EXPORT STRUCTURE QUALITY AND ECONOMIC GROWTH

Ing. Pavel Gertler, National Bank of Slovakia

The main message from the classical model of international trade is that growth in trade leads by way of comparative advantages to stronger economic performance in the future. From the long-term perspective, however, not all goods (and services) have the same character in terms of the impact of its trade on economic performance. The future growth brought by specialization is greater with certain products (commodities) than with others. Economic growth in the years ahead is affected not just by the volume of trade, but particularly by its qualitative composition. This article looks at the methodology for measuring the structural aspect of exports, and analysis it using the example of the EU-25 countries.

Export structure quality and economic growth

The level of technology intensity (sophistication level) in products is correlated positively with the level of GNI/GDP per capita (with a correlation coefficient between 0.6 and 0.9). Growth in sophisticatin level of products therefore further increases economic growth (Lall, 2005; Rodrik, 2006). Underlying this relationship, there is a quite simple principle. The products exported by economically advanced countries have such properties that ensure both their competitiveness on the world market, and, despite high labour costs, sufficient profits for their producers. These properties include mainly the level of technology, as well as marketing, geographical location of production, logistics, scope for production fragmentation, plant infrastructure, and so on. Trade restrictions and subsidies also play a role (Lall, 2005).

If the sophistication level and economic growth correlate, and this relationship persists over time, how do we know that it is sophistication affecting economic growth and not vice versa? In this case there is a multiplier effect. If an investor finds a country that offers potential for producing certain high technology goods for export, it will create a strong stimulus for other investors to enter the market. The expansion of the respective industry, or related supplier industries, will see funds move from less productive fields to new and more productive ones. The share of productive industries in overall economic output will gradually increase and the less productive fields will gradually lose competitiveness in employment owing to structural changes in the accessibility of factors. Such economic growth is based on varying productivity between sectors, and the structural change in the economy leads to rising economic performance.

The qualitative structure of the export basket and its impact on economic growth is an issue that has been addressed by many authors. Mayer and Wood (2001), for example, examined the export structure of South Asian countries through the lens of the Heckscher-Ohlin model in reaching the conclusion that the unusually high concentration of labour-intensive manufactures is the result of the low level of education in the workforce and the existence of few natural resources relative to the supply of labour. Rodrik (2006) has made a more exact examination of the relationship between indicators of export structure quality and GDP growth, while pointing out the structural change in the quality of the Chinese export basket and the economic growth reported between 1992 and 2003. Using a longer time series (1962-2000), different estimation techniques, and panels in different time horizons (5 and 10 years) on a sample of 42 countries, Rodrik (2006) and Hausmann, Hwang and Rodrik (2005) estimated the effect of export quality (sophistication) on GDP growth.

Theoretical basis

According to the comparative advantage principle, the character and arrangement of trade relations depends on how the relative production costs of a certain country differ from the costs in the domiciles of its trading partners. These differences are linked to the productivity level in the countries' industries (Ricardo model of international trade) or to the relative accessibility of production factors between countries (Heckscher-Ohlin model, hereinafter the "HO model"). Though both models are simplified, they may be used as a conceptual basis for the arrangement of trade relations.

Ricardo's comparative advantage model assumes a link between trade and differences in labour productivity using different levels of technology. Ricardo considers a single factor of production (labour), which is the source of comparative advantages. Heckscher and Ohlin, by contrast, remove technology variations, but introduce variable capital endowments (for example, from infrastructure differen-

[1] See also, for example, Learner, E.: The Hecksher-Ohlin Model in Theory and Practice (Princeton Studies in International Economics) 1995.

ces), which recreates endogenously inter-country variations of labour productivity. In the HO model of two factors, labour productivity in two countries may be the same only if the volume of capital is identical. Nevertheless, labour productivity in the Ricardo model is introduced exogenously. The original HO model of international trade assumes that the production structure of a country is circumscribed by its resources. According to this model, the exports of a country that has an abundance of capital will predominantly include capital-intensive products, and, conversely, the exports of a country that has an abundance of labour will include predominantly labour-intensive products.

The qualitative level of exports is measured on the basis of the HO theory. Indices of export basket quality are calculated as a weighted average of the quality of individual items in commodity structure, based upon the relative representation of a given item in countries' exports and their GDP. Therefore, on the basis of the HO assumption, it simulates the labour/capital endowment ratio in the commodity structure. A higher labour/capital endowment ratio represents production with higher value added and at the end, higher labour productivity, too.

The indices of export basket quality presented here measure production by sophistication level and not by technology level. This is also because the technology level reflects the intensity of the research and development in the given field, which need not be (and often is not) located where plants are being producing. Sophistication level, by contrast, requires specific natural resource, infrastructure, logistical or other needs that are not usually abundant in poorer areas. The average output of a country is usually higher in countries with high sophistication of exports. A classification of the technology level and sophistication level of production is given in the following table:

Technology level	Sophistication level	
	Low	High
Low	Technologically simple products whose export production has shifted to low wage area (e.g. textile production)	Technologically simple products whose export production remains in high-wage areas because of trade distortions, resource availability, logistical needs to be near main markets
High	Technologically advanced products with fragmentable processes located in low wage areas (e.g. consumer electronics production)	Technologically advanced products without fragmentable processes where high wage countries retain strong competitive advantage (e.g. production of optical and electronic equipment, pharmaceutical industry, and so on)

Source: Lall, Weiss, Zhang (2005).

Measuring export structure quality

The quality of export structure is generally measured:

a) as a share of the export production of high-skill industries and low-skill industries (autonomous division of industries); and

b) as an indicator constructed by mapping a country's per capita income to a particular commodity on the basis of the country's relative volume of exports in the respective commodity.

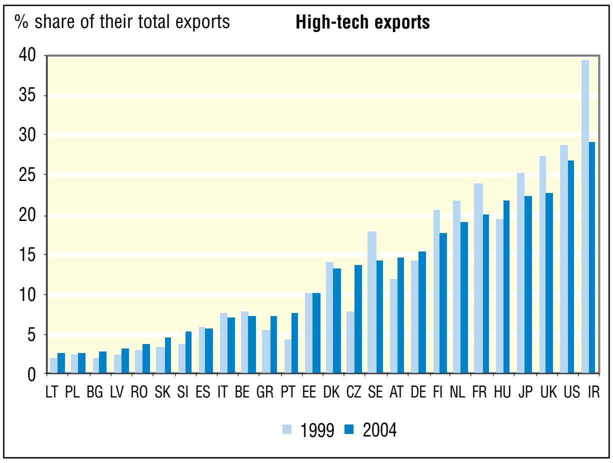
Regarding (a), the indicators used by Mayer and Wood (2001) in their study are defined as the share of primary sector products, labour-intensive manufactured products, and capital-intensive manufactured products and services on total production in the Standard International Trade Classification (SITC). Every year, within a series of structural indicators, Eurostat publishes the ratio of high-tech exports as a share of total exports of a given country. High-tech products are at the same time defined as selected commodities with high value added (products from, among others, the aeronautical, electronics, pharmaceutical, electrical equipment, and arms industries).

The main drawback of the first type of indicator is that the classification of products as labour-intensive or skill-intensive is arbitrary and, more importantly, has binary character (a product is either labour-intensive or not). The second type of indicator removes this drawback by representing the sophistication of each product (commodity).

Regarding (b), the measuring methodology proposed by Kwan (2002) is based on the assumption that products of higher quality and sophistication are exported from advanced economies with higher GDP per capita, and that low-quality products are exported from less developed economies with lower GDP per capita. It is assumed that the more a country's exports include products typical of an advanced economy's exports, the greater will be the quality of that country's exports. These two assumptions are reflected in the two steps used for the typical construction of comprehensive indicators of export quality. The first step involves calculating the average GDP/GNI per capita of countries exporting merchandise of the reference commodity. In the second step, the average export quality of a given country is determined.

In the first step, Lall, Weiss and Zhang (2005) divided

Chart 1 Eurostat indicator showing countries' high-tech exports as a share of their total exports



Source: Eurostat

countries in the database into ten income groups on the basis of nominal per capita GNI; for the k-th item of the export (product) structure they calculated a sophistication value or unique score (US) as a weighted average of per capita GNI, where the weights were exports of product k of the group of countries g as a share of the overall exports of product k.

$$US_k = \sum_{g=1}^{G} HNP_g \frac{EXP_{gk}}{EXP_k}$$

In the second step, they determined the quality of the export basket (countries or industries in a country) based on the weighted level of normalized sophistication indices. The normalized sophistication index (SI) of product k is derived using the formula:

$$SI_k = \frac{US_k - US_{min}}{US_{max} - US_{min}} \cdot 100$$

A product's normalized sophistication index yields a value ranging from 0 to 100.

Chapponière and Lautier (2006) took the same approach in constructing their indicator of Export Catching-Up (ECU), though in the first step they did not divide countries into groups. In the second step, they directly calculated the value of the ECU_j indicator as the weighted average of the US_k quality indices for the export basket of country j.

$$ECU_j = \Sigma_k \, US_k \frac{EXP_{jk}}{EXP_j}$$

The authors then normalized the ECU values.

A weight common to both these approaches is a country's exports of a given product relative to that country's total exports. This approach may, however, cause a certain bias. Where a smaller, less developed country has a relatively larger share of exports of one product, it may bring about downward bias in this product's quality index. Rodrik (2006) solves this potential bias by normalization of the weights. The sum of the weights of each of the product structure items is then equal to 1. The quality index of product k ($PRODY_k$, which has the same interpretation as US_k) will then be:

$$PRODY_k = \sum_j \frac{EXP_{jk}/EXP_j}{\Sigma_k (EXP_{jk}/EXP_j)} HDP_j$$

The expression:

$$\frac{EXP_{jk}/EXP_j}{\Sigma_j (EXP_{jk}/EXP_j)}$$

represents the normalized weights. Its interpretation is identical to that of the revealed comparative advantage (RCA) indicator.[2,3] The resulting indicator of the export basket quality of country j, $EXPY_j$, is then (as with the construction ECU_j) represented by the formula:

$$EXPY_j = \Sigma_k \, PRODY_k \frac{EXP_{jk}}{EXP_j}$$

Results and debate

The quality of exports from European Union countries was demonstrated using the indicator EXPYj. The source of the data on commodity structure is the United Nation's COMTRADE database. It is used here as a disaggregation to four-digit classification, consisting of 1,245 classes according to a harmonized commodity structure.[4] The more detailed the classification used, the less scope bias arises.

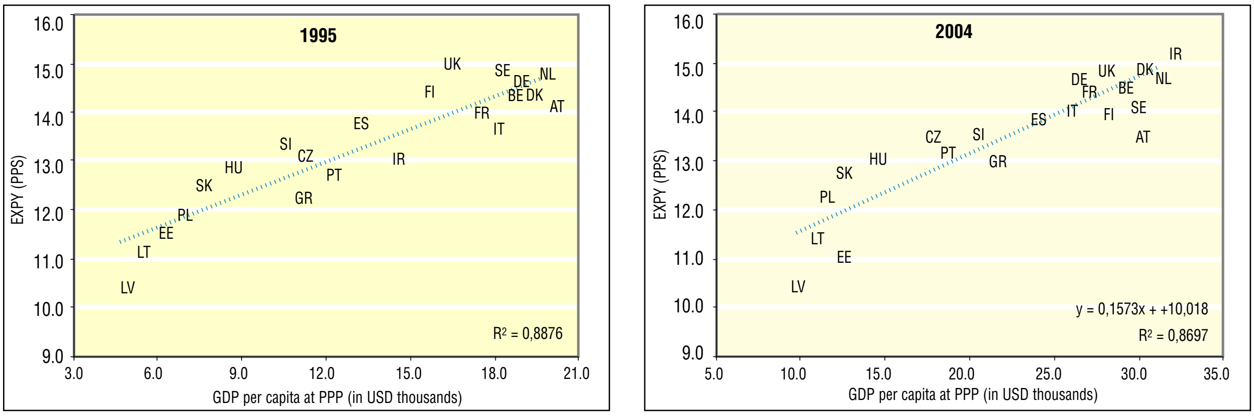
The EXPY indicator was calculated for 22 European Union countries for the years 1995 and 2004. By comparing these two indicators, it is possible to assess changes in the qualitative structure of exports, as well as related changes in GDP per capita. The resulting $EXPY$ values are presented in relation to per capita GDP at purchasing power parity (PPP) in the respective year. It is natural that

[2] The OECD annually publishes this indicator for individual industries of an economy. First constructed by Ballasa (1965), the RCA indicator represents a comparison between national export structure and overall export structure. In non-normalized form, it indicates the comparative advantage of the respective product of a given country, where $RCA_{jk}>1$.

[3] In this case, $\frac{EXP_{jk}/\Sigma_k EXP_{jk}}{\Sigma_j (EXP_{jk}/EXP_j)}$ formula is the normalized form of $RCA_{jk} = \frac{EXP_{jk}/\Sigma_k EXP_{jk}}{\Sigma_j (EXP_{jk}/\Sigma_j \Sigma_k EXP_{jk})}$.

[4] The Harmonized Commodity Description and Coding System (HS 1992, HS1996, and HS2002) is used as the basis of customs tariffs and the statistical classification of trade throughout the world. Further details may be found at http://unstats.un.org/.

Charts 2 and 3 The EXPY indicator relative to GDP per capita



Note: The changes in the EXPY indicator in the years 1995 and 2004 represent the relative growth in the quality of the export structure vis à vis other analysed countries.

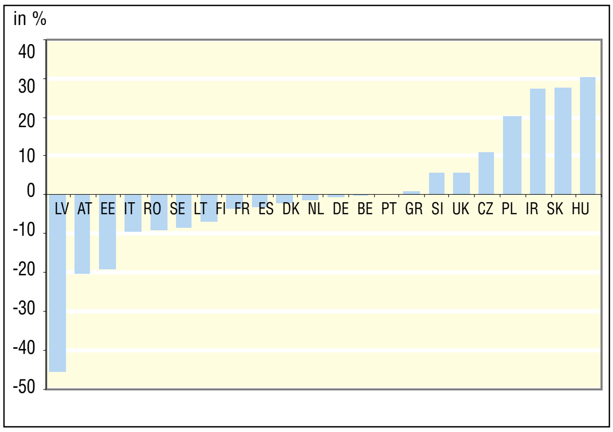
these two indicators should have a high correlation coefficient. Advanced economies (measured by GDP per capita) should have an abundance of capital and should therefore manufacture and export sophisticated products. Export production should correspond to overall production, and especially so in small, open economies whose share of exports to GDP ranges between 50% and 75%. The exports of advanced economies with abundance of capital should be more sophisticated than those of developing economies, where capital is not so easily available. Such economies do, however, have cheaper labour and therefore scope for less sophisticated and more labour-intensive production. As the charts show, countries are not distributed evenly around the regression line – some are very close, while others lie above or below it.

The V4 countries remain slightly above the regression line, with their current movement being rightwards along the horizontal axis. This means that these countries are maintaining, albeit only slightly, a higher quality of export basket than that which would correspond to their economic performance. This is, however, quite natural, since the exporting industries in central and eastern European countries often proceed from foreign investments in production capacities with deliveries to the European market. This commonly involves technologies with a productivity that is significantly higher than the country's average productivity. The quality of V4 countries' exports in 2004 refered to GDP per capita level 10% to 30% higher than that actually achieved.

Higher quality of export production should provide V4 countries with greater potential for economic growth in comparison with the EU's old Member States.

The previously mentioned studies analyse the export structure of countries which are in very different stages of economic development.[5] In the context of the world economy, these countries to a greater extent fulfil the HO model's assumption of internationally immobile capital. The greater mobility of capital between EU countries than between various other countries of the world is therefore contrary to the basic assumption of the HO model. This conflict is reflected mainly in milder slope of the regression curve for EU countries.

Chart 4 Deviation between the theoretical and actual GDP per capita at PPP (2004)



If capital mobility were closer to the ideal, the regression line would shift gradually towards the horizontal. Indeed, seen through the lens of HO theory, capital mobility leads to an erosion of comparative differences by creating the assumption that it is equally accessible in all countries for the purpose of new investments. Since HO model also assumes identical technologies, the production function would also converge (in the resulting form, the conversion of inputs into outputs would be the same in all countries).

This consequence is unrealistic in practice, even under the assumption of full capital mobility. As mentioned earlier, the movement of capital depends not only on an abundance of labour, but on other factors too (infrastructure, economic and political conditions, the business climate, human resources, and so on. In the production function, these may be included in total factor productivity (TFP)

5 In Rodrik's study (2006), for example, the selected countries include Switzerland, Finland, Hungary and Portugal, as well as developing countries such as Bolivia, Jamaica, India and several African countries.

values). However, the original HO model reckons on only two factors of production (labour and capital), where capital is understood to be homogeneous.[6]

The construction of indicators linking the sophistication of production to the level of GDP connects all the causes of export production's localization with the existence of private capital. This contrasts with the fact that, amid growing competition in goods markets, the increasing importance of timeliness in production processes, and higher prices for the shipping of goods, it is other factors (TFP) that are acquiring ever greater weight in investment decisions.

Conclusion

In a world of increasing capital mobility, indicators measuring export structure quality on the basis of the HO assumption are less meaningful. They can, nevertheless, provide interesting stimuli for examining the potential future effect that an existing export structure will have on economic growth.

WEAK POINTS IN THE EXPY INDICATOR'S CONSTRUCTION

The character of the EXPY indicator's construction may give rise to the following biases:

1) Bias due to the effect of variable quality of merchandise in individual classes. The less detailed commodity structure is used, the more goods of various type and quality can be classified into the same class. For example, in a product structure with a four-digit classification, all personal cars will be classified in a single class, while a six-digit classification would differentiate them according to horsepower and fuel type. However, in some classes, even in six-digit classifications, there may be a certain difference in the quality of products.
2) Bias arising from specialization in a certain commodity.
   Specialization increases the weight of a given country in the overall evaluation of the respective product ($PRODY_k$), while the production in that country may be the result of effects other than the presence of the necessary production factors.
3) Bias arising from unequal size of economies.
   A small, open economy is more likely to be specialized in a certain product, which results in the potential bias mentioned in point (2). This bias may also be caused by a one-off large project in a small economy. Moreover, large economies have the same weight as small economies as regards the evaluation of product level ($PRODY_k$).
4) Bias arising from different trade-to-GDP ratio.
   Each country has a different ratio of exports to GDP. In countries such as Slovakia, the effect of the export structure on the economy should be stronger than it is in, for example, Spain.
5) Bias due to inability to measure non-tradables.
   Tradable goods represent only part of overall trade; however, services, which typicly have higher value-added are usually more intensive in economically developed countries. Their non-inclusion in the export data structure therefore reduces the $EXPY_j$ of more economically advanced countries.
6) Bias in case of inclusion of countries with rich natural resources.
   This bias could arise if the selected countries include, for example, Norway and/or Russia. The resulting quality of the commodity classification including unrefined oil would artificially reduce the average quality of Norway's export basket, and, conversely, would artificially increase the quality of Russia's exports. This bias should not be a factor among the EU-25 countries.

Bibliography

[1] Chaponnière, J. R., Lautier, M.: Export Catching-up in the Mediterranean Countries: Long Term Trends and Prospects.
[2] Hausmann, R., Hwang, J., Rodrik, D.: What you export matters. NBER Working Paper no. 11905, December 2005.
[3] Kwan, Ch.: The Rise of China and Asia's flying geese pattern of economic development: an empirical analysis based on US import Statistics. Riety Discussion paper, júl 2005.
[4] Lall, S., Weiss, J., Zhang, J.: The Sophistication of Exports: A New measure of Product Characteristics. QEH Working Paper no. 123, January 2005.
[5] Laursen, K.: Revealed Comparative Advantage and the Alternatives as Measures of International Specialisation. DRUID Working Paper no. 98–30, December 1998.
[6] Leamer, E.: The Heckscher-Ohlin Model in Theory and Practice. Princeton Studies in International Finance 77, 1995.
[7] Mayer, J., Wood, A.: South Asia's Export Structure in a Comparative Perspective. Oxford Development Studies, Vol. 29, no.1, 2001.
[8] Rodrik, D.: What's so special about China's exports? CEPR Discussion Paper no. 5484, February 2006.
[9] Wood, A.: North-South Trade, Employment and Inequality. Oxford: Clarendon Press, 1994.
[10] Yifu L. J., Li, Y.: Export and Economic Growth in China: A Demand-Oriented Analysis. Peking University Working paper, no. E2002009.

[6] The original HO model is also sometimes referred to as the "2x2x2" model, since it describes two countries producing two kinds of commodities and using two factors of production.