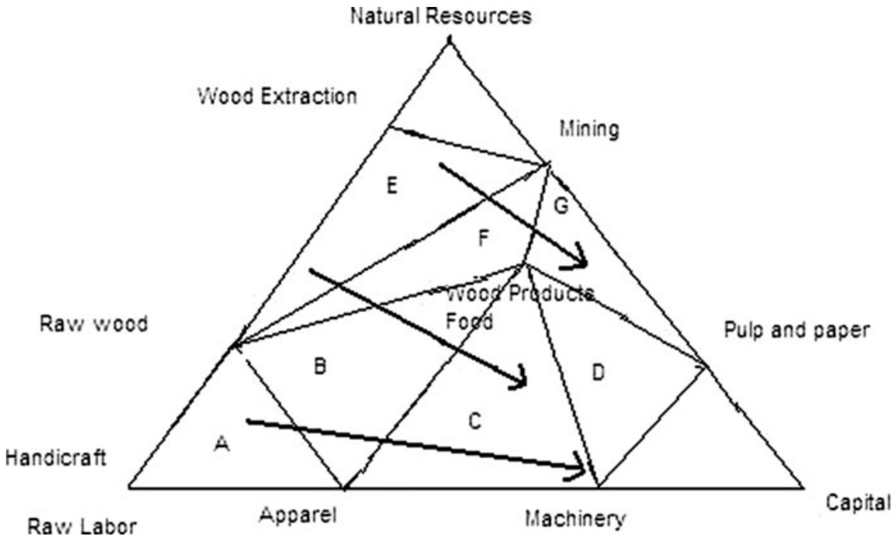

Fig. 1 Path of developments in Leamer's triangle

Figure 1 displays one specialization triangle suggested by Leamer (1987).[4] The corners of this triangle represent three factors of production: labor, natural resources and capital. Points inside this triangle represent both factor endowments of countries and factor requirements of productive sectors. Every endowment point and factor requirement is on a straight line emanating from one corner with the same ratio as the other two factors.[5] A movement in the direction of the corresponding vertex depicts an increase in the endowment of that factor. For instance, if a country originally located in cone A increases its capital endowment, it moves to cone B.

A resource-abundant country like Chile, for example, could be illustrated by an endowment point located in cone F, where this economy produces three goods: (i) mining, (ii) raw wood, and (iii) food. In contrast, a labor-abundant country (for example, China) would be located in cone A producing mainly handicrafts and apparel. Clearly the output mix in both economies is very different.

Three arrows in Fig. 1 represent three different development paths. The bottom arrow illustrates the development path experienced by economies that are relatively scarce in natural resources. As long as they accumulate capital, they move from cone A toward cones B, C, and D, reducing output in labor-intensive goods and increasing output in capital-intensive goods. An economy rich in natural resources follows a different development path, changing its specialization from cone E to F, G, and then D. Initially, these economies specialize primarily in agricultural and forestry products and extractive mining. Capital accumulation is accompanied by changes in the specialization pattern to more elaborate goods based on those natural resources that are more physical- and human-capital intensive (cone F).

[4] A more detailed discussion is presented by Leamer et al. (1999).

[5] For example, capital per worker used for producing one dollar of machinery is higher than capital per worker used for producing one dollar of apparel.

Only if these countries are able to make large increases in their capital endowments, will they produce machinery (cone D), a predominant sector in more developed countries.[6]

In the extreme, this model predicts that resource-rich countries will not produce labor-intensive goods (e.g., textiles and apparel), which can be produced at much lower costs in labor-abundant countries such as China and India. This is a main message of this model that we would like to emphasize: the abundance of natural resources may retard the specialization in capital-intensive sectors. In the following empirical section, we study this implication and expand the analysis by considering different types of natural resources abundance. We study how specialization in mineral, forest, and agricultural products affect the possibilities of gaining comparative advantage in manufactured goods.

3 Data description

Trade data comes from the World Trade Flows compiled by Feenstra et al. (2004). This data set contains information on bilateral exports and imports, disaggregated by industries at 4-digit SITC (rev. 2) for the period 1962–2000. We proceed to aggregate the data in two dimensions. First, we obtain trade flows for 10 “goods” according to Leamer’s aggregates (see Table 3 in the “Appendix”). Second, we obtain country exports by summing up export values across importers. In the same way, we obtain country imports. We also include information on trade in services from the International Monetary Fund.[7]

Most studies that analyze specialization patterns find difficulties in obtaining precise measures of natural resources abundance for a large sample of countries over time. Leamer (1984) is the most complete study in this regard, collecting information for seven types of natural resources. However, it is impossible to obtain this type of information for a large sample of countries over a long time horizon. Other papers use arable land per worker (in hectares) as a proxy for natural resources abundance to study specialization patterns (see for example, Schott 2003; Redding 2002; and Leamer et al. 1999). As discussed in the previous section, the path of development, however, can be very different depending on the type of natural resources abundance. For instance, mining activities tend to be much more capital intensive than agriculture or forestry. Therefore, the process of capital accumulation may expand the mining sector, but it may also contract labor-intensive sectors like traditional agriculture, thereby generating a completely different specialization pattern for mineral-rich countries than the one followed by forestry- or agricultural-abundant countries.

The first step is to measure comparative advantage in different products for each country. As we mention above, we work with ten goods following Leamer’s aggregates. The first six aggregates are natural resources products while the last four

[6] It is important to highlight that those paths could change if relative prices of different goods change or if there is international factor mobility.

[7] The source of this information is Balance of Payments Statistics (BOPS).

are manufactured products. An economy with comparative advantages in petroleum and raw materials is defined as mineral-abundant economy; the same definition will be applied for countries with comparative advantage in forestry products as forest-abundant economies; and comparative advantages in tropical agriculture, animal products, and cereals defined as agricultural-abundant economies. An economy that does not have comparative advantage in any of these groups is defined as natural resource-scarce economy.

Measuring comparative advantages is not an easy task. Vollrath (1991) made a comprehensive review and evaluation of different measures of revealed comparative advantages. In this paper we use his proposed measure of revealed comparative advantages, which corresponds to the index called by Vollrath as a revealed competitiveness. This index is used here to say that a county c has comparative advantage in commodity a if the index RCA is positive, while if the index is negative it reveals comparative disadvantage:

$$RCA = \left[\ln\left(\frac{X_a^c}{X_n^c}\right) - \ln\left(\frac{X_a^r}{X_n^r}\right)\right] - \left[\ln\left(\frac{M_a^c}{M_n^c}\right) - \ln\left(\frac{M_a^r}{M_n^r}\right)\right] = \ln(RXA) - \ln(RMA) \tag{1}$$

where superscript r identifies the rest of the world, subscript n identifies all other commodities with the exception of commodity a, and X and M standing for exports and imports, respectively. The index measures how large exports of commodity a are in respect to total exports of all other commodities compared to the same ratio for the rest of the world, and all this relative to the ratio for imports. Using import and export data, the index reflects relative demand and supply. Moreover, it recognizes the possibility of two-way trade, but as Vollrath (1991) points out, it can be sensitive to small values of exports and imports. This is minor concern in our case given that we work with industry aggregates.

To motivate the analysis of the next section, we show the evolution of revealed comparative advantage for four manufacturing goods in six selected countries. First, we describe the performance of two natural resource-abundant countries in Latin America: Venezuela and Chile. Then, we describe two labor-abundant countries in Asia: Korea and Singapore. Finally, we look at two Nordic countries—Finland and Sweden—that were initially rich in natural resources and that have been able to gain comparative advantage in manufactured goods.

Figure 2 shows that both Latin American countries do not have comparative advantage in manufactured goods during the period under analysis. Thus, these two resource-abundant countries seem to be "trapped" in a pattern of specialization where they are net importers of manufactured goods. In Fig. 3, the Asian countries, considered as typical natural resource-scarce situations, display changes in comparative advantage fairly consistently with the theoretical model discussed in the previous section. In the first part of the period, revealed comparative advantage in labor-intensive goods increases, but then it tends to decline significantly. Contrastingly, these countries gain comparative advantage mainly in machinery in the case of Korea and in machinery and chemicals in the case of Singapore.

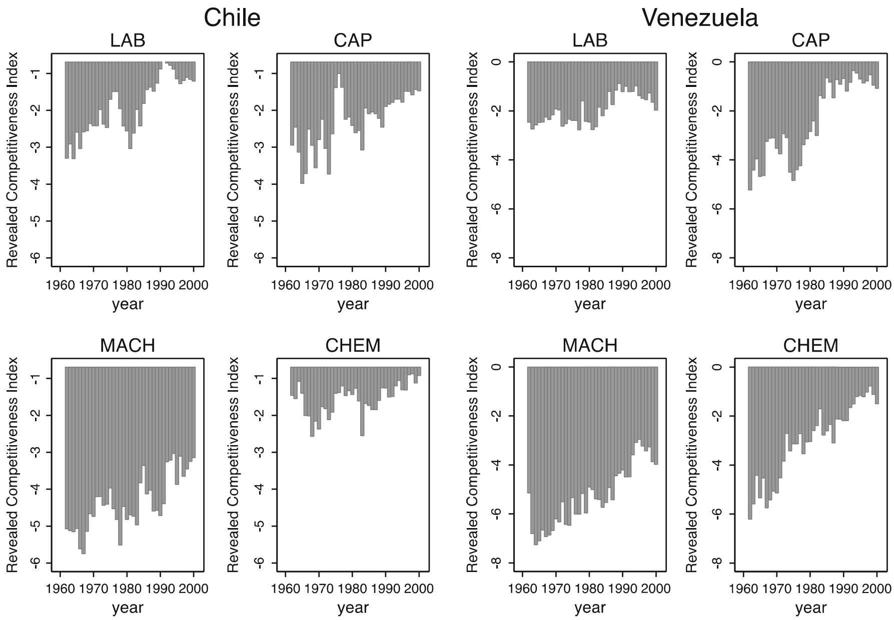

Fig. 2 Chile and Venezuela: Revealed comparative advantage in manufacturing goods

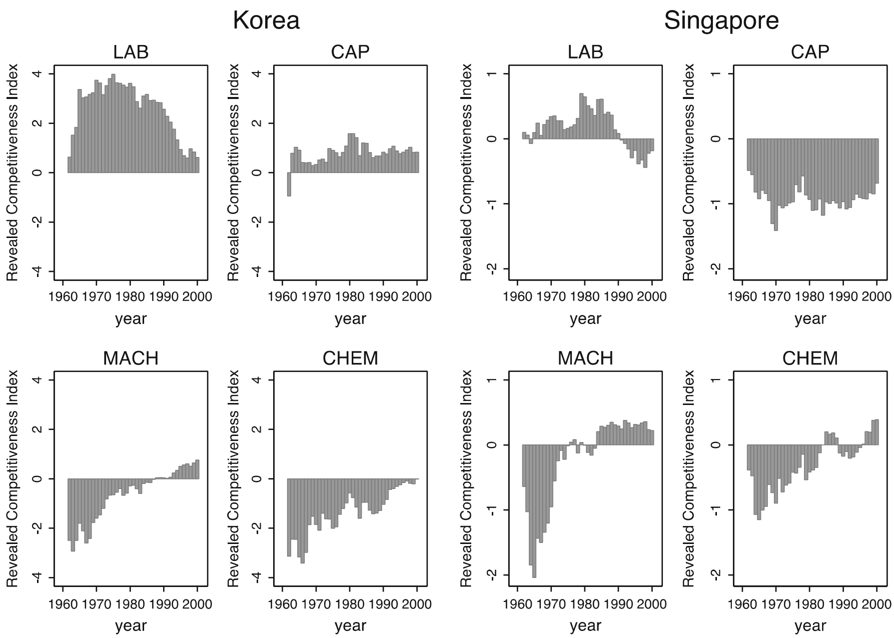

Fig. 3 Korea and Singapore: Revealed comparative advantage in manufacturing goods

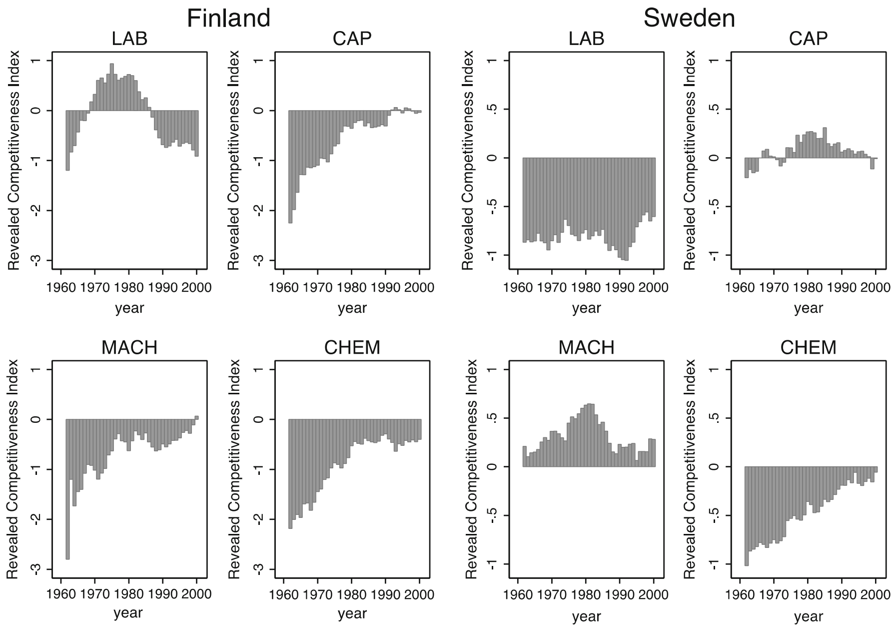

Fig. 4 Finland and Sweden: Revealed comparative advantage in manufacturing goods

The performance of Nordic countries shows that the performance of Latin American countries is not necessarily the typical pattern followed by natural resource-rich countries. Finland, although relatively rich in forestry, has greatly reduced its initial comparative disadvantage in manufactured goods. Sweden exhibits a similar pattern, with a comparative advantage concentrated in machinery and capital-intensive goods (Fig. 4).

To sum up, the evolution of comparative advantages in these countries shows some differences between natural resource-rich and natural resource-poor economies. However, Sweden and Finland exemplify that an abundance of natural resources does not necessarily impede the development of a comparative advantage in manufactured goods. In the next section, we explore these issues in a more systematic way.

4 Empirical evidence on specialization dynamics

In this section, we address the question of how comparative advantage has evolved in the last four decades. First, we analyze how dynamics differ across different aggregates, especially between natural resource-intensive goods and manufactured goods. Second, we study how the dynamics for manufactured goods differ depending on the abundance of natural resources and on the type of resources.

To do so, we construct a transition matrix for each aggregate, following the analysis pioneered by Quah (1993, 1996a, b) to study economic growth and recently applied by Proudman and Redding (2000) and Redding (2002) to analyze trade specialization dynamics.[8] In contrast to these studies, we use a much larger sample of developed and developing countries and we use Vollrath's index as a measure of comparative advantage.[9]

Consider two possible states of nature for each country-commodity combination: a country is in state 1 (it does not have comparative advantage in a particular good) when the value of the revealed comparative advantage (RCA) index defined in the previous section is less than zero, RCA < 0 for that commodity; analogously a country is in state 2 (it has comparative advantage in a particular good) when RCA > 0 for that commodity. The following law of motion describes the evolution of this distribution over time:

$$\mathrm{R}CA_{\mathrm{jt+1}} = P \cdot RCA_{\mathrm{jt}} \tag{2}$$

where the operator P maps one state into another between two time periods, t and $t+1$. Although the law of motion for RCA does not need to be first order and the relationship does not need to be time-invariant, it is useful to assume both for analyzing the intra-distribution dynamics of RCA.

The law of motion described by (2) is generally simplified by making the set of possible values of the variable of interest discrete. In such a case, the operator P becomes just a transition matrix probability. Each cell of this matrix shows the conditional probability of moving across states between two periods of time. This is a particularly useful and illustrative way of showing how fast a country moves from having to not having comparative advantages in a particular good. Moreover, by computing these probabilities, we may investigate whether there are differences across countries depending on their factor abundance.

Given that we are interested in long-run changes in the pattern of specialization, we compute transition matrices between the beginning and the end of our sample. In order to avoid the impact of cyclical fluctuations, we use a RCA averaged over several years. Specifically, we compare specialization patterns at the beginning of the 1960s—specifically 1962–1965—with the pattern at the end of the period: 1995–2000.

To analyze differences in specialization dynamics, we compare the mobility pattern underlying the transition probability matrix for products and groups of countries. We use two mobility indices developed by Shorrocks (1978). These indices attempt to summarize information on the mobility patterns in the estimated transition probability matrix (P), and are computed as follows:

$$MI_1 = \frac{q - tr(P)}{q - 1} \quad \text{and} \quad MI_2 = 1 - \det(P)$$

where P is the transition probability matrix, q is the number of states, $tr(P)$ is the trace of the matrix, and $det(P)$ is its determinant.

[8] Mancusi (2001) applies the same methodology for studying technological specialization in industrial countries.

[9] Proudman and Redding (2000) use a revealed comparative-advantage-based measure of specialization, which is not derived from any particular trade model. Redding (2002), by contrast, uses a theoretically consistent measure—the share of the industry in the country's GDP—that is derived from an aggregate translog revenue function. This analysis, however, covers only seven OECD countries.

A simple way of looking at mobility issues is to analyze the diagonal of the transition matrix P. This diagonal shows how absorbent the different states are. In the extreme, when all states are absorbent, e.g., the case of no mobility, each element in this diagonal will be equal to 1, and $tr(P)$ will reach a maximum equal to the number of states and MI_1 will be equal to zero.

The mobility index MI_2 considers not only the diagonal of P, but also the elements off the diagonal. A simple intuition for MI_2 is considering a 2 by 2 matrix with each element equal to 0.5, which would be the case of perfect mobility, i.e., it would be equally likely to move between two states. In such a case, $det(P)$ is zero and MI_2 takes a maximum value of 1. In the case of absorbent states, i.e., a singular matrix with diagonal elements equal to one, $det(P)$ is 1 and MI_2 takes a minimum value of 0. In sum, the closer to zero the indexes are, the slower the changes are in comparative advantages. In the two by two case analyzed in this paper, both indexes yield exactly the same value. Thus, from this point on we will only talk about the mobility index.

Using the mobility index, we present evidence for specialization dynamics from two main perspectives. First, we look at differences across products using the Leamer's ten aggregates plus an additional aggregate for services. Here, we are particularly interested in testing whether a comparative advantage in natural resource-intensive industries tends to be more persistent than comparative advantage in manufactured goods. Second, we concentrate on manufactured goods to analyze whether dynamics tend to be different for natural resource-rich and natural resource-poor countries. We are mainly interested in analyzing whether resources abundance tends to inhibit changes in specialization patterns.

4.1 Across-products evidence

The first issue that we explore is dynamic differences across goods. We study if changes in comparative advantage are more difficult to achieve for certain products than for others. Surprisingly, researchers have rarely investigated this issue. It may be argued that, as long as factor abundance is difficult to change, it would be expected that comparative advantages tend to be persistent. The degree of persistence, however, would be different across types of goods. Consider, for example, manufactured goods that require highly specialized skills. It is not easy for a country to quickly change the skills of its labor force in order to make the production of these goods profitable. In a more extreme case, a country that is not endowed with minerals will never change from net importer to net exporter of mineral products. Note that changes in comparative advantages also depend on how fast the rest of the world is accumulating factors of production.

We are specially motivated by evidence in Leamer (1995), which presents a graphical analysis for the phenomenon of persistence in comparative advantage. Comparing forestry products and labor-intensive manufactured products, it shows that labor-intensive manufactured goods tend to be more "footloose". His findings show that between 1965 and 1988, a large number of countries moved from being net importers to net exporters of labor-intensive goods, but these movements were less common in forestry products.

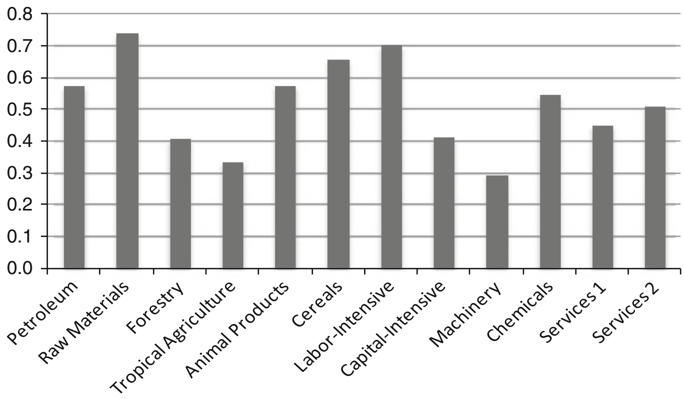

Fig. 5 Specialization dynamics across products: mobility index. Services 1 corresponds to information since 1970, and Services 2 since 1975

We have computed transition probability matrices and the mobility index for the ten product aggregates plus services. Six of the product aggregates are natural resource-intensive goods and the other four are manufactured goods. We find that there is not a clear-cut relationship between mobility and natural resources (see Fig. 5). First, we find that average mobility is higher for natural resources products (0.55) than manufactured goods (0.49). Second, there are relevant differences across industries. In the case of resource-intensive goods, changes in comparative advantage are more likely in the cases of raw materials (0.74) and cereals (0.66). For manufactured goods, comparative advantage is less persistent in labor-intensive goods (0.70) and chemicals (0.54). In the case of services, using information for two initial periods, the evidence is the same.[10] We find that comparative advantage in this industry is close to the average of the other aggregates.

To sum up, we find evidence of relevant differences in mobility patterns across goods, but that comparative advantages in resource-intensive industries are not necessarily more persistent than those in manufactured goods. This evidence is consistent with the ideas elaborated in Lederman and Xu (2007) that natural resources are not necessarily a destiny and that, depending on economic policies and other factor endowments, resource-abundant countries may be able to gain comparative advantage in manufactured goods. We explore this issue in more detail in the next section.

4.2 Does the type of natural resources matter?

To answer this question, we compute the transition probability matrices (TPM) for different groups of countries according to their resources abundance. To better analyze the issue and to not present as many TPMs as types of resources abundance exist, we define four main groups:

[10] We use data for services in two initial periods because there is more missing information for trade services than for goods in the beginning of the sample.

Table 1 Transition matrix for comparative advantage in manufactures

States: 1962–1965	States: 1995–2000		%
	1	2	
(A) Resource-scarce countries			
1	80.0	20.0	55.6
2	21.4	78.6	44.4
%	54.0	46.0	
(B) Mineral-abundant countries			
1	79.5	20.5	90.2
2	45.0	55.0	9.8
%	76.1	23.9	
(C) Agricultural-abundant countries			
1	81.7	18.4	89.0
2	30.8	69.2	11.0
%	76.1	23.9	
(D) Forest-abundant countries			
1	81.7	18.3	85.7
2	45.0	55.0	14.3
%	76.4	23.6	

(i) natural resource-scarce countries; those countries that initially (i.e., in the period 1962–1965) have an RCA < 0 for the three resources aggregates,
(ii) mineral-abundant countries, which are countries with positive RCA for two of Leamer's aggregates: petroleum (PETRO) and raw materials (MAT);
(iii) agricultural-abundant countries are those with positive RCA for tropical agriculture (TROP), animal products (ANL), and cereals (CER), and
(iv) forestry-abundant countries that have only a positive RCA for forest products (FOR) in Leamer's aggregation.[11]

Given that we are interested in changes in comparative advantage for manufactured goods, the transition probability matrices were computed by pooling the four manufacturing aggregates. This is justified by the fact that countries accumulating capital (or other productive factors) may change their comparative advantage from one manufacturing aggregate to another.[12] Thus, we study overall changes in manufacturing comparative advantage.

The transition probability matrices are shown in Section A of Table 1 for resource-scarce countries, in Section B of Table 1 for mineral-abundant countries, in Section C of Table 1 for agricultural-abundant countries, and in Section D of Table 1 for forestry-abundant countries. Each cell in the TPM shows the probability

[11] In all of these cases, we define a country as abundant in a determined resource (mineral, agricultural, and forest) when the RCA calculated for the aggregate is positive at the beginning of the period.

[12] This could be the case of Korea, as shown in Fig. 3.

of staying in the same state (the elements in the diagonal) or moving from not having comparative advantage (state 1) to having comparative advantage (state 2), and vice versa, between the initial (1962–1965) and end period (1995–2000). We focus on two main issues. First, we investigate how resource-rich countries differ from resource-poor ones in terms of their comparative advantage in manufactured goods. The other issue is how mobility patterns differ according to countries' natural resources abundance.

The last column in every TPM shows the percentage of countries that are classified in state 1 (no comparative advantage) and 2 (comparative advantage), in the initial period (1962–1965). For the end of the period (1995–2000), this percentage is shown in the last row of the corresponding TPM. It can be seen in Section A of Table 1 that natural resource-scarce countries are evenly positioned in both states, i.e., it is relatively likely that these countries have or lack comparative advantage in manufacturing goods in each period. The proportion of countries classified in states 1 and 2 in 1962–1962 is about 55 and 44 %, respectively.

Looking at TPMs for resource-rich countries, we find that rich countries are less likely to have comparative advantage in manufacturing goods than resource-scarce ones In fact, for all types of resource-abundant countries, the percentage of countries lacking comparative advantage in manufacturing is about 90 % in the initial period, and 76 % in the final period under study. This is lower than the 55 % of cases for resource-scarce countries that are classified as having comparative advantage in both periods. In addition, we find that there are only slight differences depending on the type of natural resources abundance.

We investigate a second issue related to mobility patterns across countries. We ask whether is more difficult to move from lacking to having comparative advantage in manufactures for resource-abundant than for resource-scarce countries. It has been argued that exports of primary goods may retard the production of modern manufacturing goods because they either absorb all of the physical capital accumulated or do not stimulate human capital accumulation (Leamer et al. 1999). One way of looking at these changes is to analyze how likely is the movement between the two states (not having and having comparative advantage in manufactured goods). In the case of resource-scarce countries shown in Section A of Table 1, we find that in approximately 20 % of cases there was movement to having a comparative advantage in manufactured goods. Sections B through D of Table 1 reveal that for resource-abundant countries these movements tend to be similar. In fact, the percentage of countries gaining comparative advantage is 20.5 % for mineral-abundant countries, 18.4 % for agricultural-abundant countries, and 18.3 % for forest-abundant countries.

In the case of losing comparative advantage, we find some differences across groups of countries. For resource-scarce countries, only 21 % of the countries had a loss of comparative advantage in manufactured goods. These figures increase to 45 % for mineral-abundant countries, 30.8 % for agricultural-abundant countries, and 45 % for forest-abundant countries. In sum, it is more likely for resource-rich countries to lose a comparative advantage in manufactured goods.

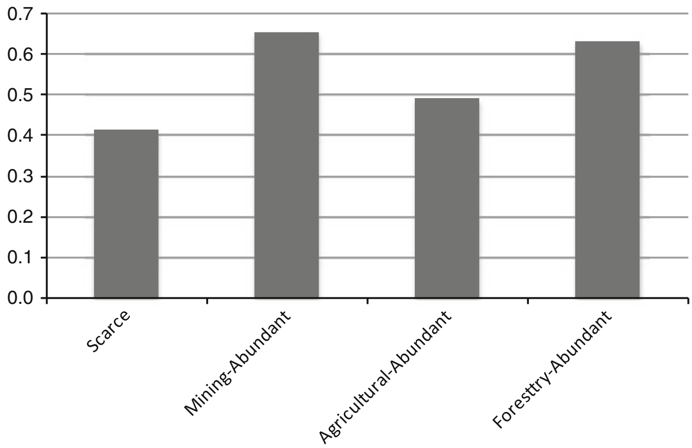

Fig. 6 Specialization dynamics according to factor abundance: mobility index

How about the overall pattern of mobility across groups of countries depending on resources abundance? We compute the mobility index in manufacturing goods for the four groups of countries (Fig. 6). The evidence shows that the mobility index is lower for resource-scarce countries (0.41) compared to resource-abundant countries (an average of 0.6). This suggests a higher dynamics in comparative manufacturing advantage for countries abundant in natural resources. These results are not consistent with the idea that resource-abundant countries are less likely to change their specialization patterns in manufactured goods. There is an interesting dynamic in comparative advantage even in resource-abundant countries, which are traditionally seen as specializing in primary commodities and thus trapped in this specialization pattern.

There are three main issues that need to be noted from this evidence. First, the higher mobility for natural resource-abundant countries is due to losing advantage in manufactured goods mainly. Second, the proportion of countries gaining comparative advantage is similar independent of the natural resources status. Finally, this last evidence should be carefully taken since the gains of comparative advantages in manufactured products could be related to manufacturing that is intensive in natural resources.

We also explore whether the changes in comparative advantage are given by changes in exports or imports. To do so, we look at changes in the two components of the revealed comparative advantage indicator (RXA and RMA) for the sample of countries gaining a comparative advantage in manufactured goods. We compute the mean and the median across countries and present the changes in both components between the initial and final period in Table 2. In general, for all of the cases shown in Table 2, gaining comparative advantage is mostly brought about by an increase in relative exports (RXA), and not through a reduction in relative imports (RMA).

Table 2 Changes in exports and imports for countries gaining comparative advantage

	Scarce	Mining-abundant	Agricultural-abundant	Forestry-abundant
Mean				
Change in RXA	3.2	0.9	1.4	1.1
Change in RMA	0.4	−0.2	−0.2	−0.5
Median				
Change in RXA	5.5	1.5	2.2	1.8
Change in RMA	−0.6	−0.3	−0.2	−0.5

5 Conclusions

This paper studies the connection between natural resources abundance and specialization dynamics. Using a large sample of countries for the period 1962–2000, we analyze changes in comparative advantage for several aggregates. In contrast to previous evidence using simple measures of factor abundance, most commonly arable land per worker, we define natural resources abundance using an index of revealed comparative advantage developed by Vollrath (1991) applied to export and import data for agricultural-, forestry- and mineral-abundant countries. This data allows us to group countries according to different types of natural resources abundance.

We study long-run changes in the pattern of specialization for countries between the periods 1962–1965 and 1996–2000. In general, the results suggest that mobility tends to differ based on product types. We find evidence that, on average, comparative advantage in natural resource-intensive goods is less persistent than comparative advantages in manufactured goods. However, there is a lot of heterogeneity within these two groups of goods. Comparative advantage seems to be less persistent in raw materials and cereals, in the case of natural resource-intensive industries, and for labor-intensive industries in the case of manufactured goods.

In addition, we find that resource-rich countries are less likely to have comparative advantage in manufacturing goods than resource-scarce countries. However, our results show that the probability of gaining comparative advantage in manufacturing is similar across groups of countries. In addition, we find evidence that resource-rich countries are more likely to lose comparative advantage. The overall evidence shows that dynamics in specialization are not necessarily impeded by having natural resources abundance.

This evidence presents interesting stylized facts about specialization dynamics that deserve further research. Why have some resource-abundant countries been able to gain comparative advantage in manufactured goods? In which types of goods? Is this explained by human and physical capital accumulation? If so, why have these countries been able to accumulate capital and change their specialization patterns? Finally, there are also questions regarding the consequences of these changes in specialization patterns, especially regarding their effects on overall economic performance and income inequality.

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Appendix

See Table 3.

Table 3 Leamer's Aggregates

Aggregate	SITC	Aggregate	SITC
Petroleum		*Cereals*	
Petroleum and derivatives	33	Cereals	4
		Feeds	8
		Miscellaneous	9
		Tobacco	12
		Oils seeds	22
		Textile fibers	26
		Animal oil & fat	41
		Fixed vegetables oils	42
Raw materials		*Labor-intensive*	
Crude fertilizers & minerals	27	Nonmetal minerals	66
Metalliferous ores	28	Furniture	82
Coal, coke	32	Travel goods, handbags	83
Gas, natural & manufactured	34	Art apparel	84
Electrical current	35	Footwear	85
Nonferrous metal	68	Misc. products articles	89
		Postal packing, not classified	91
		Special trans., not classified	93
		Coins (nongold)	96
Forestry products		*Capital-intensive*	
Lumber, wood, & cork	24	Leather	61
Pulp & waste paper	25	Rubber	62
Cork and wood manufactures	63	Textile yarn, fabric	65
Paper	64	Iron & steel	67
		Manufactured metal n.e.s.	69
		Sanitary fixtures & fittings	81
Tropical agriculture		*Machinery*	
Vegetables	5	Power generating	71
Sugar	6	Specialized	72
Coffee	7	Metalworking	73
Beverages	11	General industrial	74
Crude rubber	23	Office & data processing	75

Table 3 continued

Aggregate	SITC	Aggregate	SITC
		Telecommunications & sound	76
		Electrical	77
		Road vehicles	78
		Other transp. vehicles	79
		Prof. & scientific instruments	87
		Photographic apparatus	88
		Firearms & ammunition	95
Animal products		*Chemicals*	
Live Animals	0	Organic	51
Meat	1	Inorganic	52
Dairy products	2	Dyeing & tanning	53
Fish	3	Medical, pharmaceutical products	54
Hides, skins	21	Essences & perfumes	55
Crude animals & vegetables	29	Fertilizers	56
Processed animals & veg. oils	43	Explosives & pyrotechnics	57
Animal products n.e.s.	94	Artificial resin & plastics	58
		Chemicals material n.e.s.	59

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