CHAPTER 6

THE BENEFITS FROM PRODUCT DIFFERENTIATION IN MODERN ECONOMIES

The *division of labour* was described long ago in Adam Smith's description of the making of pins. A production process is split into subtasks, each of which is assigned to a specialized worker. Technological progress is generally embedded in a deepening division of labour. Based on the extension of markets and trade, imitation and innovation of both products and production processes fosters long-run growth. This progress is reflected in more product differentiation, i.e. in a greater number and a higher quality of available products, especially of capital goods and intermediate inputs. Measures of product differentiation can be derived from the United Nations COMTRADE Database which provides a framework, consistent across countries, for proxying the degree and quality of the division of labour in a given economy. Based on this framework, this chapter illustrates the relationship between differences in the division of labour and long-run economic development in the economies of the ECE region. The potential for deepening the growth-promoting division of labour by increasing the variety of goods available in a country via trade, innovation and imitation is also explored. The results shed light on the importance of research and development (R&D), education and external liberalization for competitiveness in a modern economy. The available data also illustrate other facets of product differentiation, such as the effect of economic development on consumption patterns.

6.1 Conceptual issues in product differentiation

"Diversity is the staff of economic life",[339] and there are numerous approaches to relate this notion to the ways in which work is organized or to the variety of choices that confront the consumer in the real world. While theoretical approaches always have to reconcile explanatory aspirations with analytical tractability, empirical measures of diversity are often constrained by data availability. All these limitations necessarily imply some divergence between theory, measurement and commonly held notions of diversity or variety.

The theoretical tool of dealing with diversity or variety is *product differentiation*: there are many different goods, each of which exists in a number of forms or variants. The differentiation of products can be vertical or horizontal, i.e. each product may exist in a number of qualities or in a number of variants of equal quality.[340] This includes the possibility of product differentiation by the country of origin, such that a German car is differentiated from a Japanese car, etc.[341]

Most consumers certainly prefer higher to lower quality. The existence of many consumers with either different tastes over product variants or individual preferences for variety implies a preference for variety in aggregate demand subject to horizontal product differentiation. On the supply side, firms specialize due to internal returns to scale in production. The justification for combining these crucial assumptions on the demand and supply sides is that both describe the most important stylized facts of industrial production. For given preferences and technology, aggregate income, i.e. the extent of the market, finally determines the degree of product differentiation.

The formal structure of this standard approach to horizontal product differentiation describes the differentiated final goods case above (involving close substitutes),[342] but it can also be taken to illustrate production processes where product variants are in fact differentiated, rather complementary intermediate inputs – or components – to be assembled into a final homogenous output. The role of the consumers' preference for variety in the final goods case is here played by gains from the division of labour that are external to the firm assembling the final good such that

[339] S. Rosen, "Markets and diversity", *American Economic Review*, Vol. 92, No. 1, March 2002, pp. 1-15.

[340] "Thus a pencil is a well-defined object and so is a refrigerator, a personal computer, a restaurant meal, and a haircut. Each one of these goods is a differentiated product, however, in the sense that there are many varieties of it available in the market and many more that could potentially be produced. There are red and yellow pencils, soft and hard pencils, white and green refrigerators, small and large refrigerators, 16K memory personal computers and 128K memory personal computers, Chinese meals and French meals, short style and long style haircuts, and so on." E. Helpman and P. Krugman, *Market Structure and Foreign Trade* (Cambridge, MA, MIT Press, 1985), pp. 114-115.

[341] P. Armington, "A theory of demand for products distinguished by place of production", *IMF Staff Papers*, Vol. 16, No. 1, 1969, pp. 159-176.

[342] A. Dixit and J. Stiglitz, "Monopolistic competition and optimum product diversity", *American Economic Review*, Vol. 67, No. 3, June 1977, pp. 297-308.

its output increases with the number of components used even if the total component input remains constant.[343]

A number of economic concepts, especially in the context of international trade and growth, are tied to product differentiation. According to modern trade theories, product differentiation in open economies, both of final output and of intermediate inputs, is the most important source of trade between similar countries, and is the origin of intra-industry trade and the vertical fractionalization of production and trade.

Most importantly, the theory of *endogenous growth* suggests that an increasing and more refined division of labour, based on deliberate product and process innovation and imitation, can help to avoid diminishing marginal returns and sustain learning-by-doing, thus fostering long-run growth.[344] This technological progress, embedded in the division of labour, is reflected in a greater variety and quality not only of consumer but also of capital goods and intermediate inputs. Accordingly, in a modern economy the innovation or imitation driven expansion of the range and variety of production as well as quality improvements matter much more for competitiveness than factors that influence volume growth.

Analysing the division of labour in terms of the improvement in the quality and variety of production seems particularly relevant for an assessment of the growth prospects of east European and CIS economies, where pre-transition production volumes were relatively high, while the variety and quality of products were often fairly limited by the nature of the economic systems. In order to embark on a path of sustained growth, quality improvements and an expanding variety of products, as the result of firm restructuring and the proliferation of SMEs, are crucial for the future growth of production.[345]

So far there exists only a very small body of well-established empirical knowledge about the quality and variety aspects of trade and growth, not least because of the difficulties of measurement. The analysis presented below attempts to quantify the state of, and trends in, the variety and quality of consumer, capital and intermediate goods available in the ECE region, in order to assess their potential implications for the region's long-term growth. The analysis is based on trade-based measures (box 6.1.1) and the conclusions are necessarily tentative.

6.2 The variety and quality of production and consumption in the ECE region

Chart 6.2.1 presents three different count measures of *variety* in all commodities across the majority of ECE countries in 2001. Countries are ranked in descending order of available product variety.[346] If no account is taken of product differentiation by country of origin, there is obviously much more cross-country variation for produced than for available item variety. The latter is quite high in most ECE economies, except for the poorest CIS economies. Trade clearly smoothes differences in this respect.[347] Once product differentiation by country of origin is taken into account, however, the cross-country spread for available product variety rises substantially.

Sorting ECE countries by each measure of variety reveals more or less the same rough grouping of countries:[348] the highest degrees of variety occur in the west European and North American economies,[349] followed by the east European EU accession countries, then by other eastern Europe, and finally the CIS (see also the subregional data in table 6.2.1).

There are a few notable exceptions to this general pattern, however, the most striking being Russia. Partly because of its relative size, and perhaps also because of the simplicity of the measures,[350] Russia displays a degree of variety similar to that of the high-income economies. This seems to conflict with the prevalent view of the Russian economy as being heavily dependent on the extraction and export of oil and related products. However, both views are probably correct: while Russia's exports, especially to the western markets, are dominated by energy products and metals (which underpin a large trade surplus and strong import capacity), imports from high-income economies and trade with the CIS and developing countries add significantly both to the domestically produced and the available variety in the economy. In respect of domestically produced item variety, Russia is still a major supplier of industrial goods

[343] W. Ethier, "National and international returns to scale in the modern theory of international trade", *American Economic Review*, Vol. 72, No. 3, June 1982, pp. 389-405.

[344] C. Jones, *Introduction to Economic Growth* (New York and London, W.W. Norton, 2002), Second Edition.

[345] Most accounts of transition have neglected this particular aspect of liberalizing a formerly planned economy. For a theoretical discussion, which asserts that a successful transition based on improved public governance involves a greater variety and improved quality of production at the cost of a lower volume of output, see R. Frensch, "Public governance as the source of quality and variety gains from transition", forthcoming in the *Journal of Comparative Economics*, June 2004.

[346] The highest relative product variety for all commodities is 41.7 per cent for Germany. The lower rank of the United States in respect of available product variety stems mainly from the biased sample of import partners in this data set (see annex to this chapter).

[347] Chart 6.2.1 indicates rather small differences between produced and available item variety in all goods for most western, i.e. high-income economies. This gap becomes larger in eastern Europe and even more pronounced in the CIS, with the exception of Russia. This suggests that richer economies import the missing few items not produced at home, and possibly that they engage to a high degree in intra-industry trade. The second explanation is supported by the literature as well as by data on import item variety not reproduced here because of space constraints.

[348] Appropriate rank order correlations are well above 0.9.

[349] This regional group in fact also constitutes the ECE's OECD members as before 1996, i.e. before the Czech Republic, Hungary, Poland and Slovakia joined the OECD.

[350] As noted above, these simple count measures are not weighted and the analysis at this stage does not take into account the geographical size of the economy (see box 6.1.1).

Box 6.1.1

Trade-based measurement of product differentiation

Measures of the quality and variety of traded products are commonly derived from detailed data on merchandise trade. Specifically, it has become common practice to measure product quality in terms of relative export and import unit values. The simplest way to measure the variety of exports or imports is to count the number of items at a sufficiently disaggregated level of the trade classification.[1] One, so far relatively neglected, way to increase the amount of detailed data is to differentiate product items by their country of origin. Using the country of origin of imports as an additional source of information on product differentiation enables an additional dimension of variety to be introduced, and one which is absent in many other data sources.

For lack of better alternatives, these trade-based measures of product quality and variety are also used in the empirical literature on economic growth. This necessarily excludes non-traded goods (goods sold exclusively in the country of origin); however, since services are excluded from this analysis, the share of this component is much lower than the total non-traded share of GDP. Another important drawback of using trade-based measures in the analysis of growth is their sensitivity to the degree of openness of an economy, to its size and borders, to tariff and non-tariff barriers to trade, and to real exchange rate movements.

In this chapter, variety and quality are proxied by measures derived from the merchandise export and import data of 45 ECE member countries according to the 5-digit level of the SITC, Rev.3. Although the data selection used here is confined to trade with partners in the ECE region, Japan, China and south-east Asia (55 partner countries are covered), for most of these countries it includes the bulk of their total trade. The geographical bias in the data is thus smaller than would result from a study based on the mirror data provided by selected partners such as the EU or OECD countries.

Count measures of ***item variety*** simply record the number of items exported and imported by a country according to the 5-digit level of the SITC, Rev.3. The number of items exported is taken as a proxy for the variety of domestic production (produced item variety). The total number of items exported and/or imported is taken to correspond to the total variety available within a country (available item variety). Thus, item variety measures do not reflect product differentiation by the country of origin, instead count measures of ***product variety*** do. The number of exported items plus the number of imported items times their places of origin corresponds to the product variety available within a country (available product variety). Produced product variety is therefore equivalent to produced item variety.

Relative measures of item variety or product variety relate the absolute count measures to the maximum numbers attainable within the existing trade classification. SITC 5-digit level data provide for a maximum number of 3,114 traded items. As the import data used here are based on each country's trade with 55 partner countries, the maximum count of the product variety of imports of all commodities in this data set rises to 171,270, assuming all 55 countries supply all 3,114 items. Consequently, the maximum count of product variety available from either domestic production (3,114 items) or trade rises to 174,384. Theoretically, the variety produced domestically should be only a small subset of the total product variety available via domestic production and trade with the rest of the world: in fact, for the ECE member countries studied here, this domestically produced subset is typically well below 5 per cent.

Quality is measured by the unit values of exports and imports relative to the average unit values of the same commodities in the aggregated EU trade flows.[2] The assumption is that the weighted average of an individual country's ***relative export or import unit values*** reflect the quality of domestically produced and imported items.[3] However, there is no straightforward way of combining relative export and import unit values in order to introduce an overall quality measure of available products (including the country of origin aspect), due in part to the different nature of reported prices in customs statistics (f.o.b. for exports and c.i.f. for imports) and to the difficulties of aggregating unit values of each item across countries of origin. Inconsistencies in the units of measurement of quantity (weight, number, volume, area, etc.) across countries and over time are substantial. In addition, the units are not always the same for exports and imports of the same item. Hence, no direct quality proxy is assigned to available products.

All these measures exist for total exports and imports, as well as for the broad economic categories of consumer, capital and intermediate goods. This distinction allows the appropriate category to be selected when testing for theoretically justifiable links with economic development, or the innovative and imitative capacities of an economy. For a more complete description of the data, see the annex to this chapter.

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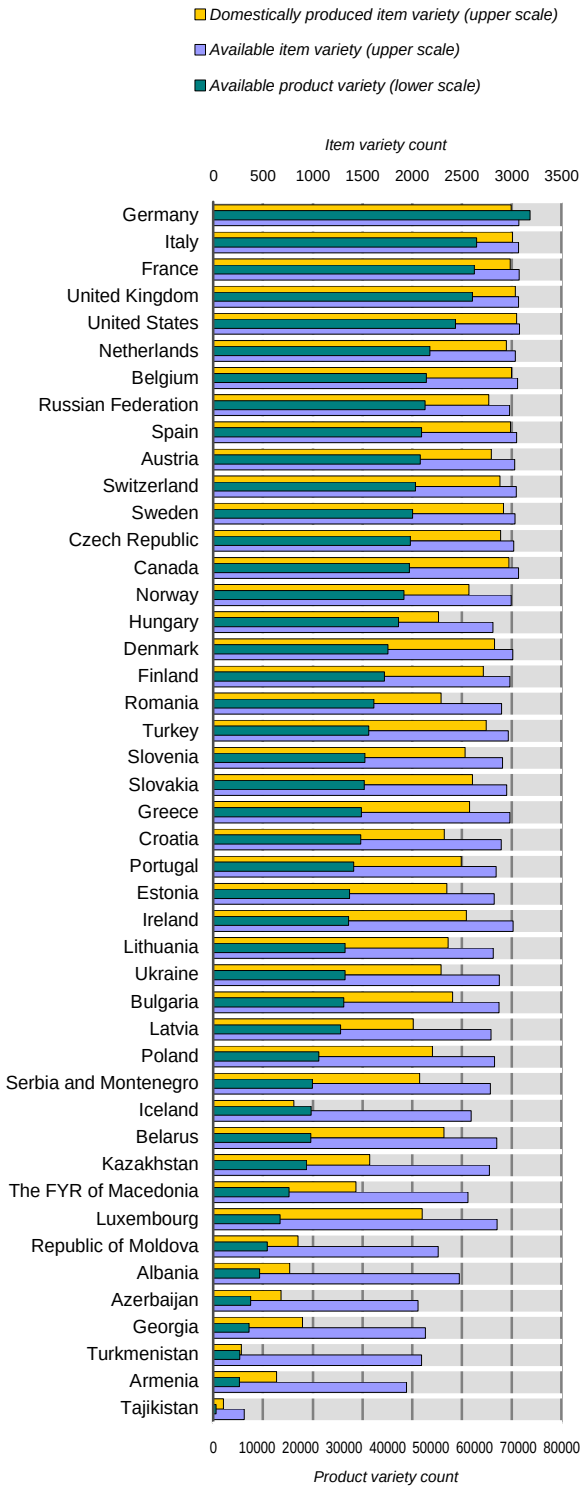
[1] Count measures are unweighted. For a weighted measure of variety, see R. Feenstra, "New product varieties and the measurement of international prices", *American Economic Review*, Vol. 84, No. 1, March 1994, pp. 157-177. The Feenstra measure and others derived from this have so far been applied in the empirical studies quoted below. However, these more sophisticated measures also have drawbacks compared with simple count measures: a country trading substantially fewer differentiated items but doing so in a much more proportional way than another one might emerge on the weighted measure as the one with the higher degree of variety. This is unsatisfactory given the commonly held notion of product diversity and variety. In the analysis below the simple count measures are used while more sophisticated measures have been set aside for subsequent studies.

[2] The reference to the EU unit values (rather than those of the United States, which are often used in the literature) was chosen for two reasons: i) quantity measurement units for merchandise trade are currently better harmonized across the west and east European countries and CIS, albeit less so, which allows for a larger commodity coverage when computing unit values; and ii) there is a certain similarity in the geographical distribution of trade flows for the majority of these countries, hence distortions arising from the price differences between very differentiated markets are reduced.

[3] However, it has to be noted that unit value interpretations in terms of quality have to be regarded with reservation. Even at the 5-digit level of disaggregation goods assigned to a certain item are not necessarily homogenous, hence they may differ quite substantially in their specifications and in price/quality. Aggregating products on the basis of their weight, number or volume blurs these distinctions even more.

CHART 6.2.1

Trade-based count measures of product variety in 44 ECE countries (all commodities), 2001



Source: United Nations COMTRADE Database and UNECE secretariat calculations. See annex to this chapter for a complete data description.

Note: Data on produced variety are based on export data, available variety on export and import data. The maximum attainable item or product variety numbers are 3,114 and 174,384, respectively. No data were available for Kyrgyzstan in 2001.

to most of its CIS neighbours and to other, mainly developing, economies outside North America and western Europe: thus, in 2000-2001, relative item variety of CIS imports from Russia amounted to 92 per cent.[351] Iceland and Luxembourg, on the other hand, are two very small countries that specialize in producing and exporting a narrow range of goods and services.[352]

Differences between domestically produced and available variety within broad economic categories are quite distinct in the ECE region (table 6.2.1). In general, the relative variety of goods produced at home is highest for consumer goods and lowest for intermediate goods. While the divergence between consumer and capital goods probably reflects larger returns to scale in the production of the latter,[353] the figures for intermediate goods are more difficult to interpret.[354] The CIS subregions, where more variety is produced in capital goods than in consumption or intermediate products, are interesting exceptions to this pattern. This may reflect the heritage of the Soviet period, when priority was given to heavy industry at the expense of consumer goods.[355] The respective patterns for variety made available at home, either by production or trade, depend on whether or not product differentiation by country of origin is taken into account. In the case of item variety, trade is obviously a way to reduce the gap between produced and the maximum attainable variety. Especially, the ranking of variety for consumption, or capital, and intermediate goods is generally the same for all the ECE regions, including the CIS. However, once product variety by country of origin is taken into account, the available product variety gap across different broad economic categories widens.

Between 1992 and 2001 variety increases in North America and western Europe were more or less entirely due to the "geographic spread of trade," i.e. to trading with more partners than before. This was also important for the reforming east European and CIS economies, where the liberalization of trade led a geographical

[351] Based on import data for 10 CIS countries (detailed statistics are not available for Uzbekistan).

[352] Services account for 72 per cent of total employment in Luxembourg and for two thirds in Iceland. Due to the limited importance of industry in these two countries, trade in intermediate and capital goods is small. In respect of consumer goods, Iceland imports from only a limited number of countries, probably due to its geographical isolation. The reason for a similar pattern in the case of Luxembourg is less clear (the re-export activities of neighbouring EU countries might be part of the explanation).

[353] This is in line with the standard theoretical approaches to product differentiation described in section 6.1. The high relative measure for consumer goods also fits the Linder model of domestic consumption being a pre-condition of a good becoming an export item.

[354] This may partly reflect the bias of the trade-based variety measure against non-traded goods. In some countries, low relative variety in the intermediate goods category may reflect a high degree of within-country specialization, but differences in resource endowments may also matter for lower levels of produced varieties of intermediate goods.

[355] However, during the transition process the growth of item variety, as captured in the trade data, has also been highest for capital goods (table 6.2.2).

TABLE 6.2.1

Relative measures of variety by broad economic categories for selected ECE subregions, 2001
(Per cent)

	Domestically produced item variety	*Available item variety*	*Available product variety*
All goods			
North America and western Europe	91.4	97.2	27.1
EU	91.4	97.1	27.6
EU acceding countries	77.1	92.1	19.5
South-east Europe	60.4	88.2	14.5
Russia	89.0	95.7	27.9
European CIS	58.4	85.5	12.4
Caucasus and central Asia	22.3	60.5	4.9
Consumer goods			
North America and western Europe	96.7	99.1	31.7
EU	97.3	99.2	32.2
EU acceding countries	85.2	96.3	22.6
South-east Europe	70.5	94.0	16.4
Russia	91.5	98.2	32.1
European CIS	64.0	90.9	13.1
Caucasus and central Asia	24.0	70.8	6.0
Capital goods			
North America and western Europe	95.0	98.5	29.5
EU	94.5	98.5	29.8
EU acceding countries	84.6	95.4	22.4
South-east Europe	64.3	92.5	17.5
Russia	94.9	98.1	35.3
European CIS	70.1	89.3	15.5
Caucasus and central Asia	33.5	68.2	6.7
Intermediate goods			
North America and western Europe	88.7	96.3	25.0
EU	88.7	96.2	25.5
EU acceding countries	72.6	89.9	17.8
South-east Europe	56.1	85.4	13.4
Russia	86.8	94.4	24.8
European CIS	53.8	83.0	11.6
Caucasus and central Asia	25.0	55.1	4.1

Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Relative variety measures are given in per cent of their respective maxima. Regional figures are unweighted averages of the countries included. Belgium and Luxembourg are treated as one country. North America and western Europe comprise the EU, Canada, Norway, Switzerland, Turkey and the United States. This corresponds to the ECE members of the OECD (without Iceland) before 1996; EU acceding countries: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia; south-east Europe: Albania, Bulgaria, Croatia, Romania, Serbia and Montenegro and The former Yugoslav Republic of Macedonia; European CIS: Belarus, Republic of Moldova and Ukraine; Caucasus and central Asia: Armenia, Azerbaijan, Georgia, Kazakhstan, Tajikistan and Turkmenistan.

diversification that went well beyond the substitution of new western for old eastern trading partners (the data in table 6.2.2 illustrate these developments during the second part of the decade).

This result complements earlier evidence about the response of trade-based variety measures to liberalization. Trade liberalization generally implies that goods traded the least prior to liberalization account for much higher shares afterwards.[356] For developing and middle-income economies, however, much of this liberalization effect appears to be due to the geographic spread of trade, especially when it is acknowledged that barriers to trade have been substantially reduced almost everywhere over recent decades.[357]

However, in most east European and CIS economies the variety available domestically also increased during the 1990s as a result of many more items being produced at home (and exported) than before. This holds especially for capital or intermediate products, or both in the cases of Kazakhstan and Slovakia (table 6.2.2).[358]

While there was some loss of variety produced or available in several countries in particular categories, the only country where all measures of variety in all broad economic categories fell between 1996 and 2001 is Russia, although it nevertheless continues to have a very high overall degree of variety. The reduction of variety in Russia may be due to the termination of some economically non-viable activities, the legacy of central planning; however, the failure to renew more substantially the domestically produced item variety indicates the slow pace of industrial restructuring.[359] Similar observations hold for Ukraine, where there has been only a slight increase in the available product variety of capital goods, while on all other counts it has fallen.

[356] This can be seen in the response of 18 North American and European countries to significant trade liberalization. See T. Kehoe and K. Ruhl, "How important is the new goods margin in international trade?", University of Minnesota, October 2002, mimeo. However, theoretical predictions of the behaviour of quantities, varieties and qualities in response to trade liberalization differ due to differences in the treatment of producers' market power. In constant returns to scale models producers face downward sloping world demand curves, while horizontal product differentiation creates market power and quality upgrading is rewarded with higher prices.

[357] On the export side, this particular feature has been noted (and termed "geographic spread of trade") in S. Evenett and A. Venables, "Export growth in developing countries: market entry and bilateral trade flows", World Trade Institute (Bern), July 2002, mimeo. The export growth of developing and middle-income economies between 1970 and 1997 was only to a small degree accounted for by the introduction of new items; the expansion was largely due to increased exports to established trading partners and, to about one third, by sales of existing products to new trading partners. A study incorporating aspects of product differentiation by country of origin supports this notion of "geographic spread of trade" on the import side as well: the 1986-1992 trade liberalization in Costa Rica led to a large increase in the average number of countries from which existing items are imported; see P. Klenow and A. Rodríguez-Clare, "Quantifying variety gains from trade liberalization", Graduate School of Business, University of Chicago, September 1997, mimeo.

[358] It should be noted, however, that in the east European region the most notable changes in domestically produced item variety took place during 1992-1996 when, for instance, item variety of intermediate and capital goods increased some 20 per cent in Poland and Romania, and 10 per cent in Hungary and Slovenia. Since data for the first half of the 1990s are sparse for the Baltic, south-east European and CIS countries, however, table 6.2.2 refers mainly to 1996-2001.

[359] These are *net* changes in variety, taking into account abandoned and newly introduced items. During 1996-2001 Russia introduced 84 "new" domestically produced items (i.e. items first appearing on the export list after 1996, the value of which exceeded $10,000 in any of the subsequent years); among them 54 were intermediate goods and 22 were consumer goods. This increase, however, compares rather poorly with many west and east European countries where levels of variety were similar in 1996.

TABLE 6.2.2

Average annual growth rates of variety measures by broad economic categories for selected ECE subregions and countries, 1992-2001
(Per cent)

	Domestically produced item variety						Available item variety						Available product variety					
	Consumer goods		Capital goods		Intermediate goods		Consumer goods		Capital goods		Intermediate goods		Consumer goods		Capital goods		Intermediate goods	
	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001	1992-1996	1996-2001
North America and western Europe	0.1	–	0.1	0.1	0.3	–	-0.1	–	-0.1	–	-0.2	-0.2	2.0	1.5	1.9	1.6	1.8	1.4
EU	–	–	-0.1	0.1	0.1	–	-0.1	–	-0.1	–	-0.2	-0.2	1.2	1.4	1.3	1.6	1.1	1.4
EU acceding countries																		
Czech Republic	-0.2	-0.1	0.4	-0.1	0.3	–	-0.2	-0.1	0.5	–	-0.1	-0.1	4.1	0.7	5.4	1.1	7.1	2.3
Estonia	..	0.6	..	–	..	1.8	..	..	..	-0.1	..	0.3	..	3.5	..	5.8	..	6.1
Hungary	0.1	0.5	2.0	0.1	2.4	1.0	0.1	0.4	0.9	0.2	0.2	-0.1	5.4	3.3	6.5	2.7	7.3	2.8
Latvia	..	2.2	..	1.2	..	1.8	..	0.4	..	0.8	..	0.6	..	6.9	..	7.2	..	6.4
Lithuania	..	-0.1	..	0.9	..	-0.3	..	-0.1	..	-0.3	..	-0.2	..	3.2	..	3.8	..	3.5
Poland	3.0	-0.3	0.9	1.2	4.7	0.4	3.1	–	3.1	-0.3	5.0	–	-8.4	2.2	-0.3	1.0	1.4	2.4
Slovakia	..	2.6	..	4.5	..	6.7	..	1.3	..	1.9	..	1.7	..	2.0	..	2.3	..	4.8
Slovenia	0.5	-0.4	2.6	0.3	0.3	0.1	-0.1	-0.1	0.2	–	-0.1	-0.3	11.5	1.7	9.0	1.5	5.7	2.2
South-east Europe																		
Albania	..	4.0	..	8.3	..	-0.8	..	1.1	..	0.8	..	0.8	..	4.0	..	4.7	..	2.3
Bulgaria	..	0.3	..	0.7	..	-1.7	1.4	0.4	1.7	0.4	1.5	0.4	..	7.2	..	6.3	..	5.3
Croatia	0.7	-0.7	3.7	1.1	-0.7	-0.7	0.8	-0.3	1.2	-0.2	0.2	-0.4	16.4	2.8	12.2	3.3	8.0	3.2
Romania	1.0	1.6	6.6	0.1	4.8	0.8	0.4	–	1.9	-0.1	1.3	0.1	10.9	2.4	16.7	3.0	16.7	4.0
Serbia and Montenegro	8.3	-1.1	7.9	-0.8	13.7	-3.4	1.5	-0.2	1.0	0.4	1.7	-1.0	11.9	..	10.3	1.1	11.0	-0.5
The Former Yugoslav Republic of Macedonia	..	2.8	..	2.6	..	-0.3	..	0.0	..	-0.6	..	-0.6	..	0.0	..	1.2	..	1.7
Russia	..	-0.4	..	-0.4	..	-0.7	..	-0.2	..	-0.1	..	-0.5	..	-5.4	..	-0.6	..	-1.6
European CIS																		
Republic of Moldova	..	-0.7	..	5.6	..	-1.4	..	1.0	..	1.6	..	0.7	..	6.0	..	7.7	..	6.7
Ukraine	..	-1.2	..	-0.5	..	-1.8	..	-0.3	..	-0.1	..	-0.4	..	-6.0	..	0.3	..	-0.1
Caucasian and central Asian CIS																		
Armenia	..	-2.5	..	2.5	..	-9.6	..	2.9	..	3.4	..	3.3	..	9.1	..	12.4	..	12.5
Azerbaijan	..	-1.3	..	13.6	..	0.8	..	0.0	..	3.3	..	1.7	..	9.6	..	21.1	..	12.4
Kazakhstan	..	36.3	..	65.6	..	50.5	..	49.9	..	69.5	..	43.1	..	43.3	..	81.7	..	50.9
Turkmenistan	..	53.1	..	150.2	..	55.6	..	71.6	..	103.1	..	68.2	..	60.8	..	109.0	..	66.8

Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Regional figures are unweighted averages of the countries included. Belgium and Luxembourg are treated as one country. North America and western Europe comprise the EU, Canada, Norway, Switzerland, Turkey and the United States.

Considering the *quality* of domestically produced and imported items, there too, as in the case of variety, the cross-country variation is much more pronounced for the former, particularly for capital goods. In 2001, the coefficient of variation of relative export unit values across 38 ECE countries was 0.25 for all goods, and 0.57 for capital goods, while the relative import unit values varied much less (0.20 and 0.35, respectively). Despite their wide range, the relative unit values of individual countries' exports of all commodities and for intermediate and capital goods reveal some distinctive patterns (chart 6.2.2). The cross-country variation in quality is characteristically lower for intermediate goods, due in part to the importance of intra-firm trade, which reflects the international fragmentation of production processes within multinational companies. The variation in quality is largest for capital goods, which is partly due to the more narrow specialization of countries and the more pronounced diversity of the items in this category.[360]

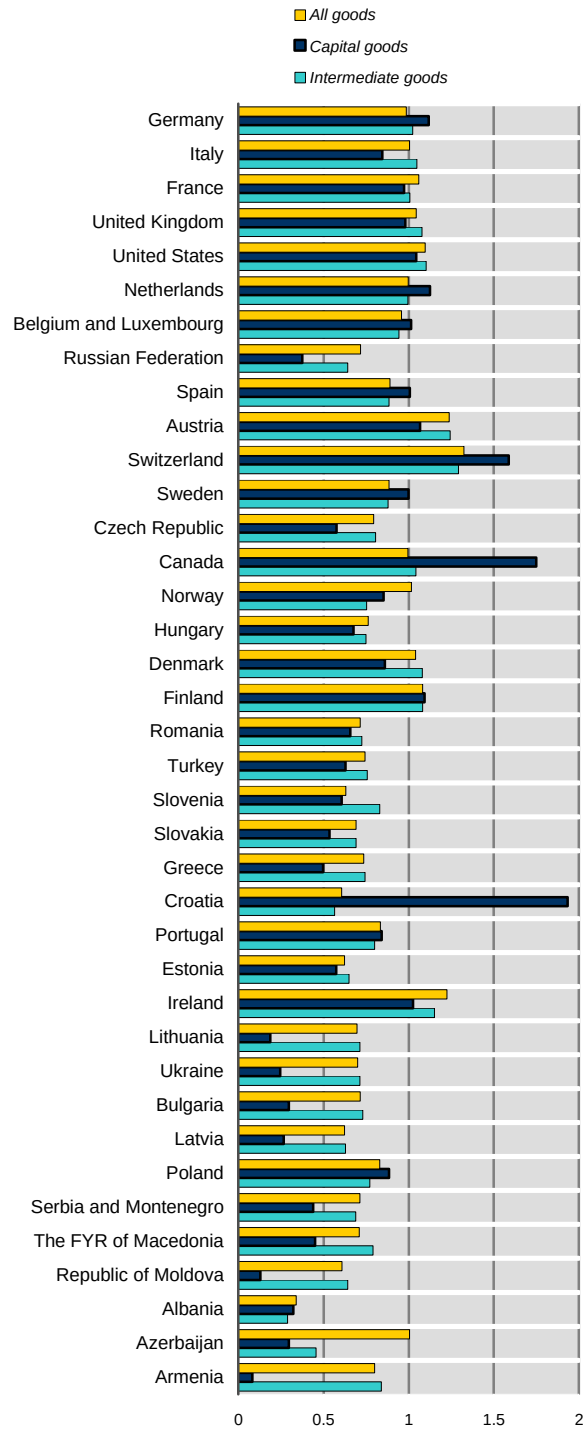
A few small and wealthy west European countries situated in the middle ranks in respect of available product variety (Austria, Denmark, Finland and Switzerland) rank highest with respect to the quality of their domestically produced items. The rapidly growing Irish economy is also characteristically well above the average measure of quality, ranking third among the countries under consideration. Of the eight EU acceding countries, only the Czech Republic, Hungary and Poland are in the middle ranks for quality (some 17-24 per cent below the EU average), whereas the other five are in the midst of the bottom ten. The CIS countries that in 2001 had the lowest available product variety ranked somewhat higher for quality, mainly because of their resource-based specialization.[361] A similar pattern holds for some of the south-east European economies.

[360] The specialization argument holds well in the case of Croatia – its specialization in shipbuilding is reflected in the very high relative export unit values for capital goods. The statistics for Canada are rather weakly based, in that the number of items for which relative unit values were established is very small.

[361] In Azerbaijan, the internationally determined crude oil export price was the main reason for the country's high rank in relative export unit values. Armenia's high average relative export unit values (chart 6.2.2) were mainly due to the exports of "specific sands", non-ferrous metals (aluminum, copper, zinc) and their products, the prices of which are also mostly internationally determined.

CHART 6.2.2

Export unit values relative to the EU average in 38 ECE countries, 2001



Source: United Nations COMTRADE Database and UNECE secretariat calculations. See annex to this chapter for a complete data description.

Note: Quantity weighted average of relative export unit values of all goods, capital goods and intermediate goods. In each case, the average EU export unit values equal one. Countries are ranked according to available product variety as in chart 6.2.1.

Russia ranks below these other CIS countries on the quality measure. The average relative unit value of its exports is pulled down by its capital goods, which are chiefly exported to the CIS and developing countries. However, the average is also pulled down by resource-based intermediate goods and fuel exports, a large proportion of which are also sold to the same countries at prices often below those on international markets.[362] The difference between Russia's high rank (and also Ukraine's to some extent) on variety and its low rank for quality confirms the delay in industrial restructuring.[363]

Most of the countries with higher initial levels of produced or available variety tend to exhibit subsequently relatively low growth rates of variety (table 6.2.3). The highest growth rates of variety in the ECE region were in countries that started from very low levels (table 6.2.2). However, in the case of the measures of available variety, this negative relationship is not significant for the North American and west European countries, which are already closer to the frontier of variety according to the count measures. For the case of variety produced domestically, this finding indicates that imitation might have played a prominent role in the process of increasing variety, a topic that will be further analysed in section 6.4 below.

Regarding relative unit values, the correlation between initial levels and subsequent growth is much weaker for both exports and imports. The eight EU acceding countries seem to show consistent behaviour during the transition period, improving the quality of domestically produced items (and presumably moving up the value added chain) and importing better quality final goods. However, the south European and CIS countries seem to show little progress in this respect.

6.3 Variety, quality and economic development

Relating measures of variety and quality to levels of economic development such as per capita income, suggests an array of potentially interesting links that are summarized in table 6.3.1. Almost exclusively, measures of variety and quality are positively correlated with per capita income, often quite strongly. The strength of the correlations, however, differs according to country groups: for consumer, capital and intermediate goods, the weakest correlations between variety measures and per capita income are all in North America and western Europe. Except for capital goods, this is not the case for

[362] In the case of fuels, this pricing is mostly policy driven and not a matter of quality differences.

[363] Russia and Ukraine stand out from the other CIS countries in variety terms from the beginning of the transition: this reflects the legacy of the Soviet Union's central planning system, which determined who produced what and was little related to comparative advantages across the Union. Hence, while many ex-Soviet republics produced too little variety, Russian and Ukrainian enterprises were subsidized to produce too much of it, albeit of low quality.

TABLE 6.2.3

Cross-country correlation coefficients between 1996 levels and average annual growth rates of variety and quality in ECE countries, 1996-2001

	Domestically produced item variety	*Available item variety*	*Available product variety*	*Export unit values* [a]	*Import unit values* [a]
North America and western Europe					
Consumer goods	-0.30	-0.03	-0.03	0.04	-0.35
Capital goods	-0.69	-0.22	0.06	-0.68	0.61
Intermediate goods	-0.05	0.33	0.11	-0.31	-0.50
EU acceding countries					
Consumer goods	-0.67	-0.78	-0.40	-0.64	-0.77
Capital goods	-0.50	-0.85	-0.66	-0.26	-0.50
Intermediate goods	-0.56	-0.55	-0.67	-0.96	-0.18
South-east Europe and CIS					
Consumer goods	-0.62	-0.94	-0.58	-0.28	-0.21
Capital goods	-0.61	-0.92	-0.57	0.01	-0.72
Intermediate goods	-0.52	-0.85	-0.59	-0.46	-0.05
All ECE countries					
Consumer goods	-0.62	-0.93	-0.55	-0.11	-0.15
Capital goods	-0.63	-0.91	-0.56	-0.34	-0.24
Intermediate goods	-0.50	-0.83	-0.54	-0.27	-0.37

Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Country groups are defined as in table 6.2.1. On data constraints see annex to this chapter.

[a] Based on data for 38 ECE countries.

TABLE 6.3.1

Cross-country correlation coefficients between GDP per capita and measures of variety and quality in the ECE region, 1992, 1996 and 2001

	Domestically produced item variety	*Imported item variety*	*Available item variety*	*Imported product variety*	*Available product variety*	*Relative export unit values* [a]	*Relative import unit values* [a]
North America and western Europe							
Consumer goods	0.22	0.45	0.26	0.57	0.57	0.45	0.41
Capital goods	0.40	0.13	0.23	0.42	0.42	0.30	0.18
Intermediate goods	0.31	0.21	0.12	0.38	0.38	0.44	0.15
EU acceding countries							
Consumer goods	0.56	0.45	0.40	0.63	0.63	-0.39	-0.40
Capital goods	0.71	0.62	0.54	0.67	0.67	0.57	0.68
Intermediate goods	0.59	0.66	0.64	0.76	0.77	0.77	0.54
South-east Europe and CIS							
Consumer goods	0.68	0.52	0.49	0.68	0.68	-0.32	0.22
Capital goods	0.68	0.55	0.51	0.75	0.75	0.55	0.46
Intermediate goods	0.70	0.63	0.60	0.73	0.73	0.20	0.26
All ECE countries							
Consumer goods	0.64	0.48	0.43	0.78	0.78	0.69	0.73
Capital goods	0.65	0.47	0.44	0.70	0.71	0.62	0.70
Intermediate goods	0.68	0.57	0.54	0.73	0.74	0.77	0.46

Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Country groups are defined as in table 6.2.1. On data constraints see annex to this chapter.

[a] Based on data for 38 ECE countries in 1996 and 2001.

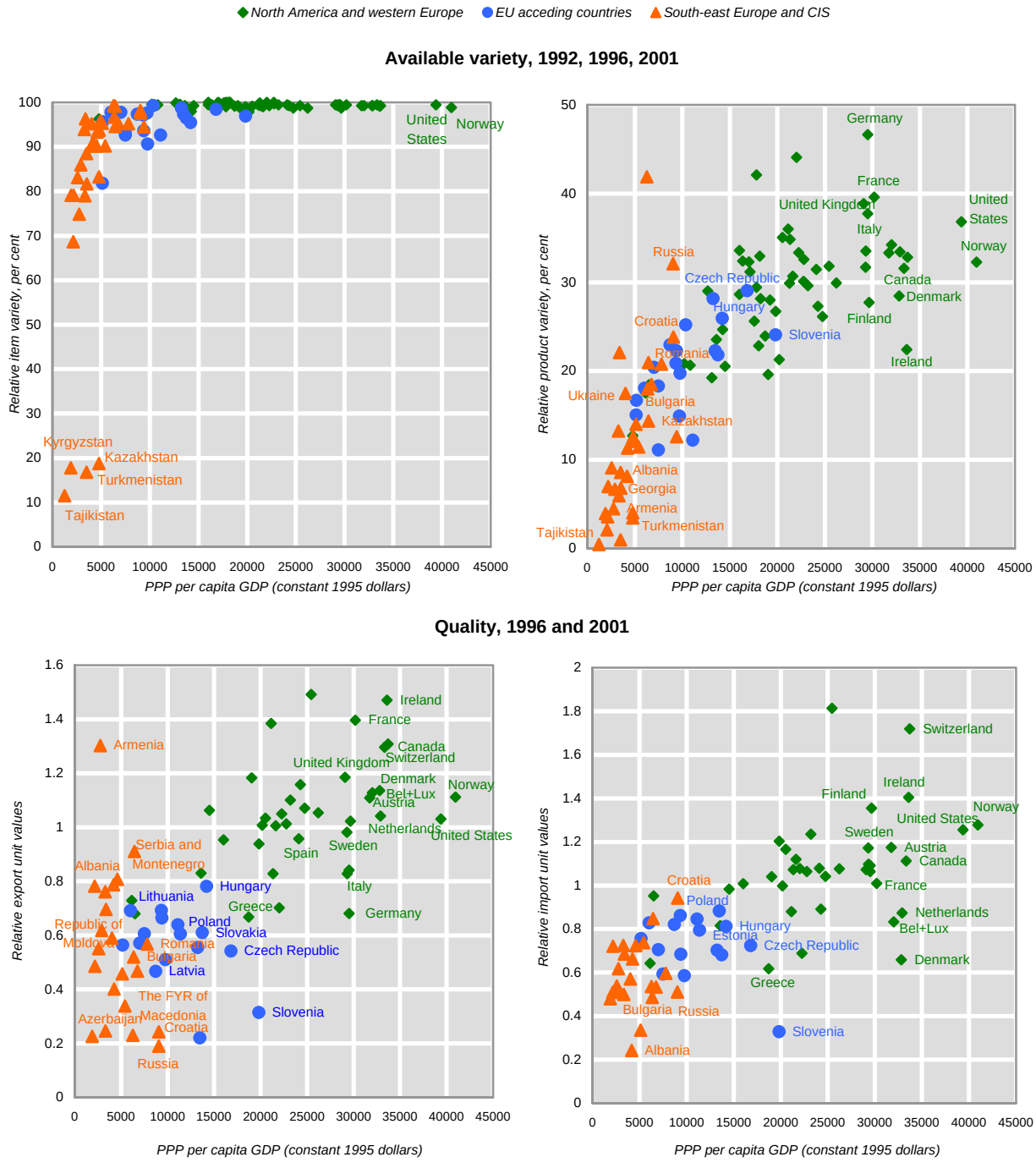
quality measures. Moreover, there is no positive link between the relative quality of consumer goods and per capita income in the EU acceding countries (for both domestically produced and imported items), south-east Europe and the CIS (for domestically produced items).

However, the correlations between the various measures of variety, quality and per capita income may be due to very different underlying relationships hypothesized in distinct theoretical approaches incorporating additional explanatory variables. Some of these approaches can be illustrated with separate sets of variety and quality data and by making use of the broad economic categories and the distinction between domestically produced versus available item variety and product variety as defined in box 6.1.1.

A first causal link on the demand side might run from per capita income to variety and quality, as in higher income economies consumers demand not simply

CHART 6.3.1

Per capita GDP and measures of available variety and quality of consumer goods in the ECE region



Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Country labels refer to 2001 data. Country groups are defined as in table 6.2.1. On data constraints see annex to this chapter.

more consumption but a greater variety and better quality of consumer goods.[364] The United States experience over the past 20 years or so suggests that consumers in high-income countries have greatly increased their spending on goods for which there is a rich variety.[365]

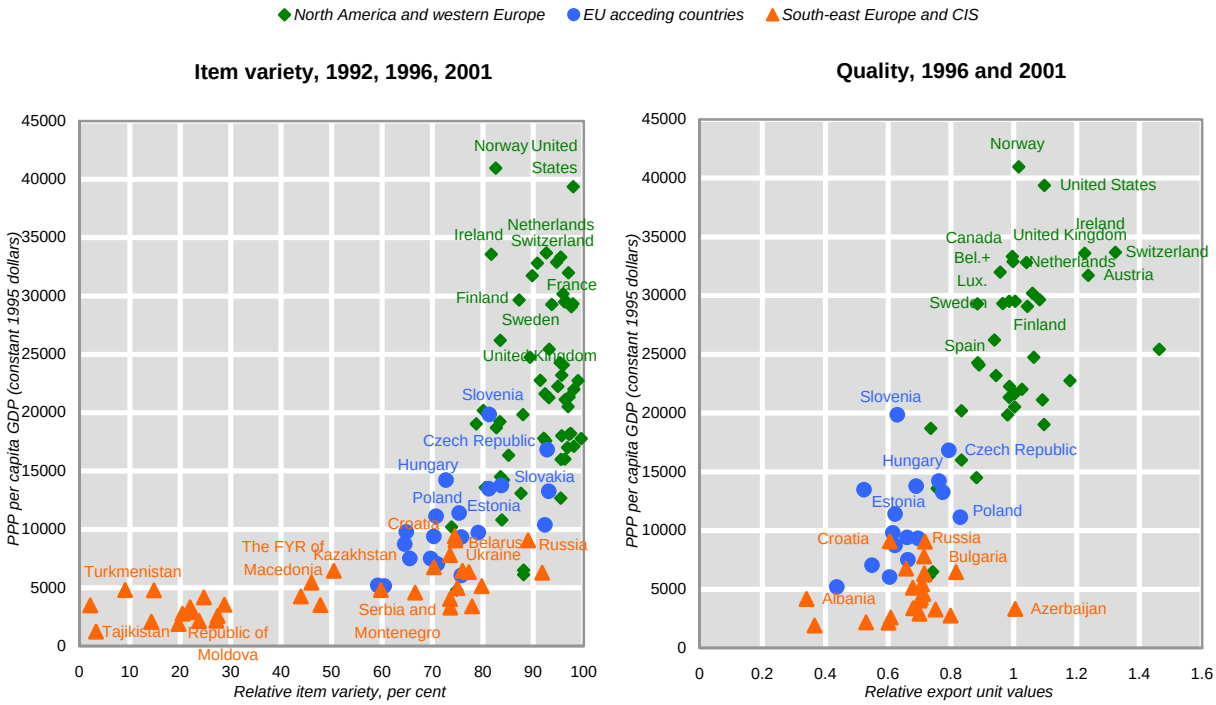
Chart 6.3.1 provides evidence to support this hypothesis, i.e. that a higher per capita income leads to increased demand for both a higher quality as well as a

[364] This hypothesis is connected to Linder's approach to production and trade as being driven by similarities in income and preferences, implying that most trade will occur as intra-industry trade between similar countries. S. Linder, *An Essay on Trade and Transformation* (New York, Wiley & Sons, 1961).

[365] M. Bils and P. Klenow, "The acceleration in variety growth", *American Economic Review*, Vol. 91, No. 2, May 2001, pp. 274-280.

CHART 6.3.2

Per capita GDP and domestically produced item variety and quality of all goods in the ECE region



Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Country labels refer to 2001 data.

greater variety of consumption. The fine degrees of product differentiation by country of origin are obviously instrumental in illustrating more clearly the relationship between per capita income and variety in consumption.

Another demand side link between variety, quality and per capita income builds on the conjecture that increased exports, in turn raising per capita income, should be due to a significant degree to the appearance of new or higher quality domestically produced items among exportables.[366] This suggests a positive correlation between the domestically produced variety and quality of all commodities and per capita income, as already established in table 6.3.1. Previous research has indeed found that richer economies export more in nominal terms than poor ones and they do so by exporting both larger quantities of each good and a greater variety of goods. Specifically, for any pair of economies, the greater item variety in the richer country accounts on average for about two thirds of the difference between the two in their levels of exports. Furthermore, the richer of two economies, again on average, tends to command slightly higher export prices while at the same time exporting larger quantities of each good, which implies that the richer economy's exports are generally of higher quality.[367] Chart 6.3.2 supports this hypothesis and the previous result, suggesting that there may be a threshold below which the relationship may not hold.

From the perspective of the modern economy, however, the most important links between variety, quality and per capita income are on the supply side, as suggested by the theory of endogenous growth. This theory conjectures that it is technological progress, embedded in an increasingly refined division of labour, based on deliberate product and process innovation and imitation, that fosters economic growth. As this evolution in the division of labour is reflected in more product differentiation, one of the simplest versions of an endogenous growth model is one that describes steady-state per capita income as a function of the variety of intermediate goods available in an economy.[368]

However, a structural approach to endogenous growth should start from the general hypothesis that per

[366] For a theoretical justification, see. P. Krugman, "Differences in income elasticities and trends in real exchange rates", *European Economic Review*, Vol. 33, No. 5, May 1989, pp. 1055-1085.

[367] For these results, based on a cross-sectional study of 1995 data, see D. Hummels and P. Klenow, "The variety and quality of a nation's exports", Purdue University, December 2002, mimeo. Note that this cross-sectional evidence does not contradict the time-series evidence, presented in section 6.2, that between 1992 and 2001 variety increases in North America and western Europe were more or less exclusively due to the "geographic spread of trade".

[368] As in P. Romer, "Endogenous technological change", *Journal of Political Economy*, Vol. 98, No. 5, 1990, pp. S71-S102. More refined approaches introduce a trade-off between productivity gains from more variety and cost reductions resulting from learning-by-doing.

capita income depends on the accumulation of physical and human capital and on technological progress. Technological progress, embedded in the division of labour in production, is in turn endogenously determined by firms' investment decisions. Investment decisions (both in physical and in human capital) are thus both a direct source of higher per capita income and instrumental for technological progress. Following the endogenous growth literature, technological progress in the division of labour in production depends predominantly on human capital rather than on physical capital investment. The direct effect of investment on per capita income is dominated by physical investment. This distinction allows for a simplified approach separating the study of per capita income subject to endogenous growth into two questions: how do physical investment and the division of labour together drive per capita income? And how does human capital investment influence the division of labour? The rest of this section deals with the first question, while the second is analysed in section 6.4 below.

A visual inspection of the cross-country data for the ECE countries in 2001 suggests that an increase in item variety in capital and intermediate goods available in each country contributes little to per capita income below a certain threshold (chart 6.3.3) but this changes sharply at higher levels of item variety. The extent of this contribution is more difficult to gauge for ECE member countries in North America and western Europe: as already noted, many of them have for some time been close to the respective frontier of available item variety (see tables 6.2.1 and 6.2.2).

This outcome may simply reflect the limitations of the level of aggregation used in this analysis and the weakness of simple non-weighted count measures that do not allow for variations according to asymmetries in item variety. These shortcomings might be overcome in at least two alternative ways: one is to apply more sophisticated – but also disputable – weighted measures of item variety; another is to add a new dimension to the data, e.g. product differentiation by country of origin. When the latter is taken into account, the data suggest that greater product variety in capital and intermediate goods is associated with higher per capita incomes in all three subregions (see also table 6.3.1) and there is no obvious threshold below which the relationship fails to hold (chart 6.3.3).

As noted above, combining relative export and import unit value data into a measure of available product quality is far from straightforward. Separate inspection of quality proxies for exports and imports of intermediate and capital goods, however, reveals positive correlations with per capita income (table 6.3.1 and chart 6.3.3). This is in line with the conjecture that not just a finer division of labour but also a higher quality of products are associated with a higher per capita income.

Cross-country data for a particular point in time, such as those in chart 6.3.3, may miss important aspects of economic development over time that are available in panel data. Furthermore, testing the hypothesis in a more stringent way requires multiple regression analysis based on the variables suggested by the endogenous growth literature. The theory specifically suggests the existence of a log-linear steady-state relationship between per capita income, the share of physical investment in GDP, and the fineness of the division of labour as represented by the available product variety of capital and intermediate products.[369] The links between per capita income and the quality properties of the division of labour have so far not been adequately explored either theoretically or empirically. The results of the available empirical work linking variety and economic activity within an endogenous growth framework suggest that across OECD and selected east European countries item variety of industrial goods, together with physical investment, is significant for explaining variations in per capita income levels,[370] and that greater item variety contributes to a lead in productivity growth.[371]

The steady-state aspect of this relationship refers to the very long run, i.e. to a time horizon when income per capita is influenced by supply-side effects without transitory shocks, especially from the demand side. While all observed real world data incorporate deviations from their steady-state levels, this is true by definition for the transition economies. The usual way to deal with this is to capture demand side influences and other transitory effects by estimating appropriate trends and fixed effects. Table 6.3.2 reports the results of three different log-linear regressions – one for each broad economic category – between GDP per capita, the share of physical investment in GDP and available product variety.[372] Distinguishing product variety by broad economic categories reduces the danger of mixing supply and potential demand effects in this hypothetical relationship.[373]

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[369] As set out, e.g. in C. Jones, op. cit.

[370] M. Funke and R. Ruhwedel, "Product variety and economic growth: empirical evidence for the OECD countries," *IMF Staff Papers*, Vol. 48, No. 2, December 2001, pp. 225-242 and *Export Variety and Economic Growth in East European Transition Economies*, Bank of Finland Institute for Economics in Transition (BOFIT), Discussion Papers, No. 8 (Helsinki), 2003.

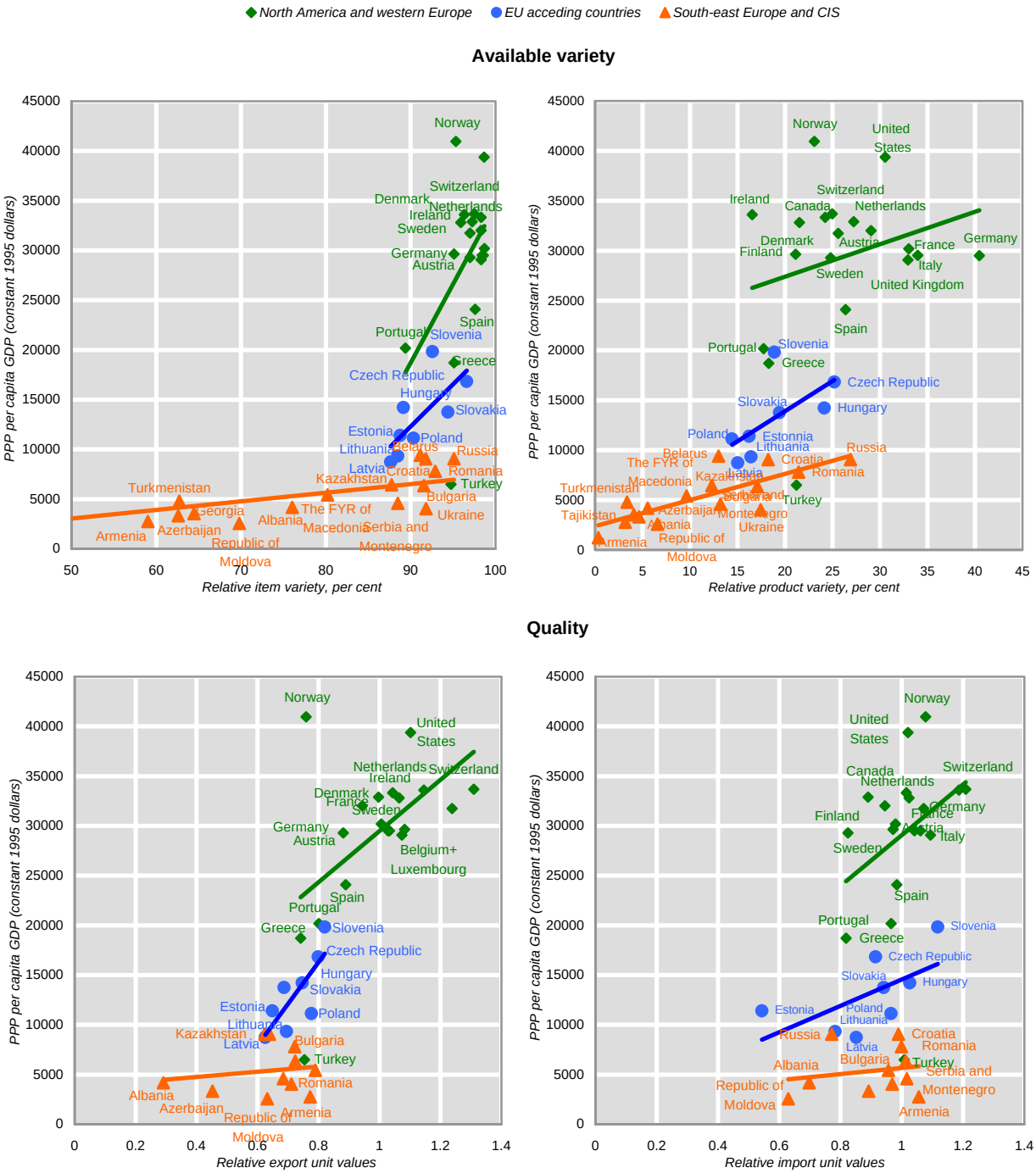
[371] This has been shown to be the case for the productivity lead of South Korea over Taiwan. R. Feenstra, D. Madani, T. Yang and C. Liang, "Testing endogenous growth in South Korea and Taiwan", *Journal of Development Economics*, Vol. 60, No. 2, 1999, pp. 317-341. One recent work has suggested that a relationship between item variety of industrial goods and total factor productivity might also hold in terms of growth rates across a number of 29 developed and developing countries. D. Addison, *Productivity Growth and Product Variety: Gains from Imitation and Education*, World Bank Policy Research Working Paper, No. 3023 (Washington, D.C.), April 2003.

[372] This approach basically follows M. Funke and R. Ruhwedel, "Product variety and economic growth: …", op. cit.

[373] When testing for the relationship between the level of per capita income and variety measures, there is a potential risk of mixing supply and demand side effects implying potential contemporaneous correlation between these explanatory variables and the error term. This is, e.g. due to the endogeneity of variety measures in consumption following the Linder hypothesis discussed above. While previous studies using aggregate variety data on all or just on industrial goods have dealt with this problem by instrumental variable approaches, distinguishing between broad economic categories can also help to alleviate endogeneity problems.

CHART 6.3.3

Per capita GDP and measures of available variety and quality of capital and intermediate goods in the ECE region, 2001



Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: Country labels refer to 2001 data. Data for Tajikistan are not included in the first panel. On other data constraints see annex to this chapter. Relative variety measures of capital and intermediate goods combined are defined as the sum of absolute variety counts for both divided by the maximum attainable measures for both.

The results of table 6.3.2 may be seen as a first step towards identifying common factors of economic development in the ECE region. The estimates support the conjecture that – besides physical investment – the division of labour in the economy, as reflected in available product variety, is an important source of the variation in income per capita across a very diverse set of countries such as the members of the ECE.

Distinguishing variety measures by broad economic categories thus appears to be a useful approach, especially when combined with product differentiation by country of origin, to describing the role of the division of labour in long-run economic development. This is suggested by the significant role of intermediate and capital product variety in table 6.3.2, in contrast to the insignificance of product variety in consumption, in

TABLE 6.3.2

The estimated relationship between GDP per capita, product variety and fixed investment in the ECE region, 1997-2001

Dependent variable: PPP per capita income, constant 1995 dollars	*Capital goods*	*Intermediate goods*	*Consumer goods*
Available product variety	0.40**	0.39*	0.16
	2.02	*1.74*	*0.96*
Investment-GDP ratio	0.34**	0.39***	0.38**
	2.42	*2.78*	*2.53*
Number of unbalanced panel observations	103	103	102
(sample period is 1992, 1996, 2001; estimation method: pooled least squares)			

Source: United Nations COMTRADE Database, UNECE Common Database and World Bank, *World Development Indicators 2003* (Washington, D.C.).

Note: The panel consists of the ECE countries in the groups defined in table 6.2.1 minus the central Asian CIS economies except Kyrgyzstan. The investment-GDP ratio denotes the share of gross fixed capital formation in GDP. For Ireland, Norway, Slovenia and the United States, 2001 investment-GDP ratios refer to 2000. All variables are in logs, i.e. the reported coefficients are elasticities. Country-specific fixed effects and regional time trends are not reported. Heteroskedastic-consistent *t*-values are reported in italics. A *, ** or *** denotes significance at the 10, 5 or 1 per cent level.

explaining variations in income per capita across the ECE countries. As such, it is in line with the endogenous growth hypothesis.

6.4 Innovation and imitation as sources of increased variety and quality

Since the division of labour matters for long-run economic development, identifying the forces that determine it is essential. If trade, as revealed in section 6.2 above, is a major tool for closing the gap between the variety in domestically produced items and internationally available product variety, the potential sources of the variety and quality of domestic production remain to be identified.

In the economic literature, this question has been tackled in the context of both trade and growth theories. Most approaches to international trade in differentiated products are static, and a combination of increasing returns to scale on the supply side and a preference for variety on the demand side leads to variety produced in each country being explained by country size (i.e. GDP or employment). Intrinsically dynamic growth models, however, take variety and quality to be the result of investment in human capital in order to innovate or imitate. The available empirical evidence has so far not rejected the international trade or the growth literature view cited above. Trade-based measures of domestically produced item variety are correlated with country size in the long run,[374] while for changes in such measures both imitation and innovation seem to matter. The introduction of new items in countries with already very high levels of variety appears to be driven by R&D. In contrast, countries that are furthest away from the frontier of observable variety tend to experience the highest growth rates of variety, which lends support to the hypothesis of an imitation effect. Lower amounts of R&D investment are required to introduce product or production processes already available elsewhere than to develop them *ex novo*. The results in table 6.2.3 are consistent with the imitation hypothesis, as almost all measures of initial levels of the variety and quality of domestically produced items are negatively correlated with their subsequent rates of growth. Previous work also supports the presence of interactive effects. A country's ability to imitate can be influenced by investment in human capital. Especially, educational attainment has been found to increase the growth rates of trade-based measures of domestically produced item variety in developing countries.[375]

According to the endogenous growth framework, innovation depends mostly on human capital rather than on physical capital investment. In particular, the rate of innovation can be increased through investment in research and development. The potential for imitation arguably increases with the level of skills of the labour force. Skills can be raised directly through education or may profit from spillovers, especially from foreign direct investment (FDI). One of the potential benefits of FDI is that foreign firms generally demand skilled labour and invest in labour through training. Labour mobility is an important means of skill enhancement throughout the host country.

Consequently, a formal test starts with the hypothesis that rates of change of domestically produced quality and item variety should be driven by initial conditions and by the innovative and imitative strengths of an economy.[376] The formal estimates (table 6.4.1) suggest that across the ECE countries changes in the variety and quality of domestically produced items are indeed related negatively to initial conditions, and positively to FDI inflows and primary school enrolment (both proxying the imitative capacities of an economy) and innovation enhancing research and development expenditures. As for variety changes, this is particularly significant for the growth of domestically produced variety in capital goods, which is arguably one of the most research- and skill-intensive sectors in the economy (table 6.4.1).[377] In particular, initial levels of both variety

[374] D. Hummels and P. Klenow, op. cit.

[375] D. Addison, op. cit. This imitation hypothesis is compatible with the market size hypothesis as long as there is income convergence across countries.

[376] This approach is in the spirit of D. Addison, op. cit., where, however, quality issues are neglected.

[377] Due to the problems of measurement noted above, an analogous result cannot be confirmed for the quality of domestically produced items at the same level of significance.

TABLE 6.4.1

Variety, quality, innovation and imitation across the ECE region, 1996-2001

Dependent variables – annual average growth rates of domestically produced:	*Item variety*		*Quality*
	All goods	*Capital goods*	*All goods*
Item variety, 1996	-0.93**	-4.86***	
	-2.45	*-9.60*	
Quality, 1996			-9.20***
			-3.63
R&D expenditures	0.07	0.60**	2.96**
	0.38	*2.36*	*2.07*
Net FDI inflows	0.07**	0.18**	0.51**
	2.13	*2.42*	*2.30*
Primary school enrolment, 1996	0.03	0.03***	0.04
	1.38	*2.96*	*0.70*
Adjusted R^2	0.19	0.83	0.42
F-statistic	3.11	65.93	7.44
Number of observations (estimation method: least squares)	36	36	37

Source: United Nations COMTRADE Database, UNECE Common Database and World Bank, *World Development Indicators 2003* (Washington, D.C.).

Note: The variety data cover the North American and western European countries as defined in table 6.2.1, the reporting east European and CIS economies (see table 6.2.2) minus the central Asian CIS economies. Quality data country coverage is as in tables 6.2.3 and 6.3.1. Dependent variables are expressed in per cent. Product item variety 1996 and product quality 1996 are the logarithmic values of the count measures of domestically produced item variety and export unit values relative to the EU, respectively. R&D expenditures and net FDI inflows are 1996-2001 period averages relative to GDP, in per cent. On the construction of the R&D measure, see annex to this chapter. Primary school enrolment is the percentage of total enrolment to the population in the corresponding age group.

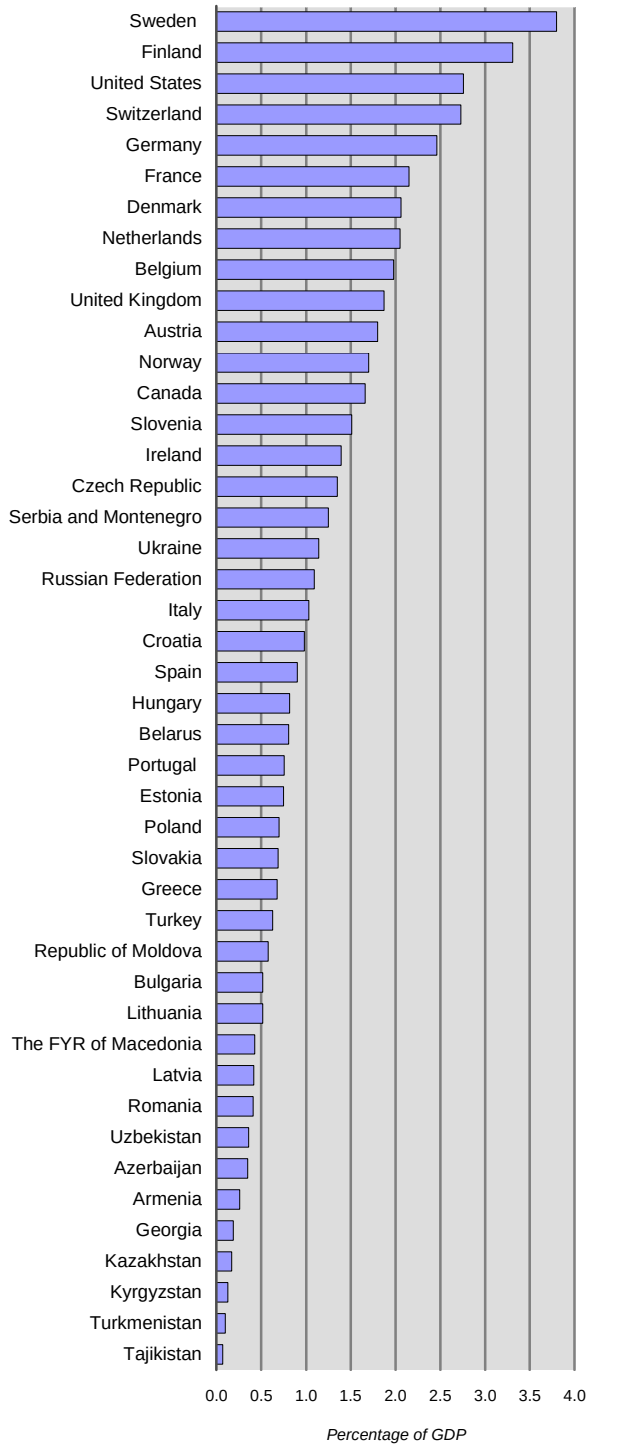
The intercept is not reported. Heteroskedastic-consistent *t*-values are reported in italics. A *, ** or *** denotes significance at the 10, 5 or 1 per cent level.

and quality have a highly significant impact on subsequent growth rates in all of the three estimated equations giving strong support to the imitation hypothesis. Additional support for it comes from the significant influence of FDI on changes in variety and quality. While primary school enrolment generally has a positive influence, this is significant only in case of the growth of variety in capital goods. This may reflect, however, shortcomings in this measure as a proxy of educational achievement rather than a general lack of support for the hypothesis that the level of skills of the labour force, raised through education, increases the potential for imitation.

All ECE economies exhibit innovative and imitative strengths to varying degrees. However, the evidence points to the North American and west European economies as the chief sources of increased variety, and thus of the increasing refinement of the division of labour in the region. The poorest CIS economies, in contrast, spend the least on innovation enhancing research and development expenditures (chart 6.4.1). Nevertheless, based on high rates of

CHART 6.4.1

R&D intensity in the ECE region: gross expenditures on research and development as percentage of GDP, 2000

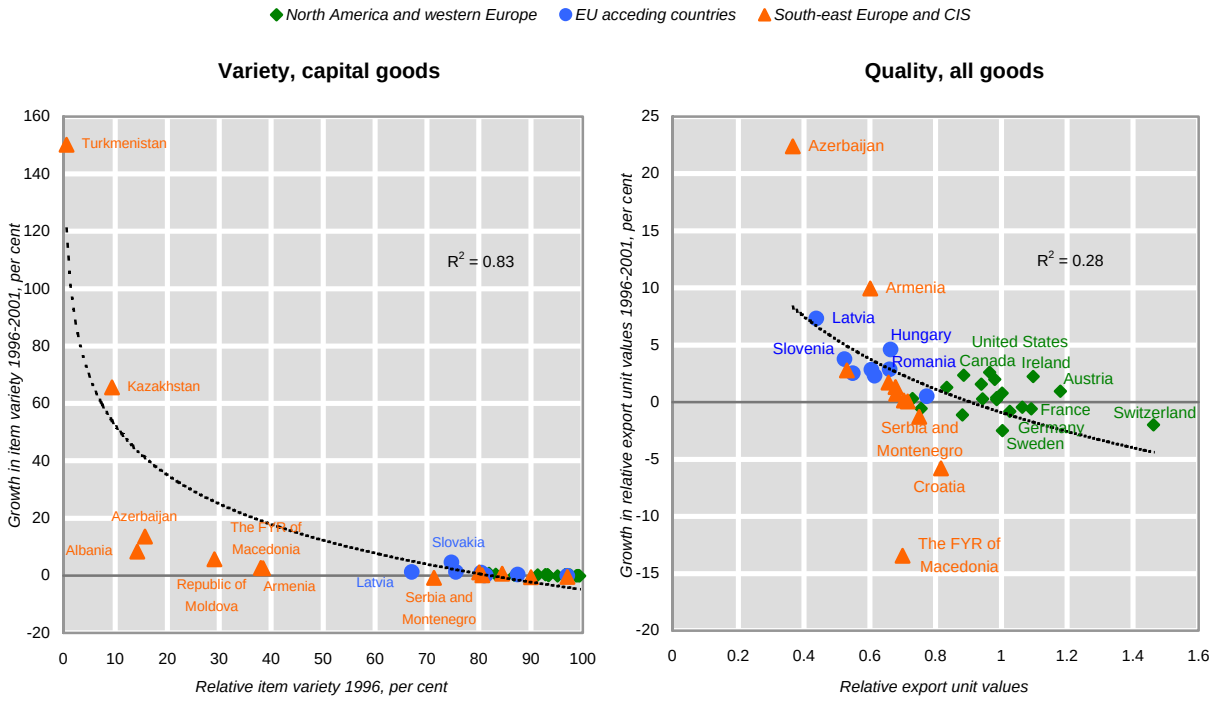


Source: UNECE, *Economic Survey of Europe*, *2002 No. 1*, p. 168.

imitation, the highest growth rates of variety in domestically produced capital goods in the ECE region during the second half of the 1990s were in countries where the initial levels were very low. This is particularly true of the natural resource intensive economies of central

CHART 6.4.2

1996 levels and average annual growth of quality and domestically produced item variety in the ECE region in 1996-2001



Source: United Nations COMTRADE Database and UNECE secretariat calculations.

Note: On data constraints see annex to this chapter. Country groups are defined as in table 6.2.1.

Asia, Kazakhstan and Turkmenistan.[378] Again, the eight EU accession countries occupy a middle rank position. For the case of capital goods this is illustrated in chart 6.4.2.

6.5 Policy conclusions

The existing large disparities in per capita income and rates of growth between countries are among the major challenges facing policymakers in the ECE countries. Understanding the sources of these disparities is important in order to design effective policies to tackle this problem.

This chapter suggests that a deeper division of labour, especially a higher quality and variety of intermediate and capital goods, could have a significant growth-promoting influence. There are several ways in which the quality and available variety of production can be increased: trade, innovation and imitation can all contribute, although they do so in different ways across countries and have done so over time. While all countries can increase the available variety of goods through trade, the particular mix of innovation and imitation capacity depends to a certain degree on their level of development and readiness to absorb technological change. The leading industrial countries increase the quality and variety of domestically produced items to a significant extent by innovation. As shown above, the south-east European and CIS countries have done this in the past decade or so mainly by imitation, while the eight east European EU accession countries appear to have combined the two approaches. The resulting increase in domestically produced item variety is impressive in both of the latter two groups, while quality improvements, which may also be taken to indicate a movement towards higher value added activities, is more characteristic of the EU acceding east European countries.

There are a number of other implications of the above findings. Growing by deepening the division of labour, or by selling a greater variety of items abroad, has been shown in several studies to be more sustainable: such a pattern of growth may result in fewer and less severe current account deficits during the catch-up process,[379] a consideration of particular importance for the EU accession countries. Inasmuch as the division of

[378] The significance of the relationship between initial levels and the subsequent growth of the variety of domestically produced capital goods depicted in chart 6.4.2 is not sensitive to these two extreme data points. The negative relationship for all countries in chart 6.4.2 holds for each of the three country groups separately. However, the base effect should be taken into account: small absolute changes in a very low, initial count measure imply high relative rates of change.

[379] P. Krugman, op. cit. In Krugman's model, faster-growing countries export new items and maintain balanced trade without suffering a deterioration in the terms of trade. For an empirical test of this approach, see J. Gagnon, *Productive Capacity, Product Varieties, and the Elasticities Approach to the Trade Balance*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers, No. 781 (Washington, D.C.), October 2003.

labour depends on human capital and skills that strengthen innovative and imitative capabilities, investment in human capital, especially in the knowledge-intensive sectors of the economy, should support the sustainability of growth.

In a modern economy, deepening the division of labour stems from the innovation and imitation decisions of individual firms, which are often subject to country-specific comparative advantages. For some time to come, the majority of east European and CIS economies are likely to rely on trade and imitation, rather than innovation, to increase the available variety of goods and to improve product quality. This obviously calls for policies that raise the quality of, and access to, skill-enhancing educational systems and which also favour international openness, especially to inflows of FDI.

The key objective should be to enhance the ability of firms to assimilate and take advantage of technical knowledge from abroad and to internalize process and product innovations efficiently. By encouraging R&D to improve the capacity to absorb new technologies and by supporting the development of supply networks as a means of technological upgrading, well-targeted public policies could increase the rates of imitation and innovation. Similarly, prioritizing skill-enhancing education (and re-education) can be an important factor in boosting the creation and absorption of new technology and, in turn, innovation and imitation. Such policies would require appropriate funding, especially in order to increase access to and the quality of education. The recognition of potential positive spillover effects from FDI on the level of skills of the domestic labour force requires encouragement by appropriate government measures in order to realize such benefits, measures that might include incentives to open access to private funding for training.

ANNEX TO CHAPTER 6

DESCRIPTION OF THE DATA

The data for the trade-based variety and quality measures were extracted from the United Nations COMTRADE Database in April 2003, complemented and corrected in a few cases by using COMTRADE-on-line in July-August 2003. The cut-off value for the selection of items is $501 (which is rounded to $1,000).

1) Commodity classifications

The **Standard International Trade Classification, Revision 3 (SITC, Rev.3)** was used at all disaggregation levels (1-, 2- and 3-digit levels for checking totals, 4- and 5-digit levels for counting product variety).

There are 3,121 basic headings in the SITC, Rev.3, 2,824 at the 5-digit level and 297 at 4-digits, that are not disaggregated any further. The 3-digit group 334 (petroleum products), which is divided into eight final headings in SITC, Rev.3, is in fact not subdivided by many reporting countries, so in the data set used in this chapter it is also treated as a single heading. Thus, there are 3,114 basic headings, which are referred to as items or goods.

The **Classification by Broad Economic Categories (BEC)** allows for commodities defined in terms of the SITC, Rev.3 to be grouped into 19 basic categories covering primary and processed foods and beverages, industrial supplies, fuels and lubricants, capital goods and transport equipment, and consumer goods according to their durability. The BEC also provides for the rearrangement of these 19 categories (on the basis of commodities' *main* end-use) to approximate the three basic System of National Accounts (SNA) categories, namely, capital goods, intermediate goods and consumer goods.

Capital goods comprise 471 headings at the 4- and 5-digit levels of the SITC, Rev.3 and include: machinery such as electric generators and computers; industrial transport equipment such as finished ships, road vehicles, aircraft, railway and tramway rolling stock; and other manufactured goods such as medical furniture, which are used by industry, government and non-profit private institutions.

Intermediate goods consist of 1,899 SITC, Rev.3 headings and include: primary and processed food and beverages designated mainly for industry; primary and processed industrial supplies (raw materials), parts and accessories of capital goods; and transport equipment. By definition it should also include primary and processed fuels and lubricants (other than motor spirit), but in this data set "fuels and lubricants", which include 32 4- and 5-digit headings of the SITC, Rev.3, are excluded.

Consumer goods cover 704 headings at 4- and 5-digits of the SITC and include primary and processed foods and beverages designated mainly for household consumption, non-industrial transport equipment, such as motorcycles and bicycles, and other consumer goods.

Because it falls into two categories, "motor vehicles for the transport of passengers", SITC, Rev.3, Heading 7812, is not included in either capital or consumer goods. Similar reasoning holds for motor spirits.

BEC 7, "goods not elsewhere classified", comprises 14 basic headings of the SITC, namely, military equipment, including arms and ammunitions, special transactions, postal packages, etc. and are excluded from all three categories.

2) Country coverage

Reporting countries' data were extracted for 45 countries in the ECE region: the 15 European Union countries (Belgium and Luxembourg reporting jointly in 1992 and 1996), 8 acceding EU countries, 3 EFTA countries (Switzerland and Liechtenstein reporting jointly), 11 CIS (Uzbekistan's data not available), 6 south-east European countries, Canada and the United States. However, for unit value calculations the data set could be completed for only 38 countries, due to the unreliable quantity data for exports and imports for a number of CIS countries (Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan). Unit value data for Iceland are also excluded from this data set.

Partner countries comprise the world (for both exports and imports), and 55 individual countries from the ECE region and Asia (for imports). These partner countries generally account for 80-95 per cent of reported imports. However, Canada and the United States trade extensively with south American countries that are not included among the 55 partners, and for this reason the trade partners in this data set cover a somewhat lower share of these countries' total imports.

3) Period coverage

Three benchmark years are used: 1992, 1996 and 2001. In some cases, owing to the lack of data, other

years had to be substituted: 1993 data for 1992 (the Czech Republic); 1997 for 1996 (Armenia and Turkmenistan); and 2000 for 2001 (Armenia, Bulgaria, Georgia, Kazakhstan, Serbia and Montenegro Tajikistan, Turkmenistan and Ukraine). For unit value calculations, 1992 data were omitted altogether.

4) Relative export and import unit values

To derive a comparative set of unit values, only export and import items for which both dollar values and units of weight were available were selected (the unit value being expressed in dollars per kilogram). In general, the number of such items accounts for 70-75 per cent of all traded items. The commodity coverage, however, varies, not only across the countries, but also across the years and trade flows, for a number of reasons (the use of different quantity units, the appearance of new items, etc.). In the case of the EU – the average unit values of which are used as the reference base – the coverage is nearly complete: the smallest number of items for which such unit values were estimated was 3,026 (out of 3,114) in 2001. The coverage is notably lower in the case of Canada and the United States, where the trade statistics often report quantity in units other than weight.

The "relative unit values" (for exports or imports) are quantity-weighted averages of the ratios of an individual country's unit value for a given commodity against the average EU unit value of the same commodity. The weights are the individual commodity's share in the total quantity of all commodities exported (or imported) by the country in the given year.

In calculating the average EU unit value for a given commodity, unit values for individual member countries that were 100 times higher or lower than the average of the other 14 EU countries were excluded, on the assumption that for this group of countries, trading in similar goods under similar conditions, variations of such magnitude are probably due to recording errors. For the other reporting countries the exclusion bound for such outlier observations was set at 1,000 times above or below the EU average unit value.

5) Special notes on R&D expenditures (as used in table 6.4.1)

The innovative strength of an economy can be assessed by several measures which are highly correlated. The measures used in this section are: (i) R&D expenditures as a percentage of GDP according to the World Bank; (ii) gross expenditure on R&D as a share of GDP according to the UNECE; (iii) personal computers per 1,000 people; (iv) spending on information and communication technology as a share of GDP; and (v) scientists and engineers working in R&D per 1,000 inhabitants. Data sources are UNECE, *Economic Survey of Europe, 2002 No. 1* for (ii), and World Bank, *World Development Indicators 2003* for the other measures.

The availability of the data required for these measures, however, varies across countries and over time. For example, measures (i) and (ii) are conceptually identical and differ only in coverage (see data sources for details). In particular, the coverage of each of these five measures is significantly lower than the coverage of the data used to measure variety and quality. In order to increase the coverage, a single synthetic measure of R&D expenditures as a percentage of GDP was estimated on the basis of the five highly correlated measures. In a first step, measures (ii) through (v) were regressed one by one on the first measure, i.e. on the original data for R&D expenditures as a percentage of GDP. These four regression equations were then used to create "R&D expenditure estimates" for those countries and years, for which measure (i) was unavailable. These fitted values were used individually – in declining order of the fit of the four equations – to fill step-by-step the missing R&D expenditure data. The resulting synthetic R&D expenditure series thus covers many more panel data points than the original R&D expenditure series.