Chapter 6

Comparative advantage and trade performance: Policy implications

by
Przemyslaw Kowalski[1]

This chapter establishes the relative importance of different sources of comparative advantage in explaining trade, with particular focus on policy and institutional factors. The policy and institutional areas shown to be important determinants of comparative advantage include physical and human capital accumulation (especially secondary and tertiary education), financial development, the business climate, as well as a number of aspects of labour market institutions. The results suggest that comparative advantage has been — and is likely to be in the future — relatively more important for North-South and South-South trade. Overall, the chapter concludes that when seeking to maintain or develop competitiveness in a certain area, it is best develop an effective broad policy approach.

For close to two centuries the comparative advantage hypothesis has been suggested as one of the principal explanations of international trade and, indeed, as one of the most potent explanations of higher incomes and income growth rates of open economies.[2] As such, the concept of comparative advantage had a strong influence on economic policy making in the post-WWII era, most notably the trade liberalisation initiatives under the auspices of the GATT and the WTO, regional integration initiatives as well as unilateral trade reforms, all of which placed emphasis on removing remaining trade barriers and facilitating trade-related structural adjustment, so that countries can benefit from comparative advantage-driven trade. There are controversies surrounding policy implications of the theory of comparative advantage. On the one hand, the theory indicates that an interference with comparative advantage, even if it entails government support to sectors in which a country may have "natural" comparative advantage, can reduce gains from trade or even render them negative (As argued in the Introduction to this volume). On the other hand, as pointed out by Rodrik (2009) even broad policies, not focused on any particular sector (e.g. education or capital market policies), may influence conditions for development of certain activities more than for others. What is then the "natural" comparative advantage? Can governments influence comparative advantage in a fashion that is sustainable and beneficial for the country and its trading partners?[3]

This chapter makes the first necessary step to answer some of these fundamental questions. It does so by: (i) estimating the extent to which comparative advantage may determine trade flows today as well as how this may have changed over time; (ii) establishing the relative importance of different sources of comparative advantage in explaining trade, with particular focus on policy and institutional factors; and (iii) drawing policy conclusions.

Sources of comparative advantage

Recent generalisations of comparative advantage, referred to by Helpman (2010) as "new sources of comparative advantage," focus strongly on the interaction of policies and regulatory frameworks with specific needs of particular sectors of the economy. For example, building on the seminal paper on the importance of financial institutions for development by Rajan and Zingales (1998), Beck (2003) and Manova (2008) showed that countries with better financial development export more in sectors that tend to rely more on external financing. Countries with better rule of law have been shown to export relatively more in sectors that have: lower levels of input concentration (Levchenko, 2007); lower shares of customised inputs (Nunn, 2007); or have higher levels of job task complexity (Costinot, 2009). Cunat and Melitz (2007) demonstrated that flexible labour market policies promote exports in industries characterised by higher volatility of demand.

This chapter builds on recent generalisations of theory and empirics of comparative advantage (e.g. Costinot, 2009; and Chor, 2010) as well as on numerous insights from the literature on specific sources of comparative advantage to quantitatively assess their relative importance for bilateral trade patterns at the industry level, with particular focus on policy and institutional factors. In this respect, the study offers the most extensive coverage of geographical, policy and institutional sources of comparative advantage in the existing literature. The policy and institutional areas posited as sources of comparative advantage in this chapter include physical and human capital endowments (distinguishing between secondary, tertiary education and average years of schooling), financial development, energy supply, doing business climate, a number of aspects of functioning

of labour markets as well as import tariff policy. To assure global coverage and to make intra-OECD and extra-OECD comparisons the exercise is performed on a group of 55 OECD and selected emerging market (SEM) economies. In addition to providing insights on relative importance of different sources of comparative advantage in general, the approach allows cross-country assessment of differences in country characteristics and of potential impact on trade flows of future changes in these characteristics across the OECD and SEM economies.

Empirical methodology

The empirical model

The empirical methodology employed in this chapter is based on Chor (2010) who extends the aggregate Eaton-Kortum model of trade (Eaton and Kortum, 2002) to account for industry trade flows. In Chor (2010) the non-random component of productivity level of firms operating in a given industry is determined by the interaction between country and industry characteristics. He motivates this approach in the following way: "industries vary in the factors and institutional conditions that they need for production, and countries differ in their ability to provide for these industry-specific requirements." The interaction approach draws on classical trade theories as well as on the recent body of empirical literature dealing with individual institutional sources of comparative advantage. For instance, Romalis (2004) interacted country-level measures of factor abundance with industry-level measures of factor intensities, as posited by the Hecksher-Ohlin-Samuelson theory. Braun (2003), Beck (2003) and Manova (2008) interacted country measures of credit availability with industry measures of dependence on external financing. Levchenko (2007) interacted a measure of input concentration with indicators measuring the quality of the rule of law. Nunn (2007) and Costinot (2009) conducted similar analyses of the rule of law using, respectively, measures of share of customised inputs and of job task complexity. Cunat and Melitz (2007) interacted a measure of labour market flexibility with a measure of industry sales volatility.

Modifying Chor's notation to facilitate exposition the empirical model of bilateral exports at the industry level can be defined as follows:

$$ln(X_{ijt}^k) = \alpha + \partial_i \ + \partial_{jt}^k + \rho ln\,(dist_{ij}) + \vartheta\big(lang_{ij}\big) + \mu\big(border_{ij}\big) + \varphi\big(colony_{ij}\big) + (1)$$

$$+\beta_1 \left(\frac{K}{L}\right)_{it} \times KINT^k + \beta_2 P_{2it} \times PD_2^{\ k} + \cdots + \beta_N P_{Nit} \times PD_N^{\ k} + \varepsilon_{ijt}^{\ k}$$

where X_{ijt}^k are exports of industry k from country i to country j in year t. ∂_i and ∂_{jt}^k are, respectively, exporter fixed effects and importer-product-year fixed effects. The former type of fixed effects allow us to capture all unobserved exporter characteristics that are not interacted with any industry characteristics (such as the size of exporter's GDP, its GDP per capita or exchange rate). The latter type of fixed effect terms account for all unobserved importer-product-year characteristics and in particular for any unobserved demand or, indeed, comparative advantage factors specific to a particular importer (e.g. the fact that a certain importer is an exceptionally significant demander of a specific commodity). With such a specification of fixed effects the variation in bilateral exports at industry level is left to be explained by relative differences in exporters' abilities to produce certain goods which stem from interactions of exporter's i characteristics with characteristics of industry k, as well bilateral factors such as distance $\ln\big(dist_{ij}\big)$, common

language($lang_{ij}$), common border($border_{ij}$), colonial relationship ($colony_{ij}$), which offer a natural benchmark for comparison of impacts for the policy and institutional variables.

The endowment, policy and institutional interaction terms are presented in the second line of equation (1) with $\left(\frac{K}{L}\right)_{it} \times KINT^k$ signifying the interaction of physical (or human) capital-to-labour ratios in exporter i in year t with physical (or human) capital-intensity of sector k. The interactive terms $P_{Nit} \times PD_N{}^k$ signify interaction between the indictor of n-th institution or policy for exporter i in year t with an indicator of dependence of sector k on institution or policy n. One example of such an interaction from the existing literature would be an interaction of the World Bank index of labour market flexibility with an industry-level indicator of sales demand volatility as in Cunat and Melitz (2007).

Equation (1) embeds several earlier empirical specifications of determinants of exports proposed by the literature (e.g. the gravity model of trade) and allows including as many country and industry interactions as one is capable of measuring and handling econometrically. The approach decomposes determinants of trade flows and allows capturing how well the conditions in country i provide for the production needs of industry k. Consequently, estimation of parameters of equation (1) allows assessing the relative importance of various sources of comparative advantage in the sample. For instance, it allows determining whether differences in physical capital-to-labour ratios across the sample have been more important in determining the industry pattern of trade flows as compared to differences in financial development. In addition, the estimated parameters can be interpreted in the context of cross-country variation in country characteristics to shed light on trade implications of any potential future changes in these country characteristics on a *ceteris paribus* basis (e.g. trade effects of aligning a given country's policy with an average or with the level of best performing peers).

Measurement of comparative advantage

A number of structural and, more recently, institutional and policy sources of comparative advantage have been identified in the literature. This section briefly summarises this literature as it relates to the sources of comparative advantage accounted for in the empirical exercise and justifies the data choices made.

The theory of comparative advantage indicates that specialisation according to comparative advantage is a precondition for reaping gains from trade. Any substantive interference with this process, even if it entails government support to sectors in which a country may have "natural" comparative advantage, can reduce these gains or even render them negative (see also Chapter 1). To reflect this, the empirical work presented in this chapter tries to get as close as it is possible to capturing the 'natural' comparative advantage. That is, we account for policies that do not target any particular sectors but rather reflect broad public choices or seek to enhance general resource endowments, even though they may indirectly favour some of the sectors. These broad policies are a potential source of comparative advantage and thus of welfare gains from trade. For example, capital accumulation can be encouraged by well developed financial markets and this can create favourable conditions for development of a competitive capital-intensive activity, but financial market reforms are not principally designed to favour any particular industry. Similarly, a good education system may boost the endowment of

human capital thus favouring human-capital intensive activities, but good education policy does not directly favour production of any particular good or service.

Given the lack of conclusive evidence on viability of targeted industrial policies in sustainably influencing comparative advantage we exclude these policies as ones potentially hindering or reducing the gains from trade (Box 6.1).

Box 6.1. The debate on targeted industrial policy

As discussed in more detail in Chapter 3, the industrial policy, or infant industry, arguments posit that because of dynamic considerations, externalities, or large fixed costs, an economically viable industry would not be established by private agents in the absence of some form of help or a subsidy from government. Thus, with a targeted support the government can and should correct these negative externalities.

Yet, this proposition proved extremely controversial. The Washington Consensus of the early 1980s has led to promotion of structural adjustment programmes which promoted the power of markets over states in resource allocation and dismantling of policy regimes which were designed to promote industrial policy (Barnes *et al.*, 2003). Some research inquiries that revisited this concept in the light of unprecedented performance of some Asian economies concluded that targeted industrial policies had been a failure and that the only viable role Asian governments had played was to promote economy-wide initiatives to correct market failures (World Bank, 1993).

However, this negative conclusion has also questioned (e.g. Lall, 1994; Rodrik, 1994; Stilglitz, 1996). In a recent survey Rodrik (2009) takes stock of the industrial policy debate and argues that there is a strong theoretical case for it based on correcting market imperfections. Rodrik argues that the case against it does not address the central premise of the need or government's ability to help an industry become viable in certain circumstances, but rather rests on practical difficulties with its implementation. Firstly, governments may be incapable of correctly identifying the "winners" and, secondly, industrial policy may trigger unwanted rent-seeking behaviour. These potential problems have been identified as particularly dangerous for developing countries which would like to emulate the benefits obtained from industrial policy by some Asian economies but which do not have as capable bureaucracies and the political ability to withdraw stimulating measures at the right time (Pack, 2000).

Many cases of industrial policy have been documented in the literature. A positive account of South Africa's Motor Industry Development Programme has been given by Barnes *et al.* (2003). Chang in Lin and Chang (2009) described the four decades long protection of the Japanese car industry by high tariffs, direct and indirect subsidies and restrictions on foreign direct investment before it became competitive in the world markets. Nokia group was cross-subsidised by its sister companies before it started making profits (Lin and Chang, 2009). Korean state owned firm POSCO benefited from import substitution-type of policies and the Brazilian aircraft company Embraer was established and developed into a global competitor through state ownership and export subsidies (Rodrik, 2009).

However, a significant scepticism persists about whether such specific examples constitute a case for a general recommendation of targeted industrial policy. Overall, currently, the debate on industrial policy remains "hung up on the question should we or should we not?" (Rodrik, 2009)

Factor intensities and factor endowments

Differences in relative factor endowments have been proposed as a source of comparative advantage in the Hecksher-Ohlin-Samuelson model of international trade.[4] A number of hypotheses identified within this framework find support in numerous empirical studies showing that countries tend to export products whose production requires a relatively intensive use of the factor of production in which they are relatively well endowed. Thus, for instance, a capital-abundant country would tend to export capital-intensive products and import labour-intensive products. Chapter 4, along with Debaere (2003), Romalis (2004), Chor (2010) are some of the studies that demonstrate that countries' relative endowments are informative of their pattern of trade.

The empirical model of trade developed in this chapter follows this literature by accounting for exporters' physical capital-to-labour ratios which are interacted with capital intensities measured at the industry level. Given the lack of readily available comprehensive time-series data on capital stocks for the 55 OECD and SEM economies considered in our study physical capital stocks series have been constructed according to the perpetual inventory method as $K_t = I_t + \delta K_{t-1}$ where I_t is gross fixed capital formation in year t and δ is the depreciation rate.[5] The Global Trade Analysis Project (GTAP) database values of physical capital stock in 2004 for each country have been taken as reference values while the data on gross fixed capital formation have been taken from the World Bank's World Development Indicators (WDI) database. Data on sectoral factor intensities come from the GTAP database and are defined as respective shares of individual endowments (skilled labour, unskilled labour and capital) in industry's total purchases of primary factors of production.[6]

Human capital intensity and education policy

In addition to physical capital the current study controls for human capital as a source of comparative advantage. The importance of human capital accumulation in economic performance has been studied by many economists. Lucas (1988) argued that human capital accumulation is the "engine of growth" citing the notable differences in productivity of human capital relative to the smaller differences in productivity of physical capital across countries. Romer (1990) and Barro (1991) carried out cross-sectional studies and found empirical support for the positive relationship between human capital accumulation and economic growth. Recently, Barro and Lee (2010) created a new data set of stocks of human capital based on educational attainment and found that length of schooling has a significant effect on output as well as income at the country level, particularly for secondary and tertiary levels of education. Some recent studies dealing with the impact of human capital accumulation on trade performance include Spiros and Riezman (2007), Manova (2008) and Spiros *et al*. (2009).[7]

The current exercise calculates the stocks and ratios of available human capital using the Barro and Lee (2010) data on percentages of population that have completed secondary and tertiary schooling combined with the WDI data on labour force as well as the Barro and Lee (2010) data on average years of study. To control for human capital as a source of comparative advantage in the presented empirical trade model these indicators of human capital are interacted with the skilled labour-intensity calculated at the level of manufacturing sector and defined as a share of skilled labour in industry's total purchases of primary factors of production. The distinction between tertiary and secondary education in Barro and Lee (2010) data allows a more nuanced analysis of relevance of education policy for trade outcomes in the discussion of results.

Dependence on external credit and availability of credit

Financial development has been established as a pre-condition for economic development. A seminal paper by Rajan and Zingales (1998) established that industrial sectors that are relatively more in need of external finance develop faster in countries with more developed financial markets. Beck (2003) and Manova (2008) built on this idea and demonstrated that financial development translates into a comparative advantage in industries that use more external finance. Beck (2003) demonstrated this effect using data for 36 industries and 56 countries. Manova (2008) showed how such an effect may arise in a theoretical trade model with heterogeneous firms where larger, more productive

firms have an advantage in obtaining external finance. She also found empirical evidence for this effect using data on bilateral exports for 107 countries and 27 industries during the period 1985-1995. More recently Chor (2010) confirmed the importance of credit constraints as determinant of international trade patterns using a sample of 83 countries and 20 industries and data for 1990.

This chapter follows the approach initiated by Rajan and Zingales (1998) and adopted by Beck (2003), Manova (2008) and Chor (2010) to measure external capital dependence of a given industrial sector as the fraction of total capital expenditure not financed with cash flow from operations. The specific indicator of external capital dependence comes from Braun (2003) and is based on data for all publically traded US-based companies from Compustat's annual industrial files. One modification that had to be performed for the purposes of the current chapter was to match the 3-digit ISIC categories used by Braun (2003) with the GTAP sectoral classification.[8] Following Manova (2008) and Chor (2010) credit availability is measured as the WDI ratio of domestic credit to private sector to GDP, an indicator that has the best country and time coverage as far as our sample is concerned. This indicator of credit availability refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.

While the choice of the indicator of dependence on external capital follows recent literature (e.g. Manova, 2008) and reflects the better availability of financial data for the US companies, it is possible that the US data may not be representative. One argument for using the US data is, as Manova (2009) argues, that the United States is characterised by one of the most advanced and sophisticated financial systems and that this makes it reasonable that the US indicators reflect firms' true demand for external capital. Using the US data is also convenient because it eliminates the potential for the measure of dependence on external finance to be endogenously determined by country's level of financial development or credit availability. However, the fact remains that the US indicators of dependence on external capital might not be representative of other countries, for example, those where government financing plays an important role. These caveats need to be born in mind when interpreting the results.

Energy intensity and energy supply

Producing goods and services requires the use of energy inputs, which tend to be scarce and often need to be imported. The shares of primary energy inputs in firms' costs vary across industries; naturally they tend to be large in sectors that produce processed energy products (e.g. *Petroleum and coal products* industry) but they are also large in some heavy industry sectors such as *Ferrous metals* and *Chemical, rubber and plastic products* or *Minerals* industries High reliance on energy inputs in these sectors means that they are vulnerable to energy price hikes as well as external supply-related pressures (i.e. reduction of supply leading to an increase in prices), in particular in the case of energy-importing countries. Differences in sectoral energy dependence as well as country characteristics in terms of primary energy supply policy can thus be an important source of comparative advantage.

After an extensive research on available energy policy indictors we chose to measure the extent of energy supply using the International Energy Agency (IEA) total primary energy supply (TPES) statistic scaled by the value of GDP. The IEA TPES measures total energy supply from a number of energy sources as found in their natural state, accounting

for their calorific content of various energy commodities and converting it into a common unit of account (tonnes of oil equivalent). It equals production plus imports minus exports minus international marine bunkers plus or minus stock changes. The TPES-GDP ratios are calculated by dividing each country's annual TPES by each country's annual GDP expressed in constant 2000 prices and converted to US dollars using PPP for the year 2000.

The definition of TPES statistic refers to energy supply but in fact the statistic unavoidably reflects also demand factors, for example, through inclusion of energy imports. In fact, the TPES-to-GDP ratio is one of the most commonly used measures of energy intensity of economies, used extensively by the IEA, World Bank and general energy economics literature. An additional caveat is that, the measure can reflect a host of environmental and energy price policies, where countries with stricter energy use regimes or better technologies can record relatively lower TPES ratios. In light of these caveats, the interpretation of results based on this measure of energy supply should be approached carefully. We propose to interpret TPES-to-GDP ratio not as a strict measure of country relative natural endowment in energy sources but rather as a measure of general availability or affordability of energy in a given exporting economy. The proposed interaction term measuring sectoral dependence on energy is the ratio of total energy costs to the value of output in the given sector calculated from the input-output data available in the version 7 of the GTAP database.

Input concentration and business climate

The business climate's impact on economic growth and development has been the subject of a variety of recent studies many of which attempted to measure the impacts of various doing business indicators on aggregate trade performance. Only a few studies addressed the question of how the business climate can influence specialisation and structure of trade. Levchenko (2007) proposed that institutional quality can be a source of comparative advantage and analysed its impact on trade using a model that captures differences in institutional quality through a framework of incomplete contracts. The study proposed to proxy the industry-level dependence on institutional quality with a measure of input concentration as a proxy for product complexity and found that institutional aspects can significantly influence trade flows. Costinot (2009) identified the impact of institutional quality on the productivity of various sectors by taking into account different levels of job task complexity associated with production of different goods and found that especially in complex industries good institutions can be a complementary source of comparative advantage. Nunn (2007) analysed the impact of contract enforcement on exports in the context of industry differences in relation-specificity as proxied by shares of customized inputs. He found that good contract enforcement is especially important for the export performance of relationship-specific sectors and that this has a crucial impact on the pattern of trade: "contract enforcement explains more of the global pattern of trade than countries' endowments of physical capital and skilled labour combined" (Nunn, 2007, p.594). All of the above studies used inter alia the *rule of law* indicator from the *World Bank's Governance Indicators* database as a proxy for institutional quality.

The present chapter follows this literature and attempts to measure the extent of comparative advantage stemming from interactions of regulatory quality, as measured by country-level indicators of *regulatory quality*, *rule of law* and *control of corruption*, with product complexity, as measured by an industry-level indicator of intermediate input

dispersion. The former three indicators are the components of the *World Bank's Governance Indicators* database that seem the most appropriate for measuring the quality of enforcement of commercial contracts.[9] The choice of the sector-dependence indicator follows Levchenko (2007) and Chor (2010) who proposed to measure the product complexity with the Herfindhal index of intermediate inputs dispersion. The index is calculated for the United States[10] based on input-output information from the version 7 of the GTAP database. The specific hypothesis is the one posited in the literature that the higher the intermediate input dispersion in a given industry (and thus the higher the complexity of products) the more important the quality of the legal framework for export performance.

Sales volatility and labour market rigidity

Cunat and Melitz (2007) proposed that differences across countries in labour market characteristics determine how firms adjust to idiosyncratic shocks and that they interact with sector-specific differences in demand volatility to generate a new source of comparative advantage. Specifically, they found that countries with more flexible labour markets tend to specialise in sectors with higher volatility of demand. This chapter follows this hypothesis and includes interactions of selected indicators of labour market regulation measured at the exporter level with an indicator of sectoral demand volatility.

There are a number of sources of information on labour market institutions including the subcategory of *World Bank Doing Business Database* on *Employing Workers* or the *OECD Indicators of Employment Protection*. However, country and time-coverage considerations as well as the extent of the covered detail and time variation in the data[11] led us to adopt indicators of regulation of labour markets developed by Botero (2004). This dataset covers legal rules in 85 countries in year 1997 and encompasses three types of laws: employment laws; collective relations; and social security laws, from which we retain the first two on the basis of more direct relevance of these laws for adjustment to economic shocks. *Employment laws* govern the individual employment contract. *Collective or industrial relations laws* regulate the bargaining, adoption, and enforcement of collective agreements, the organisation of trade unions, and the industrial action by workers and employers. As proposed by Cunat and Melitz (2007) these regulations may impose rigidities and prevent markets from adjusting to economic shocks by raising the cost for firms to hire workers and the cost of adjusting employment levels. For example, laws that raise the cost of employment adjustment, in particular those related to employment protection tend to reduce the inflow into unemployment, make firms more careful about hiring employees, and reduce the flow out of unemployment.

The following measures of labour regulation from Botero *et al.* (2004) are used in our study. *Alternative contracts* measures the existence and cost of alternatives to the standard employment contract. *Cost of increasing hours worked* measures the cost of increasing the number of hours worked. *Cost of firing workers* measures the cost of firing 20% of the firm's workers. *Dismissal Procedures* measures worker protection granted by law or mandatory collective agreements against dismissal. *Labour Union Power* measures the statutory protection and power of unions as the average of seven indicator variables indicating the presence of absence of various unionization rights and obligations. *Collective Disputes* measures the protection of workers during collective disputes as the average of eight more detailed indicator variables measuring presence or laws protecting industrial action. All of these indicators are constructed so that a higher indicator marks more rigid regulations. The adopted measure of sector-level sales volatility comes from

Braun (2003) who estimated sales volatility using data for all publically traded US-based companies from Compustat's annual industrial files.[12]

Imported intermediate inputs and import tariff policy

The final source of comparative advantage investigated in this chapter concerns tariff protection and its impact on imports of intermediate inputs. Miroudot *et al.* (2009) estimate that trade in intermediate inputs represents respectively 56% and 73% of overall trade flows in goods and services and takes place mostly among developed countries. They also find that in comparison to trade in final goods, imports of intermediates are more sensitive to trade costs. It is also a fact that industries differ with respect to ratios of values of imported intermediate inputs to the value of production with *Petroleum and coal products* as well as *Electronic equipment* industries recording the highest shares. It is thus proposed that the general level of tariff protection may constitute a source of comparative advantage with less protected economies having an advantage in sectors with high shares of imported intermediate inputs.

To account for such a possibility the level of average applied tariffs (from the *UN TRAINS* database) imposed by a given exporter is interacted with industry dependence on imported intermediate inputs. The latter is defined as the ratio of the value of imported intermediate inputs to the value of output in a given industry and calculated on the basis of the input-output data available from version 7 of the GTAP database. It is worth emphasising that the direct effects of import tariffs faced by exporters in destination markets are accounted for implicitly by the importer-product-year fixed effects (∂_{jt}^k) and thus should not bias other estimates. The import tariff variable used explicitly in our empirical model captures any impact a restrictive import regime may have on relative costs of production across sectors in the country that imposes the tariff. Thus, the estimated coefficients on tariff interaction terms should not be interpreted as measuring the impact of trade protection on trade in general but rather as measuring the extent to which high tariffs on imported intermediate inputs affect sectoral trade patterns.

Results

Data described in the previous section have been collected for 55 OECD and SEM economies for the period 1990-2009 but the coverage of policy and institutional determinants of comparative advantage is sometimes patchy. The choices of indicators described above already internalise some of the data availability constraints, with some of the proposed measures chosen on the basis of their time and country-coverage. In addition, 1995 and 2005 were selected as the years with the most consistent coverage of policies that also offer a comparison over a sensibly long time period. Thus, the empirical model is estimated separately as two cross sections for years 1995 and 2005 and jointly as a panel consisting of observations for 1995 and 2005 (i.e. including cross-sectional as well as time-series data). The existing empirical literature on institutional determinants of comparative advantage is based on cross-sectional estimations or on panels with short time spans so the addition of the time dimension in the current approach can be seen as an improvement.[13]

Instead of estimating the log-log version of model (1) we use the conditional Poisson fixed effects estimator with robust standard errors. This procedure uses the value of exports as the dependent variable and thus enables inclusion of observations for which bilateral trade is zero,[14] while at the same time yielding β coefficients that can be

interpreted as elasticities (e.g. Dennis and Shepherd, 2007). The results of estimations for 1995, 2005 and the 1995-2005 panel are reported in, respectively, Tables 6.B1-B3. The significance of different sources of comparative advantage is established by estimating *individual models* involving all fixed effects and distance and geography variables and a specific institutional or policy variable (or a set of variables) (columns 2-16 in Tables 6.B1-6.B3) as well as by estimating *joint models* with all policy and distance and geography variables included in the same estimation (column 17 in Tables 6.B1-6.B3).[15]

What have been the main sources of comparative advantage in the last decade?

In most cases the present study confirms the main results from the recent literature on the importance of individual sources of comparative advantage. In addition, it contributes to this literature by offering comparisons of their relative importance within one consistent framework. The contribution that is the closest to the current one in terms of coverage of policy and institutional areas is Chor (2010). Chor's (2010) results for 1990 can be used to compare the importance of relative factor endowments, financial development, legal system and employment flexibility but the study does not cover the energy supply or import tariffs and its treatment of human capital and labour market rigidity is less detailed as compared to the current study.

To facilitate the interpretation of results and to establish which of the posited source of comparative advantage are more important in determining exports, we calculate standardised coefficients that capture the impact on exports of one standard deviation change in a given explanatory variable, relative to the impact of one standard deviation decrease in the logarithm of distance (Figure 6.1).[16] As such, the standardised coefficients combine the information on estimated elasticities presented in Tables 6.1-6.3 with the information on the extent of variation in explanatory variables in the underlying dataset. They can be interpreted as measures of relative importance of different explanatory variables in explaining export outcomes. To establish a benchmark, and taking France as an example, a one standard deviation decrease in the distance variable, equivalent to decreasing the distance between France and Slovakia to France and Switzerland[17] (i.e. by 62%) results in boosting exports by, on average, 53%.

It is important to keep in mind that in the considered model the variation in interaction terms is driven by both the variation in country characteristics (e.g. cross-country variation in years of schooling) as well as the variation in sector characteristics (e.g. cross-industry variation in skilled labour-intensity). As can be consulted in Figures 6.3-6.7 standard deviations in selected interaction terms calculated across all exporter-importer-industry observations are typically larger than standard deviations in policy indicators calculated across exporters.[18] Figure 6.2 accounts for this by presenting the estimated average impacts on exports of one standard deviation change in a given policy indicator calculated across exporters in 2005.

In general, estimations that consider policy and institutional factors one by one (*individual models*) yield results that are more "attractive" in terms of statistical significance, as compared to estimations that account for all factors at the same time (joint models). This is not entirely surprising since some policy indicators are correlated with each other resulting in various degrees of multicollinearity and problems with attributing variation in the dependent variable to variation in specific independent variables, which in turn is reflected in sign changes and reduction in statistical significance of estimated coefficients. Hence, in what follows the discussion of results considers both these types of estimates.

Factor intensities and factor endowments

The coefficients on interaction terms involving physical capital-to-labour ratios and capital intensities are either close to or larger than one (Figure 6.1) indicating that endowments of physical capital are at least equally as important in explaining industry patterns of trade as is geographical distance. The estimated *ceteris paribus* percentage impacts on exports of one standard deviation change in the capital-to-labour ratio are, depending on model specification, between 15 and 33% (Figure 6.2), suggesting a relatively large effect.
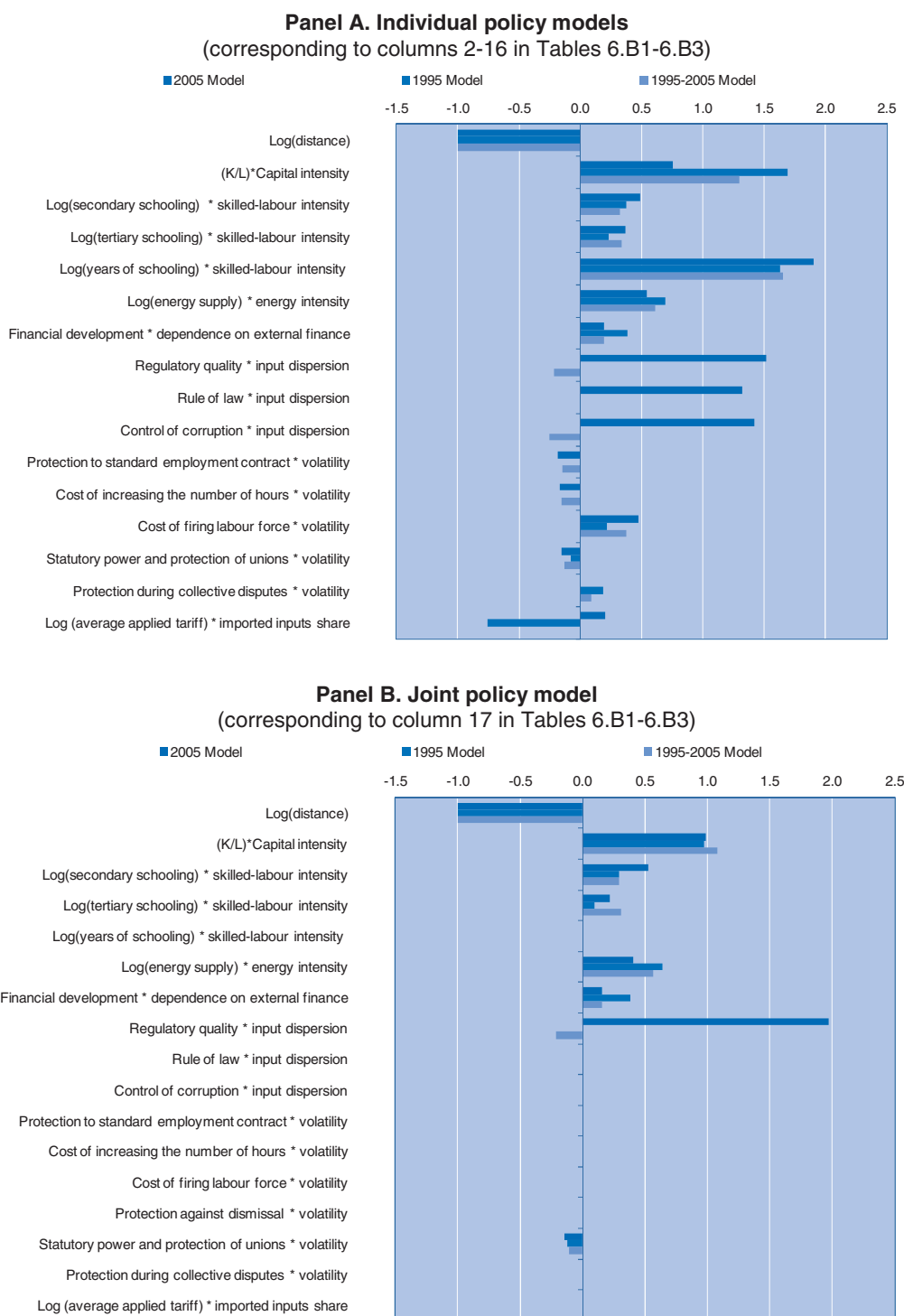
To give an example, one standard deviation increase in capital-to-labour ratio is equivalent to increasing the 2005 capital-to-labour ratio of Brazil to that of the Czech Republic or, equivalently, the one of the Czech Republic to that of Switzerland (Annex Figure 6.B1). These are important changes indicating a considerable degree of variation in capital-to-labour ratios across countries in our sample. Importantly, the so-called BRIIC countries (Brazil, Russia, India, Indonesia and China) record still some of the lowest capital-to-labour ratios in 2005 in the sample despite relative high investment rates in recent years. The importance of capital-to-labour ratios revealed by our estimations, the relatively low positioning of the BRIIC countries in the capital-to-labour ratio ranking at the end of the 2000s, and the high rates of income growth in recent decades combine to suggest that important changes in trade structures, such as an expansion of these countries' shares in exports of capital-intensive products, are likely to continue. This stresses the significance of policies that influence the pace and quality of physical capital accumulation.

Human capital intensity and education policy

Estimated coefficients on stocks of available human capital and ratios of average years of schooling interacted with skilled labour-intensity reveal some of the most statistically significant and robust results. Standardised coefficients are around 0.4 and 0.3 for the stock of labour force with secondary and tertiary schooling, respectively, and about 1.5 for the average years of schooling variable. These coefficients indicate that the first two variables have a smaller power in terms of explaining variation in observed industry-level bilateral trade flows as compared to distance, while the variable indicating average years of schooling has twice as large explanatory power as the distance.

Standardised coefficients pertaining to the interaction of average years of schooling with skilled-labour intensity suggest that the length of schooling is one of the most important variable explaining industry patterns of trade flows (Figure 6.1). One standard deviation increase in years of schooling would on average result in about 14-17% increase in exports (Figure 6.2). This would be approximately equivalent to raising the average years of schooling in China or Brazil (the two countries that are close to the average level less one standard deviation – 7.6 and 7.2 years respectively) to the level of the United Kingdom or Italy (9.2 and 9.1 years respectively) or, equivalently, to raising the average number of years of schooling in the United Kingdom or Italy to the level of Germany or the United States (11.2 and 12.1 years respectively).

Figure 6.1. Standardised coefficients on policy and institutional determinants of comparative advantage: Impact on exports relative to the impact of one standard deviation increase in the log of distance

Panel A. Individual policy models
(corresponding to columns 2-16 in Tables 6.B1-6.B3)

Panel B. Joint policy model
(corresponding to column 17 in Tables 6.B1-6.B3)

Only results statistically significant at 10% and stricter levels are reported.
Source: Author's calculations.

Figure 6.2 Average impacts of exports of one standard deviation change in policy indicator

Average % change in exports

Panel A. Individual policy models
(corresponding to columns 2-16 in Tables 6.B1-6.B3)

Panel B. Joint policy model
(corresponding to column 17 in Tables 6.B1-6.B3)
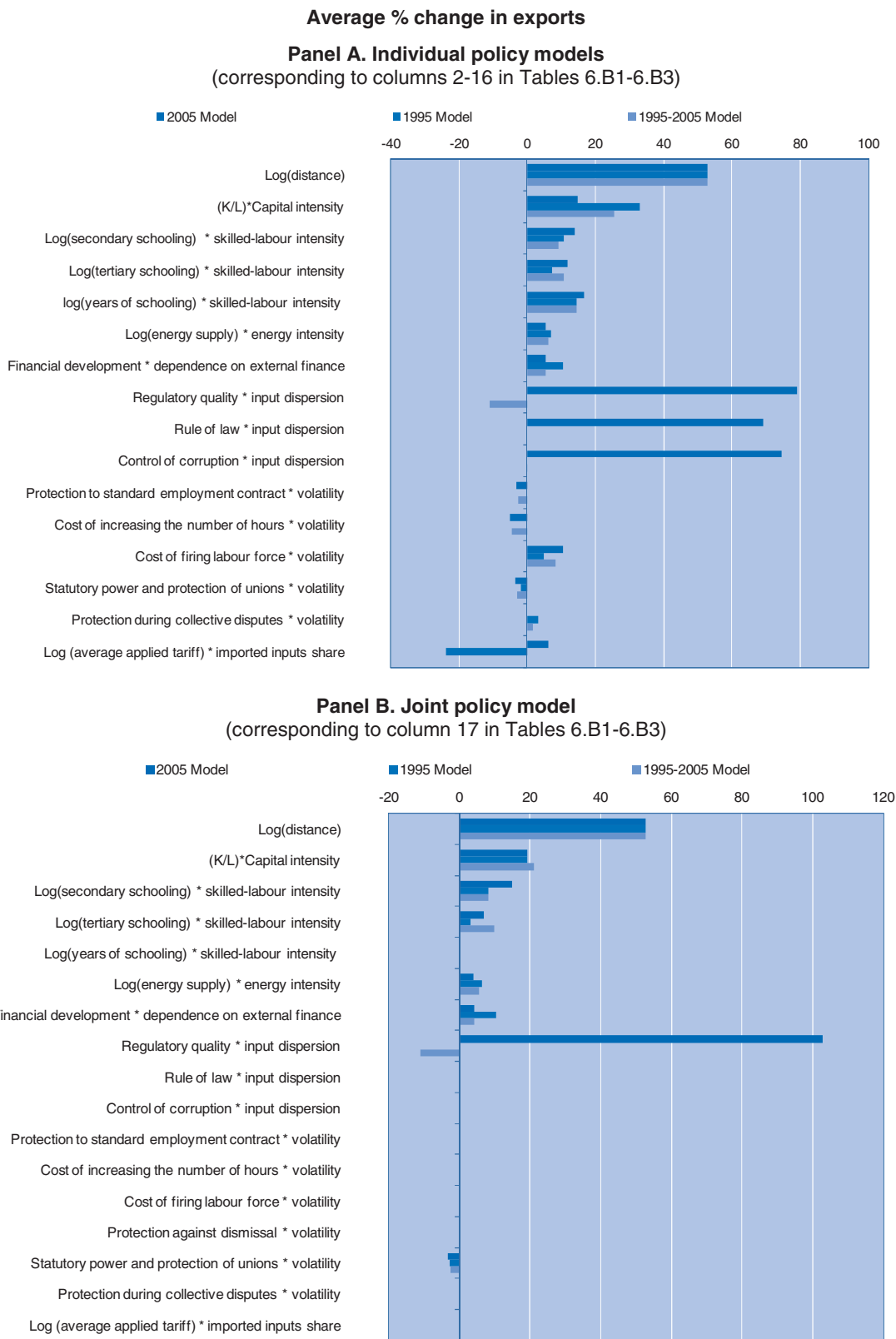
Source: Author's calculations.

Similarly to capital-to-labour ratios, the relatively low positioning of the BRIIC and other SEM economies in rankings of human capital indicators at the end of 2000s as well as the significant increases in recent decades suggest that important changes in trade structures, such as the expansion of these economies' shares in exports of human capital and technology-intensive products, associated with formation of human capital are likely to continue. This stresses the importance of policy environment that is conducive to human capital accumulation.

Interestingly, results for the impact of secondary and tertiary education indicate that the two types of education have different impacts on trade patterns. First, it is important to note that in contrast to average number of years of schooling, both these interaction terms capture the combined effect of the level of education as well as the size of the labour force (e.g. country with a smaller labour force will have a lower stock of labour force with secondary or tertiary education) and skilled labour-intensity of the sector. Nevertheless, standardised coefficients on secondary schooling interactions are higher than those on tertiary schooling in all model specifications. This indicates that cross-country differences in secondary schooling are a more important explanation of industry trade flows. Moreover, there is more variation across countries in secondary schooling (Annex Figure 6.B2) as compared to tertiary schooling (Annex Figure 6.B3). Interestingly, and in contrast to tertiary schooling, the differences have grown among OECD countries, while they have narrowed among non-OECD countries (Table 6.1). The gap between average OECD and average non-OECD score has also narrowed more quickly for secondary schooling than for tertiary schooling. Overall, our results suggest that differences in secondary schooling had a stronger influence on trade patterns in the past and that there is more potential for changes in secondary schooling policies to shape trade flows in the future and that they should be in the centre of attention of policy makers.

Dependence on external credit and credit availability

Credit availability proves to be another important source of comparative advantage, though the estimated impacts are smaller as compared to physical and human capital endowments. Coefficients are correctly signed and yield statistically significant results in all specifications of the model. The standardised coefficients for this variable are just below 0.20, i.e. of the size comparable to those pertaining to tertiary schooling (Figure 6.1). Nevertheless, cross-country variation in credit availability is relatively large and, as Figure 6.2 reveals, there is a relatively large potential for this source of comparative advantage to shape trade patterns in the future, especially as far as emerging economies are concerned (Table 6.1). It can be inferred that a one standard deviation change in the credit availability indicator would result in a 4% to 11% average increase in exports. Such a change is equivalent to increasing the 2005 ratio of domestic credit to private sector to GDP from the level observed in the Czech Republic (average less standard deviation) to the level observed in Italy or France (about average) or, equivalently, from the level observed in Italy or France to the level of Spain or Portugal (average plus one standard deviation).

Interestingly, the highest scores of credit availability in 2005 and in 1995 were recorded for some of the countries most severely affected by the dramatic tightening of credit in the early stages of the 2008-2009 and the 1997-1998 financial crises. For example, the two highest indicators of credit availability in 2005 are recorded for the United States and Iceland while Malaysia and Thailand were amongst the highest ranked

countries in 1995 (Annex Figure 6.B5). This does not necessarily undermine our result that credit availability boosts exports more in sectors with higher dependence on external financing but rather points to the fact that credit squeezes similar to the ones observed during the 1997-1998 and 2008-2009 crises may have important implications for patterns of trade. In fact our results suggest an interesting and testable hypothesis that exports of external finance-dependent sectors could have been hit particularly hard in countries experiencing the toughest credit conditions in the aftermath of the recent crisis.

Energy intensity and energy supply

An in increase in energy supply is estimated to boost exports in relatively energy-intensive sectors though estimated impacts are somewhat smaller as compared to factor endowments or credit availability. Coefficients are correctly signed and highly significant in all model specifications. A one standard deviation increase in energy supply indicator could result in about 4 to 7% increase in exports, on average. Such an increase would be equivalent to increasing energy supply from the ratio observed in Israel in 2005 (average minus one standard deviation) to the level of Sweden (average) or equivalently from the level of Sweden to the level of Canada or Estonia (Annex Figure 6.B4).

This means that availability and affordability of energy can be an important determinant of export performance, a finding that that should certainly be deliberated together with environmental considerations associated with higher energy intensity.

Input concentration and doing business climate

The results on the impact of *regulatory quality*, *the rule of law* or *the control of corruption* on exports of industries with relatively high dispersion of intermediate inputs are mixed. The results are insignificant or incorrectly signed in models estimated as a cross-section for 1995 and as a 1995-2005 panel. The 2005 cross section yields expected signs and highly statistically significant point estimates with respect to these regulatory indicators. The higher significance of 2005 results could be explained by the fact that data on intermediate input concentration come from the GTAP database benchmarked to 2004, thus yielding a potentially more relevant correspondence between the sector characteristics, doing business indicators and observed trade flows. The 2005 estimates would indicate a very strong influence of this type of regulatory characteristics on industry trade patterns, with sectors characterised by higher dispersion of intermediate inputs exporting significantly more in countries with better regulations.

The standardised coefficients suggest that the importance of this source of comparative advantage can be compared to the impact of average years of schooling or indeed capital-to-labour ratios. The potential for future changes in trade patterns driven by changes in regulatory quality across countries would be equally as high. Our estimates indicate that, for example, moving up the 2005 regulatory quality in China (about average regulatory quality less one standard deviation) to the level of regulatory quality in Poland (about average) would bring about 80 to 103% average increase in Chinese exports. Equivalently, moving up the regulatory quality in Poland to the level observed in Denmark or the Netherlands (average plus one standard deviation) would be estimated to boost Polish exports on average by the same proportion.

Sales volatility and labour market rigidity

Some of the results pertaining to the impact on exports related to differences in labour market rigidities are statistically insignificant or counterintuitive. For example, estimations performed jointly for all policy areas do not yield significant results which may be related to the correlation of labour market indicators with other variables. The individual estimations yield correctly signed and consistently statistically significant results on *protection to standard employment contract, cost of increasing the number of hours worked* and *statutory power and protection of unions* having significantly negative effect on exports in industries characterised by relatively high levels of sales volatility. For example, one standard deviation increase in the indicator measuring protection of a standard employment contract would result in 3% decrease in exports. Such a change would be an equivalent of aligning regulations on protection of standard contract in Slovakia (average minus one standard deviation) to that in Hungary (approximately average) or of aligning protection of standard contract in Hungary with that of Finland (average plus one standard deviation). A one standard deviation increase in the indicator measuring cost of increasing the number of hours worked would result in 5% decrease in exports. This would be equivalent to increase the 2005 costs of increasing extra hours from those observed in the United Kingdom to those observed in Indonesia.

Imported intermediate inputs and import tariff policy

Results for the impact of import tariffs on exports of industries dependent on imported intermediate inputs do not yield robust results. While the individual model considering this policy area yields a relatively large and statistically significant negative impact for 1995, this result in not confirmed by the 2005 cross-sectional estimation or the 1995-2005 panel estimations. Neither is a statistically significant impact found when all policy areas are considered jointly. This leads us to conclude that import tariffs could not be established as an important source of comparative dis(advantage) given the adopted methodology. This result needs to be qualified to the extent that the presented approach explicitly accounts only for the impact of import tariffs on the pattern of exports of the tariff-imposing country while it does not directly measure the impact of import tariffs on the pattern of imports. This latter impact is accounted for implicitly in the importer-product-year fixed effects in equation (1). Thus, this result should not be interpreted as a lack of evidence of a negative effect of tariff protection on trade flows in general but rather as a lack of evidence of a significant impact of tariffs on imported intermediate inputs on trade patterns.

Has comparative advantage become less or more relevant for the trade of OECD and non-OECD countries?

The comparative advantage theory emphasises the relative differences between countries as the reason for international trade and, indeed, for gains from trade. The greater the differences in underlying sources of comparative advantage across countries, the larger the gains from trade. It is thus interesting to ask whether the countries in our sample have become more or less similar to each other during the last decade. Were this to be the case, the potential for gains from comparative advantage trade would have diminished. It is also interesting to investigate the evolution of these differences within and between the OECD and SEM groupings as an indication of changes in the potential

for comparative advantage-driven gains from North-North, North-South and South-South trade.

Table 6.1 summarizes different basic measures of variation in indicators of sources of comparative advantage investigated in this chapter and presents some simple estimates of their convergence in time. Coefficients of variation, presented in Table 6.1, Panel A, suggest for example that a typical deviation from the average capital-to-labour ratio across the 55 countries has fallen from 64% to 58% of the mean. The results of conditional convergence regressions presented in the right-hand pane of Table 6.1, Panel A, shed more light on the speed and nature of changes in cross-country variation in these indicators.[19]

Comparing jointly across the OECD and SEM groupings for 1995 and 2005, we find that cross-country differences, and thus the potential for gains from comparative advantage-driven trade, decreased for *physical capital, average years of schooling, tertiary education, primary energy supply, availability of credit*. While this means that countries have become more similar as far as these factors are concerned and this reduced the potential for comparative advantage-driven trade, it also means that best performers in 1995 may have seen their comparative advantage erode in industries that use these resources relatively intensely. The conditional convergence regressions indicate that the so-called β-convergence, whereby worst performers improve their scores relatively quicker, has been an important part of this process and that it has been particularly fast for *availability of credit*, *average years of schooling and primary energy supply*.

At the same time there is no major change in cross-country variation for *secondary education* and, indeed, cross-country variation increases for *regulatory quality*, *rule of law*, *control of corruption* as well as *import tariffs*. This means that the potential for comparative advantage trade associated with these areas has actually increased. Thus, we can conclude, certain sources of comparative advantage have been eroded as countries have become more similar to each other, while others have actually expanded.

Table 6.1, Panel B, breaks up the sample into the OECD and non-OECD groupings in order to investigate the relevance of comparative advantage for trade within and between these groupings. It is interesting to note that the OECD grouping considered alone has become more homogenous as far as many country characteristics are concerned (*rule of law* and *control of corruption* remain largely unchanged), implying that the potential for comparative advantage-driven North-North trade may have diminished.

The non-OECD grouping, in addition to being generally more heterogeneous (e.g. 133% coefficient of variation for *physical capital-to-labour* ratios or 95% coefficient of variation for *tertiary schooling*), displayed no clear tendency for cross-country differences to diminish over time, indicating a persistently high potential for gains from comparative-advantage driven South-South trade. While differences diminished for *education*, *energy supply* and *financial development* indicators, there was no such tendency for *capital-to-labour ratios* or *regulatory indicators*.

As far as the potential for North-South trade is concerned, the widening differences between OECD and non-OECD for *physical capital*, *availability of credit* or *regulatory quality* suggest an increasing trade potential. However, differences between OECD and non-OECD have narrowed for *human capital* indicators (Table 6.1, Panel B). Overall, these results suggest that comparative advantage has been—and is likely to be in the future—relatively more important for North-South and South-South than for North-North trade.

Table 6.1. Convergence of comparative advantage sources

Panel A. Convergence across all countries in the sample

	Coefficient of variation		Estimated speed of convergence across all countries		
	Across all countries in 1995	Across all countries in 2005	β coefficient of convergence	Statistical significance	R2
K/L ratio	64%	58%	-0.06	***	0.15
Secondary schooling	46%	46%	-0.08	**	0.09
Tertiary schooling	64%	58%	-0.08	*	0.05
Years of schooling	26%	22%	-0.20	***	0.62
Energy supply	70%	58%	-0.15	***	0.25
Financial development	69%	62%	-0.42	***	0.34
Regulatory quality	32%	34%	-0.18	*	0.06
Rule of law	33%	37%	0.00		0
Control of corruption	37%	38%	-0.08	*	0.05
Average applied tariff	90%	98%	-0.42	***	0.26

Panel B. Convergence within OECD and non-OECD and between the groups

	Coefficients of variation				Non-OECD average as % of OECD average		
	Across OECD countries in 1995	Across OECD countries in 2005	Across non-OECD countries in 1995	Across non-OECD countries in 2005	1995	2005	Reduction in gap 2005-1995 (% points)
K/L ratio	61%	58%	132%	133%	21%	19%	-2%
Secondary schooling	35%	39%	61%	54%	64%	70%	6%
Tertiary schooling	45%	40%	95%	78%	44%	46%	1%
Years of schooling	16%	14%	31%	25%	69%	74%	4%
Energy supply	40%	32%	79%	63%	156%	158%	2%
Financial development	59%	52%	88%	69%	82%	57%	-25%
Regulatory quality	14%	12%	46%	47%	62%	56%	-6%
Rule of law	17%	18%	42%	50%	60%	55%	-5%
Control of corruption	17%	17%	52%	53%	55%	54%	-2%
Average applied tariff	50%	78%	66%	57%	290%	384%	95%

Coefficients of variations are standard deviations from the mean divided by respective means.
***, **, * denote respectively 1%, 5% and 10% levels of statistical significance.

Conclusions

This chapter builds on recent contributions to theory and empirics of comparative advantage and presents a quantitative assessment of relative importance of various sources of comparative advantage for bilateral trade flows of 55 OECD and SEM economies, with particular focus on policy and institutional factors. It follows the recent literature in emphasising the interaction between product and country characteristics, such as the interaction of policies and institutions with specific needs of sectors of the economy, that together form the basis for comparative advantage. In this respect, this chapter offers the most extensive coverage of policy and institutional and geographical sources of comparative advantage in the existing literature. The policy and institutional areas posited as determinants of comparative advantage in this chapter include physical capital accumulation, human capital accumulation (distinguishing between secondary, tertiary education and average years of schooling), financial development, energy supply, the business climate, a number of aspects of functioning of labour markets as well as import tariff policy.

Overall, the results show that comparative advantage remains an important determinant of trade. For example, *capital-to-labour ratios* are at least equally as

important in explaining industry patterns of trade as is geographical distance. The cross-country differences in *secondary and tertiary education* provide approximately half of the explanatory power as compared to distance, while the indicator of *average years of schooling* has twice as large explanatory power as the distance variable. Other important sources of comparative advantage include the *availability of credit* and *primary energy supply* while *regulatory quality* and *labour market rigidity* tend to influence trade patterns less significantly.

The comparative advantage theory emphasises the relative differences in productivity between countries as the reason for international trade and hence for gains from trade. The larger the differences in underlying sources of comparative advantage across countries, the larger the gains from trade. Comparing jointly across the OECD and SEM groupings we find that cross-country differences, and thus the potential for gains from comparative advantage-driven trade, decreased for such sources of comparative advantage as: *physical capital, average years of schooling, tertiary education, primary energy supply, availability of credit*; while they increased for *secondary education* and *regulatory quality*.

The OECD grouping considered alone has become more homogenous as far as many comparative advantage sources are concerned, implying that the potential for comparative advantage-driven North-North trade may have diminished. The non-OECD grouping, in addition to being generally more heterogeneous, displayed no clear tendency for cross-country differences to diminish over time, indicating a persistently high potential for comparative advantage-driven South-South trade. The widening differences between OECD and non-OECD for *physical capital*, *availability of credit* or *regulatory quality* suggest an increasing potential for comparative advantage trade in North-South trade. However, differences between OECD and non-OECD have narrowed for *human capital* indicators. Overall these results suggest that comparative advantage has been—and is likely to be in the future—relatively more important for North-South and South-South trade than for North-North trade.

Our results show that comparative advantage remains an important determinant of trade and that it has changed over time, including as a result of changing policies and institutions. For example, the high explanatory power of *physical* or *human capital* revealed by our results underscores the significance of policies that influenced the pace and quality of physical and human capital accumulation. Similarly *availability of credit* has been found to boost exports more in sectors with higher dependence on external financing. An increase in *primary energy supply*-to-GDP ratio has been found to boost exports in relatively energy-intensive sectors.

Taken together, our results underscore the importance of a comprehensive approach to designing economic development policies which should seek consistency between trade and other policy objectives. Governments should avoid actively affecting trade patterns in general but such actions may be particularly counterproductive if they are inconsistent with country's resource base and other policies in place.

Thus, when seeking to maintain or develop competitiveness in a certain area—for instance *capital-intensive* sectors—this is best achieved through drawing on best practices and developing effective broad policies that facilitate capital accumulation. In case where a country succeeds in increasing its endowment of capital, relative to other countries and other factors of production, this is likely to result in the re-orientation of its exports toward *capital-intensive* sectors. Importantly, a broad-based approach involves a lower risk of reducing welfare gains from such specialisation, compared to policies involving

direct support to capital-intensive sectors, though we certainly cannot exclude the possibility that the overall costs of such an approach exceed the benefits.

Moreover, the finding that comparative advantage has been evolving together with policies and institutions does not imply that countries should try to actively influence it. Instead, our results confirm that it is the differences between countries, including differences in policy settings and policy performance, that create relative differences in productivity and give rise to trade and gains from trade. Some of these differences in policy settings may reflect different stages of economic development but some may also reflect strategic policy choices, such as investment in human rather than physical capital. This does not mean that countries should not try to catch up with their best performing peers if they wish so, but it emphasises that trade yields benefits even at the early stages of such a catching-up process. More than anything, this implies that trade openness and comparative advantage-driven specialisation is not a constraint to the economic development process but rather its catalyst.

Notes

1. Trade Policy Analyst, Trade and Agriculture Directorate, OECD. This chapter has greatly benefited from consultations on empirical methodology with Patricia Sourdin and Ricardo H. Cavazos Cepeda, from the statistical assistance of Clarisse Legendre and from help with identification and collection of policy and sector dependence data by Ricardo H. Cavazos Cepeda, Isabel Hofmann, Anna Jankowska, Monika Sztajerowska and Zhang Bin. Material presented in this chapter is based on the work declassified by the OECD Working Party of the Trade Committee (Kowalski, 2011). It has also benefited from numerous comments on earlier drafts received at the OECD Enhanced Engagement Economies Working Meeting on the project, the OECD Global Forum on Globalisation, Comparative Advantage and Trade Policy Trade in Chengdu, China, the OECD Working Party of the Trade Committee and a number of internal OECD seminars. All the remaining errors and erroneous interpretations are the sole responsibility of the author.

2. According to the concept of comparative advantage productive resources of an open economy are directed towards sectors with the highest productivity, thereby raising aggregate productivity and income levels. There is strong empirical evidence that open economies enjoy higher level of incomes. Evidence on impact of trade on long-run rate of productivity growth is less conclusive (e.g. Nordas *et al.*, 2006).

3. See, for example, Lin and Chang (2009) for a recent synopsis of the debate.

4. As explored in Chapter 4.

5. Results of these estimations are available upon request.

6. For more details on this and other data explanations, see OECD (2011).

7. Spiros and Riezman (2007) show that the skill level properties of human capital distribution directly impacts both the terms of trade as well as the effects of trade on inequality. Spiros *et al.* (2009) confirm the welfare enhancing impact of education policies in switching terms of trade and allowing countries to "move up the value chain." Manova (2008) measured the influence of human capital on trade patterns using data on the average number of years of schooling.

8. The matching is approximate as the GTAP classification is less aggregate as compared to the 3-digit ISIC. Hence, a number of GTAP sectors, particularly in the agro-food segment, are assumed to have the same degree of dependence on external capital (OECD, 2011).

9. The other three governance indicators included in this database are *voice and accountability*, *political stability* and *government effectiveness*.

10. It is a common approach in the related literature to take the United States as a benchmark.

11. The OECD data are only available for the OECD countries and a small number of non-member countries in 2008. The *Employing Workers* segment of the *WB Doing*

Business data is more aggregated as compared to Botero *et al.* (2004) and covers only the period 2004-2010.

12.   The same data source has been used by Manova (2008). One modification that had to be performed for the purposes of the current chapter was to match the 3-digit ISIC categories used by Braun (2003) with the GTAP sectoral classification. See also endnote 9.

13.   Cunat and Melitz (2007) estimate a cross section for 1996; Chor (2010) estimates a cross-section for 1990, Manova (2008) estimates a panel covering the 1985-1995 but has less extensive coverage of different institutional comparative advantage determinants.

14.   Santo-Silva and Tenreyro (2006) highlight the importance of accounting for zero trade flows as well as addressing the form of heteroskedasticitiy inherent in the log-linearization of the multiplicative form of the gravity equation. This form of heteroskedasticity induces biases in the OLS estimator – thus rendering the resulting estimates unreliable for policy analysis. The Monte Carlo simulation results obtained in their paper show that the Poisson pseudo maximum likelihood estimator provides consistent estimates of the parameters of the gravity equation, while simultaneously ridding the model of the induced bias. In addition, since the model is estimated with the dependent variable in levels, rather than in logs, the problem of omitting zero trade is circumvented.

15.   Some of the individual policy indicators are highly correlated with each other (e.g. the Governance Indicators) and cannot be included in the same regression because of the risk of multicollinearity. In such a case only one variable concerning this policy area is included. For example, regulatory quality and rule of law interactions are included separately in regressions (6-9) and only regulatory quality is included in the joint regression (column 17).

16.   The choice of a comparator is not important for assessing relative impacts of other variables but comparisons with distance are interesting in themselves given the past rivalry between the neo-classical trade theory based on comparative advantage and the new trade theory based on increasing returns and integrating trade costs. Distance is also a natural comparator because of the highly significant and stable results it yields across various model specifications (Tables 6.A1-6.A3).

17.   Switzerland is France's closest trading partner in our dataset. The measure of distance used in the current chapter is the population-weighted distance statistic from the CEPII Distances database. This is the distance between two countries based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country's population.

18.   For a discussion of all interaction terms, see OECD (2011).

19.   These estimations are based on a standard β-convergence regression: $\ln I_{t,i} - \ln I_{t-1,i} = \alpha + \beta \ln I_{t-1,i} + \varepsilon_t$ where $I_{t,i}$ is the value of indicator I (e.g. capital/labour ratio or average years of schooling) in period t in country i. negative estimate β indicates convergence and the size of the coefficient indicates the speed of convergence.

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Annex 6.A

Details of data

Distance and geography

Distances and *Gravity datasets* provided by the *Centre d'études prospectives et d'informations internationales* (CEPII).

Factor intensities and factor endowments

Industry characteristic: physical capital-intensity calculated as a share of capital in industry's total purchases of primary factors of production the GTAP version 7 database; averaged across all countries.

Country characteristic: exporters' physical capital-to-labour ratio using capital stocks series constructed according to the perpetual inventory method combining the GTAP version 7 database values of stock of physical capital in 2004 (the reference values) with gross fixed capital formation data from the World Bank's WDI database.

Human capital intensity and education policy

Industry characteristic: skilled labour-intensity calculated as a share of skilled labour in industry's total purchases of primary factors of production the GTAP version 7 database, averaged across all countries.

Country characteristic: stocks of labour force with completed secondary and tertiary schooling calculated using Barro and Lee (2010) data on percentages of population that have completed secondary and tertiary schooling combined with the WDI data on labour force. For average years of schooling, Barro and Lee (2010) data on average years of study.

Dependence on external credit and availability of credit

Industry characteristic: external capital dependence of a given industrial sector measured as the fraction of total capital expenditure not financed with cash flow from operations; from Braun (2003); based on data for all publically traded US-based companies from Compustat's annual industrial files; (approximately) concorded by the author from the 3-digit ISIC categories used by Braun (2003) to the GTAP sectoral classification.

Country characteristic: the WDI ratio of domestic credit to private sector to GDP covering financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.

Energy intensity and energy supply

Industry characteristic: share of primary energy inputs in firms' costs in the given industry; from version 7 of the GTAP database; average across all countries.

Country characteristic: International Energy Agency (IEA) total primary energy supply (TPES) statistics scaled by the value of GDP in 2000 prices and converted to US dollars using PPP for the year 2000.

Input concentration and business climate

Industry characteristic: Herfindhal index of intermediate inputs dispersion calculated for the United States; based on input-output data from the GTAP version 7 database.

Country characteristic: *regulatory quality*, *rule of law* and *control of corruption* indicators from the WB Governance Indicators database.

Sales volatility and labour market rigidity

Industry characteristic: sales volatility estimated using data for all publically traded US-based companies from Compustat's annual industrial files; from Braun (2003).

Country characteristic: measures of labour regulation from Botero *et al.* (2004); *Alternative contracts* measures the existence and cost of alternatives to the standard employment contract; *Cost of increasing hours worked* measures the cost of increasing the number of hours worked; *Cost of firing workers* measures the cost of firing 20% of the firm's workers; *Dismissal Procedures* measures worker protection granted by law or mandatory collective agreements against dismissal; *Labour Union Power* measures the statutory protection and power of unions as the average of seven indicator variables indicating the presence of absence of various unionization rights and obligations; *Collective Disputes* measures the protection of workers during collective disputes as the average of eight more detailed indicator variables measuring presence or laws protecting industrial action.

Imported intermediate inputs and import tariff policy

Industry characteristic: the ratio of value of imported intermediate inputs to the value of output in a given industry; based on input-output data from the GTAP version 7 database; averaged across all countries.

Country characteristic: average applied tariffs from the UN TRAINS database accessed through the World Integrated Trade Solution (WITS) database.

Country coverage

Countries covered: Argentina; Australia; Austria; Belgium; Brazil; Canada; Switzerland; Chile; China; Chinese Taipei; Czech Republic; Germany; Denmark; Egypt; Spain; Estonia; Finland; France; United Kingdom; Greece; Hong Kong, China; Hungary; Indonesia; India; Ireland; Iceland; Israel; Italy; Japan; Kazakhstan; Korea; Luxembourg; Morocco; Mexico; Malaysia; Nigeria; Netherlands; Norway; New Zealand; Poland; Portugal; Russian Federation; Saudi Arabia; Singapore; Slovak Republic; Slovenia; Sweden; Thailand; Tunisia; Turkey; Ukraine; United States; Venezuela; Viet Nam; South Africa.

Please note that the country coverage in specific regressions depends on data availability and may be less extensive than the one above.

Annex 6.B.

Table and figures

Table 6.B1. Conditional Poisson fixed effects regression model of industry trade flows for year 1995
(Dependent variable: value of exports)

|	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Distance and geography																	
log(distance)	-0.780*** (0.03)	-0.789*** (0.03)	-0.793*** (0.03)	-0.790*** (0.03)	-0.791*** (0.03)	-0.815*** (0.03)	-0.789*** (0.03)	-0.789*** (0.03)	-0.789*** (0.03)	-0.835*** (0.03)	-0.833*** (0.03)	-0.838*** (0.04)	-0.834*** (0.03)	-0.836*** (0.03)	-0.835*** (0.03)	-0.828*** (0.03)	-0.867*** (0.03)
border	0.542*** (0.06)	0.545*** (0.06)	0.545*** (0.06)	0.547*** (0.06)	0.545*** (0.06)	0.513*** (0.07)	0.545*** (0.06)	0.545*** (0.06)	0.545*** (0.06)	0.522*** (0.07)	0.523*** (0.07)	0.517*** (0.07)	0.523*** (0.07)	0.521*** (0.07)	0.523*** (0.07)	0.571*** (0.07)	0.525*** (0.07)
common official language	0.401*** (0.06)	0.365*** (0.06)	0.355*** (0.06)	0.357*** (0.06)	0.372*** (0.06)	0.362*** (0.06)	0.365*** (0.06)	0.364*** (0.06)	0.365*** (0.06)	0.290*** (0.06)	0.288*** (0.06)	0.291*** (0.06)	0.290*** (0.06)	0.286*** (0.06)	0.296*** (0.06)	0.362*** (0.06)	0.332*** (0.07)
colony	-0.239** (0.09)	-0.234** (0.10)	-0.229* (0.09)	-0.225* (0.09)	-0.237* (0.10)	-0.114 (0.09)	-0.234* (0.10)	-0.234* (0.10)	-0.235* (0.10)	-0.126 (0.10)	-0.125 (0.09)	-0.128 (0.10)	-0.125 (0.09)	-0.124 (0.09)	-0.128 (0.10)	-0.265*** (0.09)	-0.117 (0.07)
Heckscher-Ohlin																	
(K/L)*capital intensity		1.139*** (0.23)	0.990*** (0.21)	0.876*** (0.21)	1.271*** (0.23)	0.774*** (0.22)	1.128*** (0.23)	1.189*** (0.23)	1.164*** (0.23)	1.148*** (0.23)	1.156*** (0.23)	1.178*** (0.23)	1.142*** (0.24)	1.155*** (0.23)	1.148*** (0.23)	0.628** (0.25)	0.659** (0.25)
Policy and institutions																	
Human capital																	
log(secondary schooling) * skilled-labour intensity			0.013*** (0.00)														0.010*** (0.00)
log(tertiary schooling) * skilled-labour intensity			0.021*** (0.01)														0.009 (0.01)
log(years of schooling) * skilled-labour intensity				13.292*** (1.76)													
Energy																	
log(energy supply) * energy intensity					3.335*** (0.49)												3.080*** (0.48)
Financial development																	
financial development * dependence on external finance						0.023*** (0.00)											0.023*** (0.00)
Doing business climate																	
regulatory quality * input concentration							-0.014 (0.02)										-0.024 (0.03)
rule of law * input concentration								0.038 (0.02)									
control of corruption * input concentration									0.020 (0.02)								
Labour market institutions																	
Protection of labour and employment laws																	
protection to standard employment contract * volatility										-0.120 (0.14)							0.150 (0.10)
cost of increasing the number of hours * volatility											-0.142 (0.07)						
cost of firing labor force * volatility												0.379** (0.14)					
protection against dismissal * volatility													-0.121 (0.13)				
Protection of collective relations laws																	
statutory power and protection of unions * volatility														-0.139* (0.06)			
protection during collective disputes * volatility															0.344** (0.11)		
Import tariff policy																	
log (average applied tariff) * imported inputs share																-3.451*** (0.50)	-1.154 (0.72)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Importer-industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	117 936	107 162	107 162	107 162	107 162	105 019	107 162	107 162	107 162	96 321	96 321	96 321	96 321	96 321	96 321	100 509	91 832

Robust standard errors by importer-product group, ***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively, brackets contain standard errors.

Table 6.B2. Conditional Poisson fixed effects regression model of industry trade flows for year 2005
(Dependent variable: value of exports)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Distance and geography																	
log(distance)	-0.852***	-0.861***	-0.865***	-0.863***	-0.862***	-0.873***	-0.861***	-0.861***	-0.861***	-0.881***	-0.880***	-0.885***	-0.883***	-0.882***	-0.882***	-0.865***	-0.884***
	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
border	0.395***	0.401***	0.401***	0.400***	0.402***	0.399***	0.401***	0.400***	0.401***	0.413***	0.415***	0.409***	0.411***	0.412***	0.413***	0.443***	0.445***
	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
common official language	0.242**	0.171**	0.170**	0.175**	0.174**	0.154**	0.167**	0.167**	0.166*	0.119	0.118	0.117	0.122	0.116	0.122	0.159*	0.123
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)
colony	-0.101	-0.065	-0.059	-0.060	-0.068	0.045	-0.064	-0.065	-0.065	0.053	0.053	0.055	0.053	0.056	0.052	-0.066	0.052
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Heckscher-Ohlin																	
(K/L)*capital intensity		0.492*	0.490*	0.465*	0.718***	0.324	0.784***	0.772***	0.806***	0.478*	0.492*	0.556***	0.489*	0.492*	0.480*	0.658***	0.648**
		(0.23)	(0.21)	(0.21)	(0.23)	(0.22)	(0.21)	(0.21)	(0.21)	(0.24)	(0.23)	(0.22)	(0.24)	(0.23)	(0.24)	(0.24)	(0.23)
Policy and institutions																	
Human capital																	
log(secondary schooling) * skilled-labour intensity			0.014***													0.015***	
			(0.00)													(0.00)	
log(tertiary schooling) * skilled-labour intensity			0.029***													0.017*	
			(0.01)													(0.01)	
log(years of schooling) * skilled-labour intensity				14.908***													
				(2.26)													
Energy																	
log(energy supply) * energy intensity					2.453***											1.821***	
					(0.40)											(0.35)	
Financial development																	
financial development * dependence on external finance						0.009***										0.007***	
						(0.00)										(0.00)	
Doing business climate																	
regulatory quality * input concentration							0.070**									0.091***	
							(0.02)									(0.03)	
rule of law * input concentration								0.058**									
								(0.02)									
control of corruption * input concentration									0.061***								
									(0.02)								
Labour market institutions																	
Protection of labour and employment laws																	
protection to standard employment contract * volatility										-0.252**						-0.086	
										(0.10)						(0.08)	
cost of increasing the number of hours * volatility											-0.192**						
											(0.07)						
cost of firing labor force * volatility												0.837***					
												(0.12)					
protection against dismissal * volatility													0.109				
													(0.07)				
Protection of collective relations laws																	
statutory power and protection of unions * volatility														-0.280***			-0.261***
														(0.07)			(0.07)
protection during collective disputes * volatility															0.071		
															(0.09)		
Import tariff policy																	
log (average applied tariff) * imported inputs share																1.204*	-0.427
																(0.49)	(0.49)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Importer-industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	124 470	113 096	113 096	113 096	113 096	108 573	113 096	113 096	113 096	101 740	101 740	101 740	101 740	101 740	101 740	105 989	94 630

Robust standard errors by importer-product group, ***, **, and * denote statistical significance at 1%, 5% and 10% levels respectively, brackets contain standard errors.

Table 6.B3. Conditional Poisson-fixed effects regression model of industry trade flows for two-year panel 1995-2005

(Dependent variable: value of exports)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Distance and geography																	
log(distance)	-0.821***	-0.830***	-0.833***	-0.832***	-0.831***	-0.842***	-0.830***	-0.830***	-0.831***	-0.855***	-0.853***	-0.859***	-0.856***	-0.856***	-0.855***	-0.843***	-0.863***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
border	0.446***	0.452***	0.454***	0.452***	0.452***	0.446***	0.451***	0.451***	0.451***	0.459***	0.461***	0.454***	0.458***	0.458***	0.459***	0.491***	0.485***
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
common official language	0.277***	0.218***	0.211***	0.215***	0.222***	0.206***	0.220***	0.218***	0.220***	0.157***	0.156***	0.156***	0.159***	0.154***	0.161**	0.199**	0.172**
	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)
colony	-0.146*	-0.120	-0.116	-0.116	-0.124*	-0.012	-0.123*	-0.120	-0.121*	-0.003	-0.002	-0.003	-0.003	-0.000	-0.004	-0.127*	-0.008
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Heckscher-Ohlin																	
(K/L)*capital intensity		0.862***	0.807***	0.804***	1.028***	0.681***	0.839***	0.874***	0.759***	0.866***	0.874***	0.914***	0.870***	0.875***	0.867***	0.785***	0.718***
		(0.14)	(0.13)	(0.13)	(0.14)	(0.13)	(0.14)	(0.13)	(0.15)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Policy and institutions																	
Human capital																	
log(secondary schooling) * skilled-labour intensity			0.010***														0.009***
			(0.00)														(0.00)
log(tertiary schooling) * skilled-labour intensity			0.028***														0.026***
			(0.00)														(0.00)
log(years of schooling) * skilled-labour intensity				13.172***													
				(1.28)													
Energy																	
log(energy supply) * energy intensity					2.851***												2.623***
					(0.35)												(0.35)
Financial development																	
financial development * dependence on external finance						0.010***											0.008***
						(0.00)											(0.00)
Doing business climate																	
regulatory quality * input concentration							-0.010*										-0.010***
							(0.00)										(0.00)
rule of law * input concentration								0.004									
								(0.01)									
control of corruption * input concentration									-0.011**								
									(0.00)								
Labour market institutions																	
Protection of labour and employment laws																	
protection to standard employment contract * volatility										-0.207*							-0.030
										(0.08)							(0.06)
cost of increasing the number of hours * volatility											-0.176***						
											(0.05)						
cost of firing labor force * volatility												0.665***					
												(0.09)					
protection against dismissal * volatility													0.028				
													(0.06)				
Protection of collective relations laws																	
statutory power and protection of unions * volatility														-0.231***			-0.196***
														(0.05)			(0.05)
protection during collective disputes * volatility															0.170*		
															(0.07)		
Import tariff policy																	
log (average applied tariff) * imported inputs share																-0.093	-0.067
																(0.42)	(0.48)
Exporter fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Importer-industry-year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	242 406	220 258	220 258	220 258	220 258	213 592	220 258	220 258	220 258	198 061	198 061	198 061	198 061	198 061	198 061	206 498	186 462

Robust standard errors by importer-product-year group, ***, ** and * denote statistical significance at 1%, 5% and 10% levels respectively, brackets contain standard errors.

**Annex Figure 6.B1. Hecksher-Ohlin sources of comparative advantage:
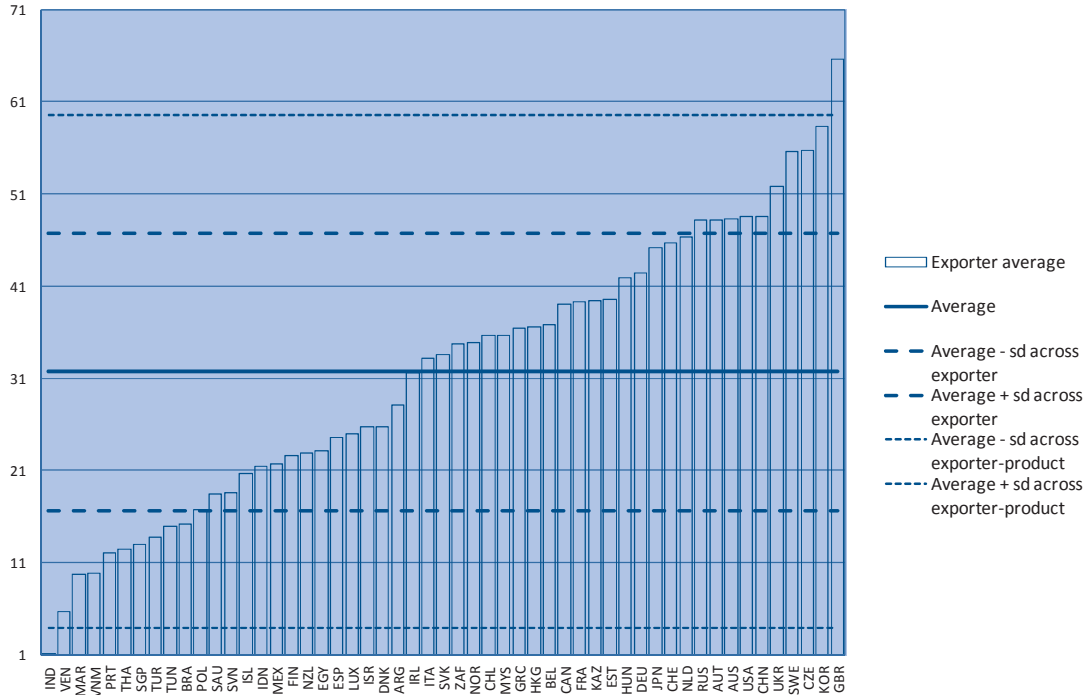Variation across exporters and industries**

1995

Log(K/L)*capital intensity

2005

Log(K/L)*capital intensity
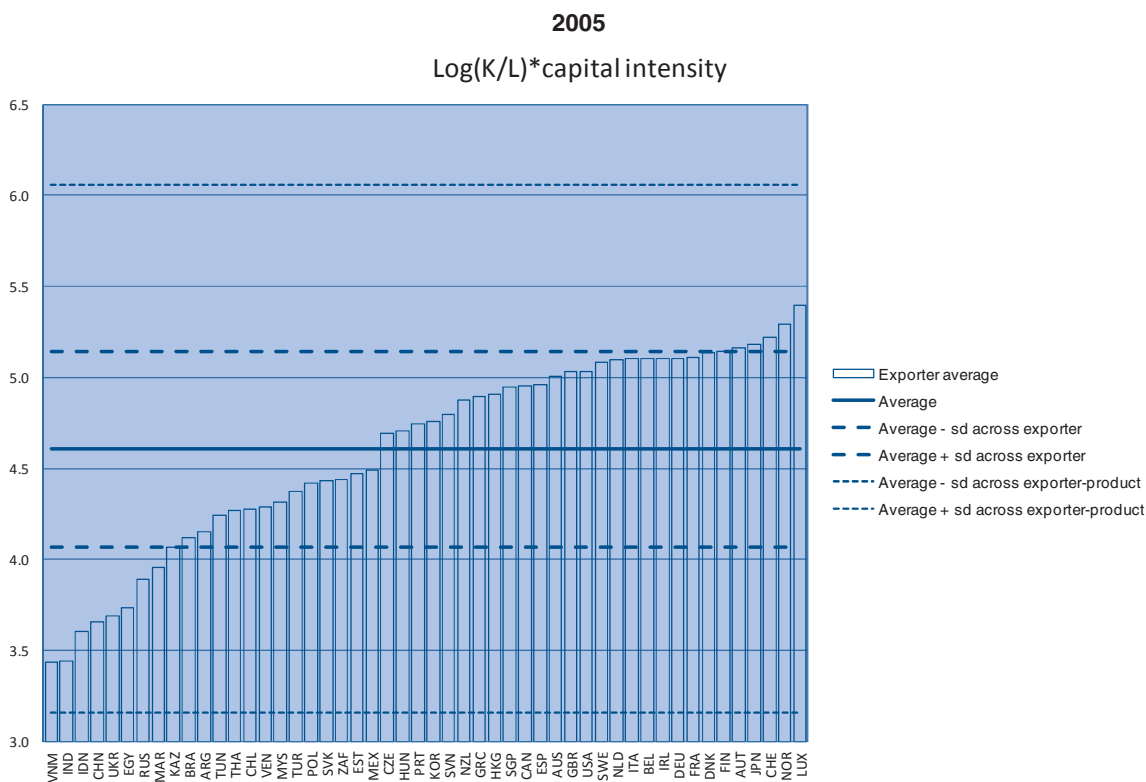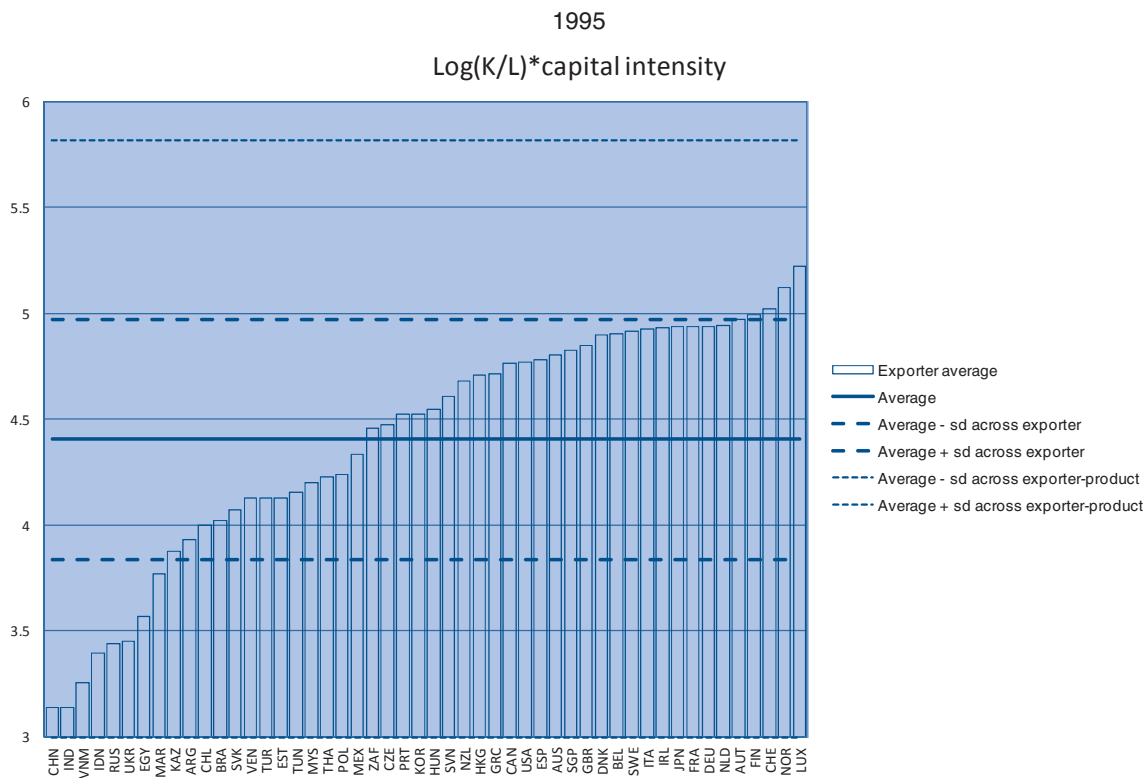
See variable definitions and sources in Annex 6.A.

Annex Figure 6.B2. Labour force with secondary schooling and skilled labour-intensity: Variation across exporters and industries
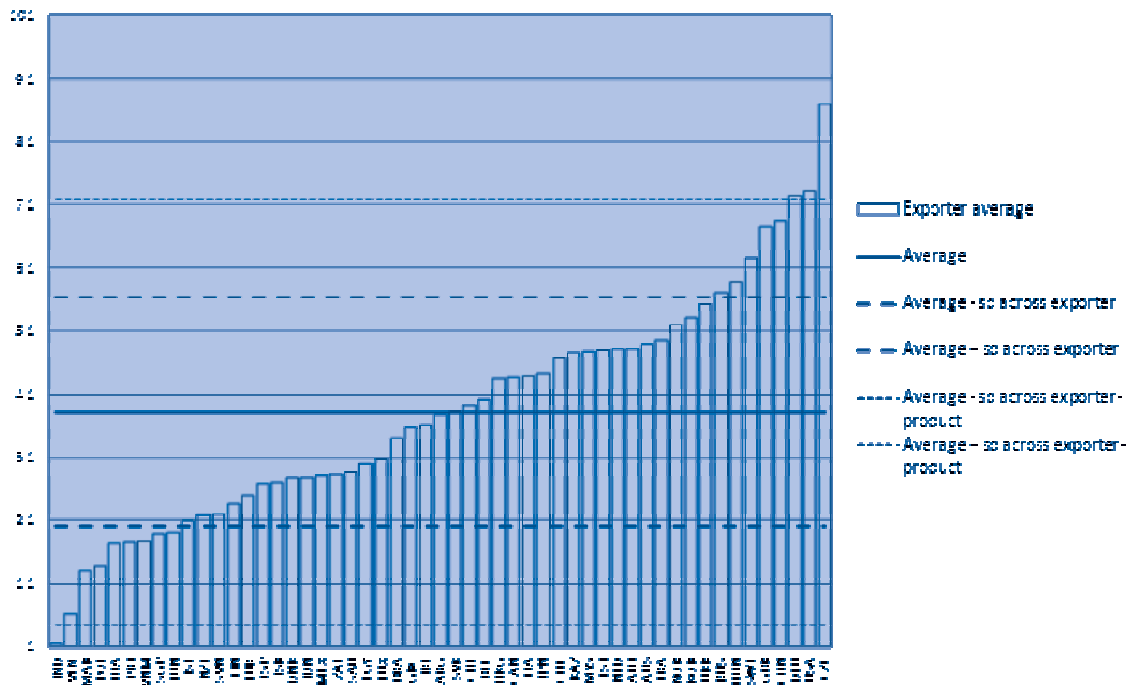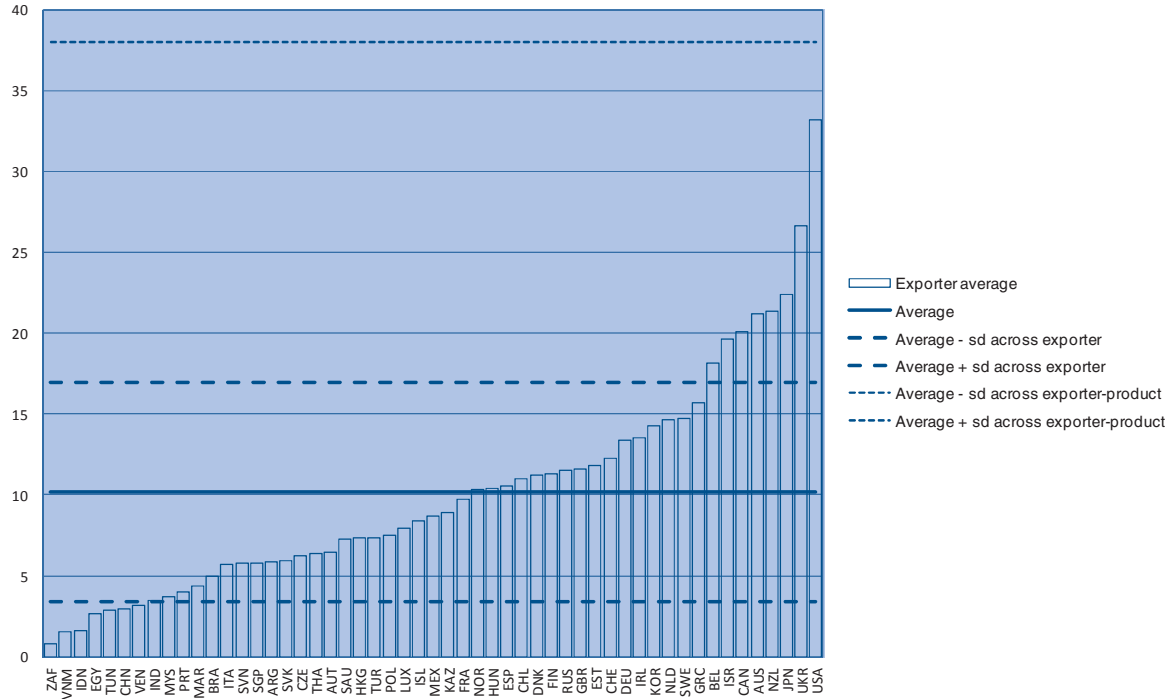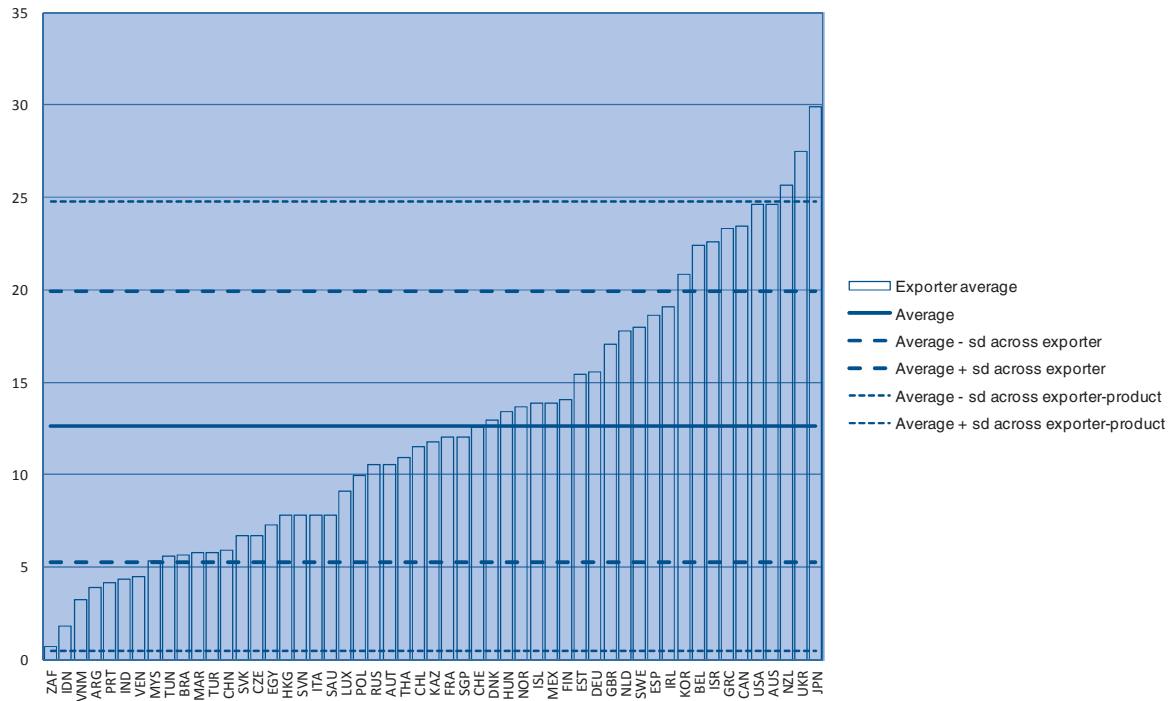
1995

Log(Lab force with secondary schooling) * Skilled-labour intensity

2005

Log(Lab force with secondary schooling) * Skilled-labour intensity

See variable definitions and sources in Annex 6.A.

Annex Figure 6.B3. Labour force with tertiary schooling and skilled labour-intensity: Variation across exporters and industries

1995

Log(lab force with tertiary schooling) * skilled-labour intensity

2005

Log(lab force with tertiary schooling) * skilled-labour intensity

See variable definitions and sources in Annex 6.A.

**Annex Figure 6.B4. Energy supply and energy-intensity:
Variation across exporters and industries**

1995

Log(energy supply) * energy intensity
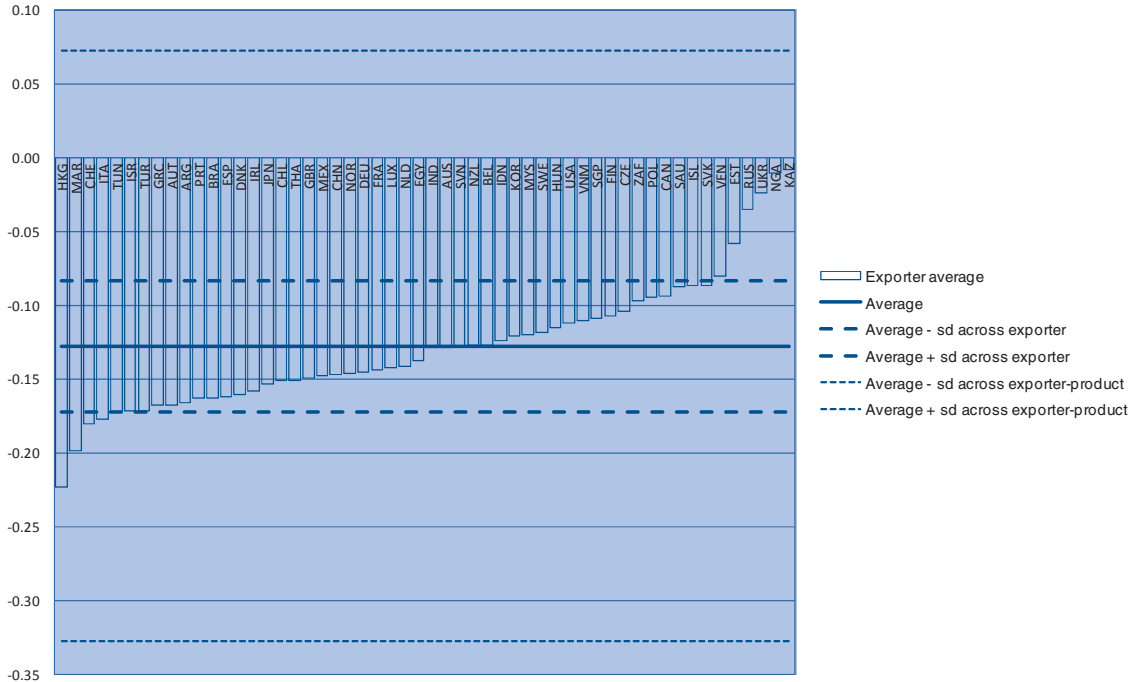
Exporter average
Average
Average - sd across exporter
Average + sd across exporter
Average - sd across exporter-product
Average + sd across exporter-product

2005

Log(energy supply) * energy intensity

Exporter average
Average
Average - sd across exporter
Average + sd across exporter
Average - sd across exporter-product
Average + sd across exporter-product
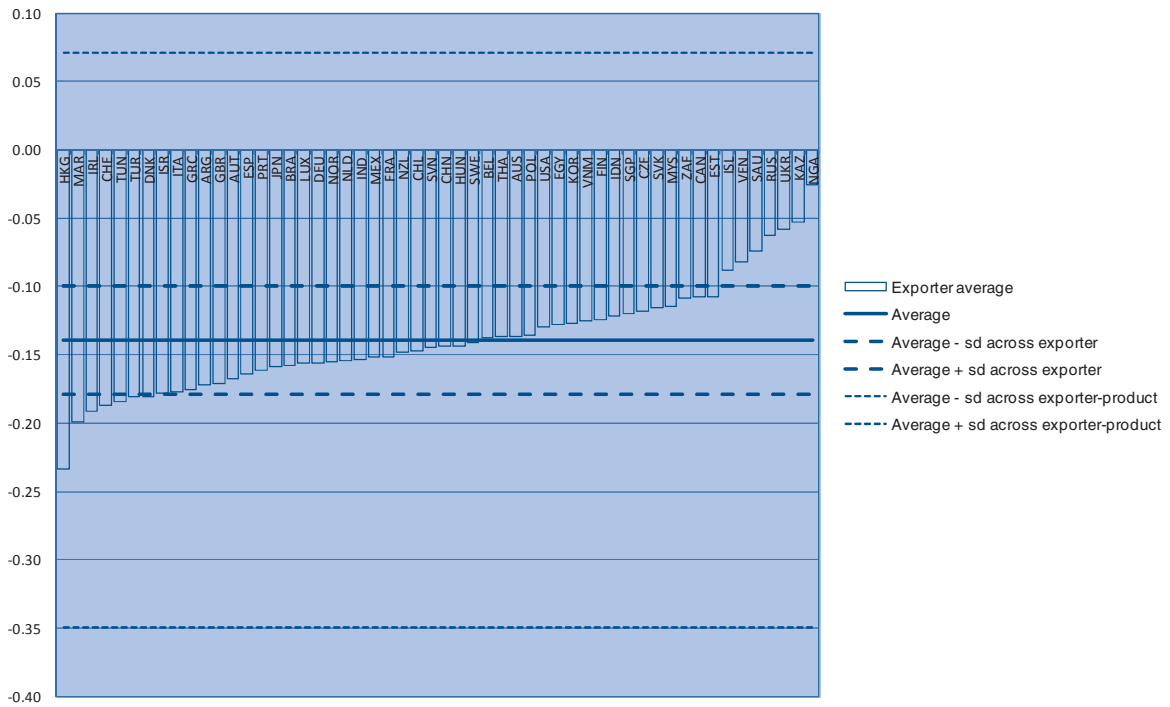
See variable definitions and sources in Annex 6.A.

**Annex Figure 6.B5. Financial development and dependence on external finance:
Variation across exporters and industries**

1995

Financial development * dependence on external finance
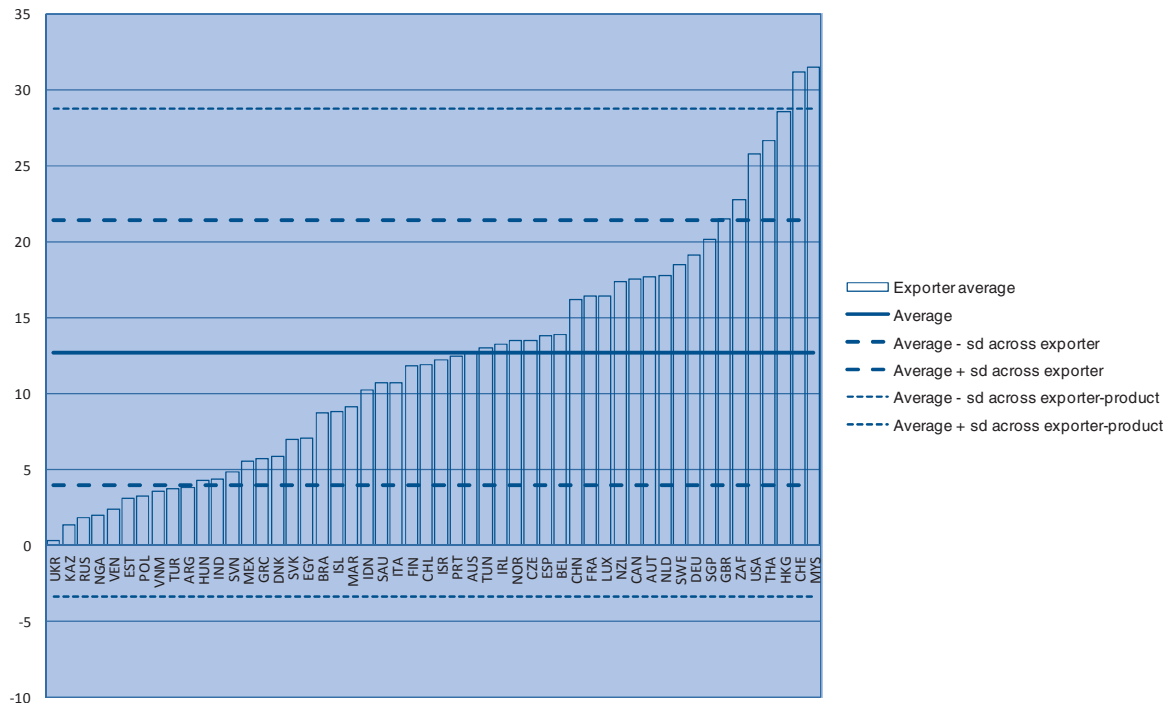
2005

Financial development * dependence on external finance

See variable definitions and sources in Annex 6.A.