The Demand for Skills 1995 – 2008: A Global Supply Chain Perspective

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(Draft)

Abstract

We propose a new method to analyze the changing skills structure of employment in countries based on the input-output structure of the world economy. Demand for jobs, characterized by skill type and industry of employment, is driven by changes in technology, trade and consumption. Using structural decomposition analysis, we study the relative importance of these drivers for the period 1995-2008. In doing so, we derive a new measure of technological change in vertically integrated production chains and show that it has been skill-biased. We find that skill-biased technological change has played the most important role in the different employment growth rates of high-skilled, medium-skilled and low-skilled labor in advanced countries. For emerging countries, the patterns of employment growth are very heterogeneous.

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1. Introduction

The structure of employment in the economy is constantly evolving. In past decades, the share of jobs in the services sector in advanced countries increased relative to industry, and there was a shift in favor of skilled relative to unskilled workers. Technological change, international trade and changes in consumption are often hypothesized to be major driving forces behind this process of structural change. Typically, the increasing share of services employment has been attributed to sector-biased technological change and non-homothetic preferences.[1] The shift in favor of skilled workers in advanced countries was mainly attributed to skill-biased technological change, with only a minor role for trade.[2] However, quantifying the effects of these determinants in empirical work is not straightforward and recently this consensus view is being challenged again (see e.g. Autor et al., 2013).

A major bottleneck in this type of work is the lack of an empirical identification of global supply chains and their evolution. Typically, use is made of measures of foreign direct investment, imports and exports over GDP or the share of intermediate imports in overall imports. Even when this type of data is available at the country-industry-time level, it is still not capturing how activities are combined together in global supply chains. One of the contributions of this paper is to provide an empirical method for identifying global supply chains in the sense of Costinot et al. (2012) and to measure the rate and skill-biased nature of technological change in these chains. A second bottleneck is in the modeling of the skill and job content of imports from the emerging world, in particular China. What matters for the effect of imports on domestic labor demand is its skill content which can only be inferred from data on the skill content of the production activities carried out by the exporting country (Krugman, 2008). We have collected new data on the use of labor by industry and skill type in a wide range of developing countries that are important exporters to advanced countries. This data also allows us to present results on the relative importance of the factors underlying change in the demand for skills in a number of important emerging economies, viz. Brazil, China, India and Indonesia.

[1] See e.g. Ngai and Pissarides (2007) and Gollin *et al*. (2002) building upon the ideas of Chenery and Clark (1959) and Baumol (1967).

[2] See e.g. Autor and Katz (1999), a more recent overview by Feenstra (2010), Acemoglu and Autor (2011), and Michaels *et al.* (2013).

The most important contribution of this paper is to provide a conceptual framework for analyzing changes in the demand for jobs through modeling the input-output structure of the world economy, building upon the pioneering work of Leontief (1936, 1941). Based on a world input-output model we decompose changes in employment, characterized by skill type and sector of employment, into changes in global supply chain technology, international trade and consumption. Using a structural decomposition technique we analyze the relative importance of the main drivers in a large set of countries for the period 1995-2008. The methodology used is akin to the one used in the context of measuring vertical specialization (Hummels et al., 2001) and trade in value added (Johnson and Noguera, 2011; Trefler and Zhu, 2010).

The paper is organized as follows. In Section 2, a stylized example of a global supply chain (GSC) is introduced to illustrate the decomposition method in an intuitive way. Section 4 describes the data. We then evaluate to what extent the changes in jobs per skill-type and country can be explained by each of the different channels affecting demand for skills in Section 5.[3] Section 6 concludes.

2. The Global Supply Chain Approach to Labor Demand: The Intuition[4]

Due to advances in information and communication technology, reductions in transportation costs and reductions in trade barriers, companies have experienced increasing opportunities to relocate part of the production processes leading to final products to countries where the availability and costs of the production factors are most favorable for these specific activities (Baldwin, 2006). As is stressed in the case study literature (e.g. Dedrick et al., 2010), these relocations can be governed within the firm (by means of FDI) or by agreeing on contracts with specialized foreign suppliers. No matter what form is chosen, such relocation decisions have consequences for the distribution of demand for jobs (of different types) in the countries involved, both the home and the host countries. The internationally dispersed activities that together yield a final product (i.e., a consumption product or a physical capital good) are often called a

[3] The discussion in the main text focuses on quantifications of the sources of change in skills demand in aggregate economies and two main broad sectors. More detailed results are presented in sets of tables in Appendix B.

[4] See Appendix A for a detailed, more formal explanation of the methodology.

Global Supply Chain (GSC). At the level of specific products, like the iPod and other high-end electronic products, much research has been done to see in which countries the labor involved in the GVC has been employed and where value added was generated. At a more macro level, such studies are much more recent.

To explain how input-output analysis can be used to sketch such macroeconomic pictures, the illustration in Figure 1 might be helpful. We consider a final product (e.g. a car) with Country 3 as the "country-of-completion". The country-of-completion is the country in which the last stage of production takes place before it is shipped to wholesalers, retailers or consumers. Domestic and foreign demand for Country 3's cars will require labor (and other production factors) in 3's car industry itself.

***** INSERT Figure 1 ABOUT HERE*****

It will also generate employment in upstream industries in Country 3 itself, for example because the car manufacturer needs intermediate inputs from the business services industry. Next to domestically sourced intermediate inputs, other intermediate inputs (metal products, for example) are imported from Country 2. The manufacturing of these metal products require labor inputs as well and the metal products manufacturers in their turn also need intermediate inputs, partly produced in Country 2 and partly in Country 1. Due to demand for final products completed in Country 3, jobs are created in all three countries. We will label Countries 1, 2 and 3 as "countries-of-employment", to highlight the locations of the labor inputs associated with the production of a final good with a specific country-of-completion.

Using well-established techniques from the field of input-output analysis (Miller and Blair, 2009), information contained in World Input-Output Tables can be deployed to estimate the (gross) output levels of all industries in each of the countries required to meet final demand (i.e. consumption and investment demand) for a specific product group with a specific country-of-completion. After these output levels are determined, information about the labor requirements per unit of output can be combined with the output levels to arrive at an estimate for the employment levels associated with the specific final demand level studied. If the employment levels associated with final demand for *all products with all countries-of-completion* are estimated in this way, these will exactly sum to actual labor inputs in each of the industries in each of the countries-of-employment. In this analysis, World Input-Output Tables are thus seen as descriptions of the world production structure, which is considered to be an evolving network of Global Supply Chains.[5]

The focus of this report is on the relative importance of changes in determinants of the level of demand of jobs in countries (and sectors within these countries). Our analysis is among the first ones to frame the quantification of these effects in a setting of internationally fragmented Global Supply Chains, as in the theoretical work of Costinot *et al*. (2012). In our analysis, two situations will be compared, for two years (1995 and 2008, in the empirical study). In the most elaborate version of our empirical analysis, the contributions of six determinants are quantified. We illustrate this along the lines of Figure 1:

1) *Changes in GSC-technology*. We define the GSC-technology for a car completed in Country 3 as the factor inputs (in quantity terms) anywhere in the world and in any industry required to produce a million US dollar of final output of the car industry in Country 3. Since workers in Country 1 might be much less productive than workers in Country 3, we express labor in terms of efficiency units (which are defined as US workers in our empirical study). Technological progress in this GSC will, ceteris paribus, lead to lower demand for labor in all three countries and in all industries;
2) *Changes in efficiency*. If the productivity levels of workers in initially low-productivity Country 1 catch up to the productivity level of the country of which a worker is considered to be an efficiency unit (Country 3), labor demand in Country 1 will, ceteris paribus, decline;
3) *Changes in location-of-intermediate stages*. If some of the intermediate inputs required by Country 3's car manufacturers were initially purchased from domestic suppliers but are bought in Country 2 at a later stage, the associated labor inputs will also be relocated from Country 3 to Country 2.
4) *Changes in location-of-completion*. If cars with Country 3 as the country-of-completion lose market share (for example to cars from Country 4), labor demand in all countries that contribute to Country 3's car GSC will be reduced, ceteris paribus. Changes in preferences of users can cause changes like these, but also decisions by lead firms to relocate their assembly activities.

[5] Wolff (1985) considered productivity in 'vertically integrated industries'. A GSC can be seen as an internationally vertically integrated industry.

5) *Changes in consumption compositions*. If consumers (at home and abroad) decide to change the composition of their consumption bundle away from cars to electronic products, labor demand in the countries and industries contributing to Country 3's car GSCs will be reduced (unless they contribute more to GSCs for electronics);
6) *Changes in consumption levels*. If consumers (at home and abroad) increase their spending over time, more cars completed in Country 3 will be sold (ceteris paribus) and consequently more workers will be employed in each of the industries in the countries-of-employment involved in this GSC.

In the input-output model, the changes listed above can be considered as exogenous and mutually independent. Furthermore, they are exhaustive: the total change in the demand for labor (or labor of a particular skills level) can be attributed to these six types of change, without a residual being left unexplained.[6]

For reasons of exposition, we will present most of the empirical results after having merged the effects 1) and 2) into a "technology" effect. Effects 3) and 4) together constitute the "trade" effect.[7] "Consumption" effects (which include changes in the patterns and levels of investment demand) are obtained by adding effects 5) and 6).

It should be stressed that the method adopted in this paper does not aim at explaining changes in the demand for skills in particular countries and industries-of-employment. The focus is on accounting for these changes, to see which determinants have contributed most. In a next step, which clearly falls outside the scope of this paper, the most important 'proximate sources of change' can be subjected to further analysis, with the aim to see which 'ultimate sources of change' have been behind this. Another limitation that should be emphasized here is that the input-output decomposition methodology does not allow us to consider effects of the changes in demand on factor prices. Hence, we cannot study the consequences of technology effects, trade effects and consumption effects on the often divergent wages of low-skilled, medium-skilled and high-skilled workers.

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[6] This exhaustiveness only holds if all final products, including agricultural products, mining products, construction and services, are supposed to have a GVC. As opposed to Timmer *et al*. (2013), which focuses on manufactures GVCs, we consider all final products throughout this report.

[7] Note that relocation of the production of components (intermediate inputs) would lead to effect 3), while relocation of assembly activities (e.g. of consumer electronics products from the US to China) would lead to effect 4).

3. Data Issues

Almost all data required for the analysis underlying this report were taken from the World Input-Output Database (free and publicly available at www.wiod.org). The steps used to construct the 1995-2008 time series of World Input-Output Tables (from National Accounts data, national Supply and Use tables and bilateral trade statistics) have been described in detail in Dietzenbacher et al. (2013). Data expressed in national currencies have been converted to US dollars by means of market exchange rates. Information about the construction of data (based on educational attainment, ISCED levels) regarding skills use by each of the industries in each of the countries can be found in the Sources and Methods document that goes with the database (Timmer, ed., 2012). For most countries, Labor Force Surveys were the main source of data. Data limitations prevent us from using skill inputs expressed in fulltime equivalents, but self-employed are included.

For the specific purposes of this report, a World Input-Output Table for 2008 expressed in prices of 1995 was required.[8] We estimated such a table by deflating all industry outputs by industry-specific gross output deflators. This double-deflation method implies that industry value added is obtained as a residual. It is well-known that these residuals can be affected substantially by measurement and aggregation error, but this is not relevant for this study: value added figures do not play a role in the analysis.

The expression of labor inputs in efficiency units (required to arrive at meaningful numbers describing changes in GSC-technologies) required indicators of relative productivity levels of workers in the countries involved. To compare productivity across countries and sectors, a key issue is how to convert real value added into common currency units. Conceptually, the appropriate rate of exchange is a Purchasing Power Parity (PPP). Inklaar and Timmer (2013) provide detailed PPP estimates in the GGDC productivity level database (see www.ggdc.net). These estimates of relative prices across sectors are based on price data collected by the World Bank in the 2005 ICP round except for agriculture, which is based on unit value information from FAO.

[8] Using tables in current prices would have led to an overestimation of output growth, among other things, because of inflation. As a consequence, changes in GVC-technologies would have been overestimated as well.

Basic headings from the ICP round are matched to sectors that are the main producers of the good or service and PPPs are estimated using the EKS method. The FAO data for agriculture are used in the CPD method to estimate agricultural PPPs (Rao, 2005). It is well known that relative prices vary substantially across tradable and non-tradable sectors, such that the use of aggregate PPPs is not appropriate. Therefore, we used two PPPs: for tradable and for non-tradable industries. Because of data limitations, we had to assume that labor productivity levels of countries relative to the US changed identically across skill categories.

4. Results

Let us first focus on quantifying the actual changes in demand for skills, which we would like to split into the changes in underlying factors using the decomposition methodology, focusing on total economies first. Figure 2 clearly shows that demand for high-skilled workers increased in all countries. With the exception of Japan, demand for medium-skilled labor also increased everywhere. In most countries, demand for low-skilled labor declined. The clear exceptions are Indonesia and India, but some demand growth for low-skilled labor is also found for Australia.

*****INSERT Figure 2 ABOUT HERE*****

Figure 2 gives absolute changes in the demand levels, which mainly leads to insights into global patterns in job creation. It shows that many changes in the EU15 and the US are dwarfed by changes in countries like China and India, in particular when employment of medium-skilled labor is concerned. To get more insights into the impacts of changes in individual countries, however, changes expressed in proportional growth rates relative to 1995 are probably more useful (Figure 3).

*****INSERT Figure 3 ABOUT HERE*****

Figure 3 shows that the decline in demand for low-skilled labor was felt most strongly in Japan, and among the large economies in Europe in France and the UK. Germany hardly lost low-skilled jobs. The demand for medium-skilled labor grew fastest in

Brazil, followed by Australia and Indonesia. The relative growth in employment of high-skilled labor was fastest in China, but growth rates in the EU were considerably higher than in the US and Japan.

How did employment in sectors contribute to these changes at the total economy level? We have studied changes in skills demand for two industry groupings (see Appendix B). Figure 4a shows how the broad sectors defined as those in the most aggregated classification scheme (Aggregation scheme 1 in Appendix B) contributed to the change in total economy demand for low-skilled labor. For all countries included, natural resources industries (agriculture and mining) used less low-skilled labor over time. In manufacturing, China and India were the only two countries that experienced an increase in the demand for labor. Other industry (construction and public utilities) employed more low-skilled labor in 2008 than in 1995 in the emerging and natural resources-rich countries, but less low-skilled labor elsewhere. Business services contributed positively in all advanced countries, but did not mean much for total changes in low-skilled labor demand in the emerging countries. With the exceptions of Germany and Australia, other services employed less low-skilled workers in 2008 in advanced countries, but considerably more in emerging countries.

*****INSERT Figure 4a ABOUT HERE*****

*****INSERT Figure 4b ABOUT HERE*****

Figure 4b shows that the growth in high-skilled jobs has predominantly taken place in other services. Especially in advanced countries, though, about 20% of the high-skilled job growth took place in the business services industries. In Indonesia and India the natural resources sector contributed much more than in other countries. The manufacturing sector has been relatively unimportant as a growing employer of high-skilled labor.

To what extent have the six proximate sources of change introduced in Section 2 contributed to changes in skills demand between 1995 and 2008? To this end, we employ our structural decomposition analysis, the details of which are set out in Appendix A. Figure 5a illustrates the results for the total economy of the EU15, while Figure 5b refers to the market economy.

*****INSERT Figure 5a ABOUT HERE*****

*****INSERT Figure 5b ABOUT HERE*****

The grey parts of the bars give the skills employment in 1995, and the six colored bars relate to the sources of change between 1995 and 2008. As a consequence, the total lengths of the bars represent skills employment in 2008. The changes in consumption levels effect has been the major contributor to growth of employment in the EU15, for all skills. It should be stressed that this effect is not only due to growth in consumption in the EU15 itself, but is also fostered by the increasing demand by consumers (and investors) in the emerging countries. Changes in efficiency also account for more employment: labor productivity in the EU15 grew slower than in the US, as a consequence of which an equal input of efficiency units required more jobs. These two effects led to positive employment growth for mediums-skilled and high-skilled workers, but were not sufficient to compensate for the downward pressure exerted by the other effects for low-skilled labor. The effects of improvements in GSC-technology in particular have left their marks for this skills group. The skill bias in technological change within GSCs is very apparent: while this effect considered in isolation would have led to higher employment of high-skilled labor, lesser-skilled workers would have faced lower employment. The relocation of both intermediate and final stages of production also contributed to the decrease in low-skilled employment.

The tendencies sketched for the total EU15-economy are also clearly reflected in the results for the market economy of the EU15. The relative importance of changes in the location of stages of production is larger, however. While we estimate that roughly 80% of the economy-wide losses in LS-employment as a consequence of GSC-technology took place in the market economy, these percentages amount to as much as 98% and 99% for the LS-job losses due to changes in the location of intermediate production stages and changes in the location-of-completion, respectively. These results reflect the fact that many nonmarket services can only be produced in the country were consumption takes place.

After having illustrated results for the detailed six-factor structural decomposition for the EU15 economy, we now turn to comparisons of results for several countries, within and outside the EU. From this stage onwards, we will present results based on the three-factor aggregation of decomposition results outlined in Section 2: To what extent have "technological change", "changes in trade" and "changes in consumption" been responsible for the changes depicted in Figures 2-4? Table 1 gives results for the total economy.

*****INSERT Table 1 ABOUT HERE*****

If everything else would have remained equal, *technological change* would have led to a reduction of the total number of jobs in all countries. It has been skill-biased though. With the exception of the US, China and India, high-skilled employment would have grown, even if technological change would have been the only source of change. For all countries, these effects on high-skilled labor would have been dwarfed by huge reductions in the demand for low-skilled and medium-skilled jobs (in the US, more than 80% of the reduction in total jobs would have been medium-skilled jobs, whereas in the EU15 most of the jobs lost would have been low-skilled jobs).

If only patterns of *international trade* would have changed, emerging countries would have seen substantial increases in total jobs, while the advanced countries would have seen reductions. In China, the creation of more than 200 millions of jobs can be attributed to changes in trade patterns. In the EU15, about 6.5 millions of low-skilled jobs were lost due to changes in trade, while roughly 4.7 millions of medium-skilled jobs in the US can be considered as having been traded away.

Changes in consumption have led to increases in the demand for jobs of all skills levels. For Japan, however, the positive effect has been almost negligible with respect to low-skilled employment. Together with China, Japan is the only country for which the increase in total jobs as a consequence of consumption change has not been sufficient to compensate for the loss of total jobs as a consequence of technological change.

Assessing the relative importance of the three sources of change in more general terms, our results show that changes in technology have been the most important driver of differences in the growth rates of demand for skills in advanced countries. These have in general been reinforced by changes in trade patterns, to an extent that is far from non-negligible. Consumption growth (combined with changes in the composition of consumption) has had a positive effect on demand for all skills, but these positive effects have not been substantial enough to keep the number of low-skilled jobs at a stable level over the 1995-2008 period. In most emerging countries, changes in consumption have led to high employment growth, as a consequence of which the net effects of consumption change and technological change have often been positive. The favorable employment effects of changes in trade patterns were only substantial in China, and much smaller in the other emerging countries studied here (and even negative in India).

So far, results have been presented for total economies. Figures 4a and 4b showed that the numbers of workers did not change evenly across broad sectors in most countries, over the 1995-2008 period. Tables 2 and 3 present the decomposition results for changes in employment of skills for manufacturing and market services separately (note that Appendix B contains sets of results for finer-grained industry-aggregates).

*****INSERT Table 2 ABOUT HERE*****

*****INSERT Table 3 ABOUT HERE*****

For employment in manufacturing, we find that changes in technology and trade both have contributed substantially to the decline in LS-employment. These effects also exerted a downward pressure on MS-employment. For HS jobs, we find that about two-thirds of the employment-reducing effects of trade were offset by an upward effect of technology, which gives more prominence to the skill-biased technological change hypothesis. A closer look at the three major EU15-countries for which we separately report results shows that the UK-workers suffered considerably more from trade effects than workers in France and Germany. Nevertheless, the loss of MS- and HS-employment in German manufacturing due to trade effects is noticeable.

All skill types of workers in the US and Japan faced downward pressures on their employment from both technical change and trade effects. In the US, the technology effects were almost three times as large as the trade effects, both for LS-labor and MS-labor. In Japan, the impacts were much more asymmetric. The trade effect was much less important for MS-workers in manufacturing than for LS-workers in the same sector. The employment-enhancing effects of changes in consumption were not sufficient to compensate for the employment-reducing effects of technology and trade, which mainly represents the sluggish growth of consumption and investment demand in Japan itself.

For Brazil, China and Indonesia, we find upward effects of trade on total employment in the manufacturing industry, while this effect has a minus sign for India.

While all skill categories experienced higher employment levels due to trade in China and Indonesia, the effects for China were much stronger. In Brazil, trade did not benefit the demand for LS-labor in manufacturing.

Turning to market services in the EU15, we find very unevenly distributed effects of technology again. Employment of HS-workers increased substantially, while technological progress would have reduced employment of MS-labor and LS-labor if trade and consumption effects would have been zero. This pattern is not only found for the EU15 as a whole, but can also be observed for the three major economies in this region separately (with the exception of LS-labor in Germany). A much less homogeneous pattern is found for the effects of trade. British and French employment in market services was hit by trade, while employment in German services was positively affected by changing trade patterns. Germany seems to be a non-typical EU15 country in this respect. Except for low-skilled labor in France's and the UK's services sector, the employment-enhancing effects of growing consumption inside and outside the EU15 have been sufficiently sizable to ensure positive growth rates of market services employment in its economically most important countries.

Results for the US again show that LS-labor and MS-labor faced more or less similar adverse employment effects of changing technology and trade, while the downward pressure of these sources of change were substantially less marked for HS-labor (in particular regarding technology effects). For Japanese market services, consumption change was too sluggish to prevent a loss in jobs for low-skilled workers of more than 50%. In China and India, HS-employment in market services grew considerably, not only due to upward consumption effects, but also as a consequence of favorable effects of changes in trade patterns. These effects were also present for LS-workers and MS-workers, but to a lesser extent.

5. Conclusions

This paper uses data from the WIOD database to quantify the contributions of changes in (i) technology, (ii) trade and (iii) consumption to changes in employment levels of high-skilled, medium-skilled and low-skilled labor in a number of sectors in various countries. The World Input-Output Tables allow us to view the world economy as a network of Global Supply Chains. Technological change affects the factor requirements per unit of output of these chains. To pay justice to this view, we developed a new concept of technological change which is not defined for national industries as is usually done, but for GSCs themselves. Furthermore, changes in the location of the production of raw materials, parts and components as well as final products have an impact on employment levels in countries (and industries within these countries). Finally, changes in the composition and volume of national consumption bundles have effects on the relative sizes of GSCs and therefore on the amount of skills demanded in countries contributing to GSCs.

Using our new decomposition method, we find that skill-biased technological change is the main culprit regarding downward pressures on employment of low-skilled and medium-skilled workers in advanced countries in 1995-2008. Relocations of stages of production (both of intermediate stages and the final stage) add significantly to this effect. The demand for high-skilled labor suffered much less from the consequences of technological change. Growth of consumption and investment demand (both in the advanced countries themselves and in emerging countries) had employment-enhancing effects. In many cases, these consumption effects were sufficiently large to make employment growth positive, but not always.

For emerging countries, we found heterogeneous patterns. While the analysis for China yielded particularly strong upward effects of trade changes in manufacturing employment, we found employment-reducing effects for Indian manufacturing (for all skill levels). India, however, appeared to have benefited from trade in generating employment in the broad market services sector.

The approach chosen in this paper might lead to further research. First, the structural decomposition analysis can be improved by not comparing 1995 and 2008 directly, but by chaining decomposition results obtained for annual changes. Second, it might be interesting to see to what extent domestic outsourcing has contributed to changes in employment patterns. In the current analysis, we implicitly assumed that all manufacturing workers carried out manufacturing tasks, while outsourcing services tasks to specialized suppliers might have increased over the 1995-2008 period. If so, this phenomenon might have affected the numbers appended to our concept of GSC-technology, since services firms tend to have input combinations that differ from those of manufacturing companies. Thirdly, and related to this, the identification of Global Supply Chains on the basis of global input-output tables can become much more accurate if these would explicitly contain information on the production processes and destinations of the output of firms that produce for domestic markets and of firms producing for foreign markets. Based on non-public data, Chen *et al*. (2012) show that evaluations of the Chinese export performance are affected considerably if a split between production for processing exports, regular exports and domestic use is made. Given the importance of specific processing exports activities in China, the results for other countries would most probably be revised to a lesser extent, but it would still be worthwhile to try to construct global input-output tables that contain such disaggregations.

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Appendix A: Technical Details

We distinguish between low-skilled labor (LS, primary education and/or lower secondary education completed, 1997-ISCED 1 and 2), medium-skilled labor (MS, upper secondary education and/or post-secondary non-tertiary education completes, ISCED 3 and 4) and high-skilled labor (completed tertiary education (ISCED 5 and 6). Our point of departure is that effects of globalization (as a consequence of which an industry in a country does not necessarily stay engaged in the same activities needed to produce a unit of final product), skill-biased technological change, the evolution of compositions of consumption bundles and differential consumption growth rates translated into changes in the demand for labor of a particular skill group. To disentangle these effects, we use "World Input-Output Tables" (WIOTs) and associated employment by skill group figures that were constructed in the WIOD project (see Timmer (ed.), 2012). The accounting method we adopt is known in the input-output literature as "Structural Decomposition Analysis" and bears similarity to more widely known index number approaches (see Miller and Blair, 2009).

We suppose that the use of labor inputs is driven by demand. For any period, the scalar x_i (which stands for the employment of skill group i in the focal country) can be written as

$$x_i = \mathbf{u}_k' \hat{\mathbf{l}}_i \mathbf{q} \tag{1}$$

The diagonal matrix $\hat{\mathbf{l}}_i$ contains the quantities of labor requirements of skill type i per unit of (gross) output in each of the n industries in each of the m countries.[9] The mn-vector $\mathbf{q}$ stands for (gross) output levels in each of the industries in each of the countries. $\mathbf{u}_k$ is a mn-"selection vector". It contains ones in the cells associated with the industries in the focal country. All other elements of $\mathbf{u}_k$ are zero.

Following Leontief's (1936, 1941) insights, output can be seen as the result of the interplay between final demand levels (demand for final consumer products and capital goods) and the intermediate inputs required to produce these final products. In input-output tables for a single country, exports are considered to belong to final demand for the focal country as well. Intercountry input-output tables such as those compiled in the WIOD project allow for a distinction between exports of final products (such as consumer electronics exported by China to the US) and exports of intermediate products (such as electronic components exported by Japan to be used in assembly activities in China). This feature enables us to link all output (and employment) to demand for specific final products, sold by industries either inside or outside the focal country. Timmer et al. (2012) label this approach the "Global Value Chain perspective".
Denoting the number of countries in a WIOT by m, we define $\mathbf{Z}$ as the mnxmn-matrix that contains all domestic and international deliveries of intermediate inputs. The corresponding mnxmn-matrix $\mathbf{A}$ of intermediate inputs requirements per unit of gross output can be obtained as $\mathbf{A} = \mathbf{Z}\hat{\mathbf{q}}^{-1}$. The fact that the production of intermediate inputs often requires intermediate inputs itself is taken into account if the so-called mnxmn-"Leontief inverse" is considered. The typical element b_{ij} of this matrix $\mathbf{B} \equiv (\mathbf{I} - \mathbf{A})^{-1}$, in which $\mathbf{I}$ stands for the mnxmn-identity matrix, indicates the output of each industry i that is required per unit of final demand for the products delivered by industry j. We can thus rewrite Equation (1) as

[9] A hat (e.g. $\hat{\mathbf{y}}$) indicates a diagonal matrix, with the elements of the vector $\mathbf{y}$ on the diagonal.

$$x_i = \mathbf{u}_k \hat{\mathbf{I}}_i \mathbf{B}\mathbf{f} \qquad (2)$$

in which **f** is an *mn*-vector with final demand levels for each of the *n* products delivered by each of the *m* countries.

In what follows, we will specify three determinants of intertemporal changes in x_i that affect the product $\hat{\mathbf{I}}_i\mathbf{B}$ and three determinants that affect **f**. The former effects relate to changes within global value chains, whereas the latter are associated with changes in the relative weights of global value chains.

We first look at demand for final products and trade in final products. We consider three sources of change in **f**. First, total final demand as exerted by countries can change. Second, the composition of consumption bundles can change. If consumption demand in China grows faster than consumption demand in Japan, it is likely that product-specific income elasticities will also imply that the Chinese consumption bundle will change faster than its Japanese counterpart. Finally, market shares of countries in selling final products might change over time. Relocation of electronics assembly activities in the US to China will imply that market shares of Chinese final electronics products will increase at the expense of market shares of American final electronics products will be reduced. These three factors can be incorporated into the analysis by expressing the final demand vector as[10]

$$\mathbf{f} = [\mathbf{T}^* \circ (\mathbf{S}^* \cdot \hat{\mathbf{c}})]\mathbf{u} \qquad (3)$$

c is an *m*-vector. It's typical element c_i contains total final demand exerted by country *i*. **S*** is an *mn*x*m*-matrix constructed by stacking *m* identical *n*x*m*-matrices of final demand shares for each of the *n* outputs. The rows of the *n*x*m* matrices that together form $\mathbf{S}^*$ are obtained by aggregating over final goods supplied by each of the trade partners: if German consumers would spend 0.1 of their total consumption on German food and 0.05 of their total consumption on French food, the share of food in German consumption would amount to 0.15. **T*** is an *mn*x*m*-matrix of final product trade coefficients. It is constructed by stacking *m* *n*x*m*-matrices **T**, of which the typical element t_{ij} represents the share of the country considered in final demand for product *i* in country *j*. **u** is an *m*-elements summation vector consisting of ones.

[10] The symbol ◦ stands for the "Hadamard product", obtained by cell-by-cell multiplication (i.e., $\mathbf{W} = \mathbf{X} \circ \mathbf{Y}$ means that $w_{ij} = x_{ij}y_{ij}$, for all *i* and *j*).

Equation (3) indicates how three factors together determine the relative importance of *mn* global value chains, a global value chain being defined as all activities required to produce the final product of an industry in a country. If skill-specific labour requirements would vary across global value chains, changes in relative importance of these chains could lead to changes in the relative demand for particular skills. Within such global value chains, however, (skill-biased) technological change and changes in the type of activities countries specialize into can also lead to differences in the amounts of labor of various skills that are deployed in the focal country. If Italy would contribute substantially to the value chain that ultimately produces British food products and the low-skilled labor requirements within this chain would decrease rapidly as a consequence of technological change, Italian low-skilled employment would decline, all other things equal. Alternatively, Italy could experience changes in the part of the value chain for British food products that it captures. Initially, it could contribute agricultural activities only, while Italy might also become responsible for some of the food processing activities in a later period. Generally, such changes also lead to changes in the extent to which labor of various skills is employed in the focal country.

If the production of final products is a fragmented process organized in (global) value chains, the *mn*-vector $\mathbf{l}_i^{w\prime} \equiv \mathbf{l}_i'\mathbf{B}$ gives a more appropriate measure of the techniques used to produce final products. $\mathbf{l}_i^{w}$ gives the worldwide inputs of labor of skill group i used to produce one unit of each of the *mn* final products, irrespective of the location of the activities required. Changes in $\mathbf{l}_i^{w}$ would only reflect skill-biased technological change if labor of a skill group would be equally productive across regions. Loosely speaking, if the productivity of an HS-worker in country A would be double that of a worker in country B and an HS-intensive activity would be relocated from A to B, we would observe technological change biased towards HS. To correct for this, we introduce an *mn*-productivity vector $\boldsymbol{\pi}$, the typical element of which contains the industry-specific labor productivity levels of labor relative to levels in the US.[11] This allows us to specify a global value chain's technology in terms of labor measured in efficiency units, $\mathbf{l}_i^{*\prime} \equiv (\boldsymbol{\pi} \circ \mathbf{l}_i)'\mathbf{B}$.

It is important to note that the values in the cells of the matrix $\mathbf{B}$ are not only determined by the technical production requirements in terms of intermediate inputs, but also by the shares of these intermediate inputs delivered by each of the potential countries-of-origin. As a consequence, some industries in some countries will employ

[11] The elements of $\boldsymbol{\pi}$ can change over time, but are assumed to be identical across skill groups.

more labor of a given skill group than expected on the basis of $\mathbf{l}_i^*$, while others will employ less. Since a WIOT represents *mn* industries in which labor is employed and *mn* global value chains to which this labor contributes, we can compute an *mn*x*mn*-matrix with shares of each of the *mn* industries in total employment of skill type *i* per unit of final demand produced by a global value chain. Rows correspond to industries of employment, columns correspond to the global value chains to which labor of type *i* contributes:

$$\mathbf{R}_i = \{\hat{\boldsymbol{\pi}}\hat{\mathbf{l}}_i\mathbf{B}\}\hat{\mathbf{l}}_i^{*-1} \tag{4}$$

Finally, demand for labor of a skill group in the focal country as measured in numbers of jobs is affected by labor productivity relative to the US. Given global value chain technologies and the specific activities in the chains performed in the focal country, higher productivity levels lead to lower demand.

Writing $\hat{\mathbf{l}}_i\mathbf{B} = \hat{\boldsymbol{\pi}}^{-1}\mathbf{R}_i\hat{\mathbf{l}}_i^*$ and substituting Equation (3) into Equation (2), we can express the employment of skill type *i* in period 0 in the focal country as[12]

$$x_{i0} = \mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\hat{\mathbf{l}}_{i0}^*[\mathbf{T}_0^*\circ(\mathbf{S}_0^* \cdot \hat{\mathbf{c}}_0)]\mathbf{u} \tag{5}$$

$x_{i1} - x_{i0}$ (the difference between demand for a skill at two points in time) can be written as:

$$x_{i1} - x_{i0} = \mathbf{u}_k'\hat{\boldsymbol{\pi}}_1^{-1}\mathbf{R}_{i1}\hat{\mathbf{l}}_{i1}^*[\mathbf{T}_1^*\circ(\mathbf{S}_1^* \cdot \hat{\mathbf{c}}_1)]\mathbf{u} - \mathbf{u}_k\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\hat{\mathbf{l}}_{i0}^*[\mathbf{T}_0^*\circ(\mathbf{S}_0^* \cdot \hat{\mathbf{c}}_0)]\mathbf{u} =$$

$$\mathbf{u}_k'\langle\hat{\boldsymbol{\pi}}_1^{-1} - \hat{\boldsymbol{\pi}}_0^{-1}\rangle\mathbf{R}_{i1}\hat{\mathbf{l}}_{i1}^*[\mathbf{T}_1^*\circ(\mathbf{S}_1^* \cdot \hat{\mathbf{c}}_1)]\mathbf{u} \; + \tag{6a}$$

$$\mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\langle\mathbf{R}_{i1} - \mathbf{R}_{i0}\rangle\hat{\mathbf{l}}_{i1}^*[\mathbf{T}_1^*\circ(\mathbf{S}_1^* \cdot \hat{\mathbf{c}}_1)]\mathbf{u} \; + \tag{6b}$$

$$\mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\langle\hat{\mathbf{l}}_{i1}^* - \hat{\mathbf{l}}_{i0}^*\rangle[\mathbf{T}_1^*\circ(\mathbf{S}_1^* \cdot \hat{\mathbf{c}}_1)]\mathbf{u} \; + \tag{6c}$$

$$\mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\hat{\mathbf{l}}_{i0}^*[\langle\mathbf{T}_1^* - \mathbf{T}_0^*\rangle\circ(\mathbf{S}_1^* \cdot \hat{\mathbf{c}}_1)]\mathbf{u} \; + \tag{6d}$$

$$\mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\hat{\mathbf{l}}_{i0}^*[\mathbf{T}_0^*\circ(\langle\mathbf{S}_1^* - \mathbf{S}_0^*\rangle \cdot \hat{\mathbf{c}}_1)]\mathbf{u} \; + \tag{6e}$$

[12] For ease of exposition, we did not include indices for time periods in the matrix algebra above.

$$\mathbf{u}_k'\hat{\boldsymbol{\pi}}_0^{-1}\mathbf{R}_{i0}\hat{\mathbf{l}}_{i0}^*[\mathbf{T}_0^*\circ(\mathbf{S}_0^*\cdot\langle\hat{\mathbf{c}}_1-\hat{\mathbf{c}}_0\rangle)]\mathbf{u} \tag{6f}$$

As mentioned above, we identified six determinants of changes between initial period 0 and final period 1 in the domestic demand for skill group *i*, related to changes within global value chains and the relative weights of these chains. We isolate the partial effects of these determinants, assuming that the other five partial effects were zero.

Equation (6a) represents the changes in domestic demand for labor of skill type *i* that can be attributed to productivity catch-up to the United States (*changes in efficiency*). Equation (6b) gives the employment of skill group *i* in the focal country in the final year if only the shares of global value chains as captured by countries would have changed (*changes in location-of-intermediate stages*). In a similar vein, (6c) shows what would have happened if the only technological change within global supply chains would have been the only source of change (*changes in GSC technology*). (6d) indicates the demand in period 1 for the counterfactual case in which market shares of global value chains would have changed, but everything else would have remained stable (*changes in location-of-completion*). Equation (6e) isolates the effects of changes in consumption patterns (*changes in consumption composition)*, while (6f) focuses on the effects of differential rates of consumption growth in the *m* countries considered (*changes in consumption levels*).[13] The changes regarding the composition and levels of consumption also include the effects of changing patterns and levels of investment demand.

Appendix B

This appendix presents the decomposition results for two aggregation schemes. In each of these, the 35 WIOD-industries have been merged in broader sectors. Sums over the sectors in each aggregation scheme thus equal the results for the total economy, as presented in Table 1 in the main text. Aggregation scheme 1 splits the total economy in 5 broad sectors, aggregation scheme 2 contains 11 sectors.

[13] The decomposition as represented by Equations (6a-f) is not unique, since weights can be chosen differently (see Dietzenbacher and Los, 1998). The results presented in the report have been obtained as the arithmetic average over (6a-e) and its so-called polar form, in which all initial year weights in (6a-e) have been replaced by final year weights and the other way round.

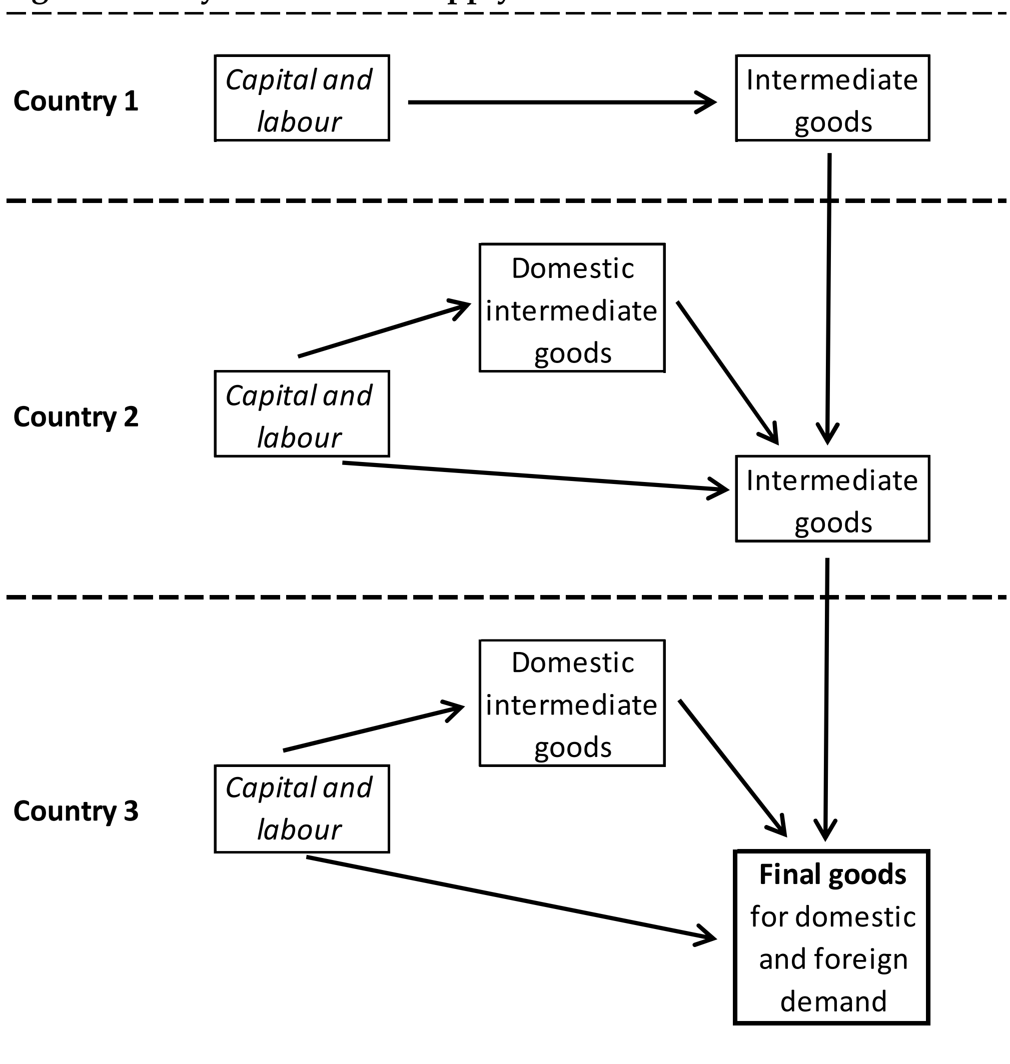
The decomposition results for Aggregation scheme 1 have been documented in Tables B.1a-e, those for Aggregation scheme 2 in Tables B.2a-k.

*****INSERT Tables B.1a-e ABOUT HERE*****

*****INSERT Tables B.2a-k ABOUT HERE*****

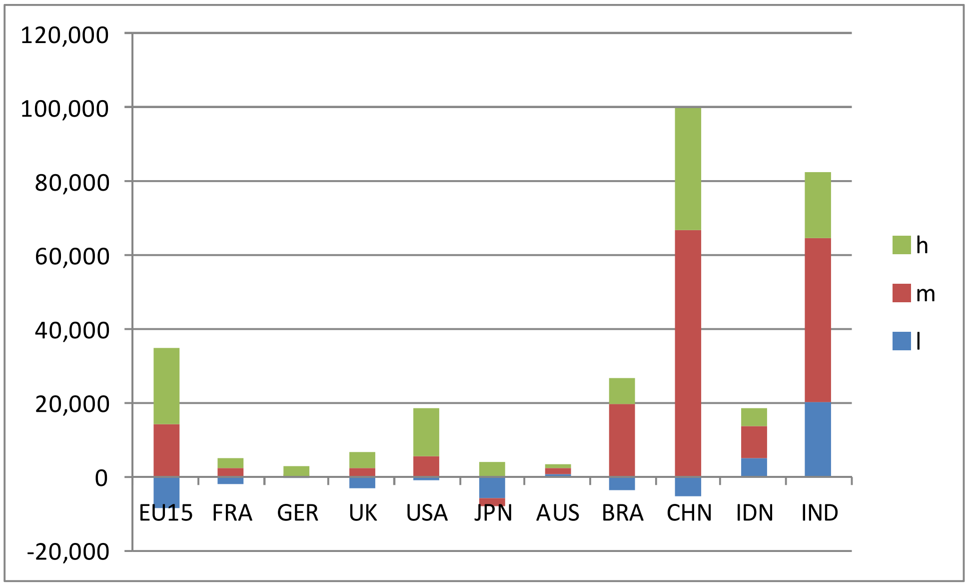
Figures and Tables

Figure 1: A Stylized Global Supply Chain



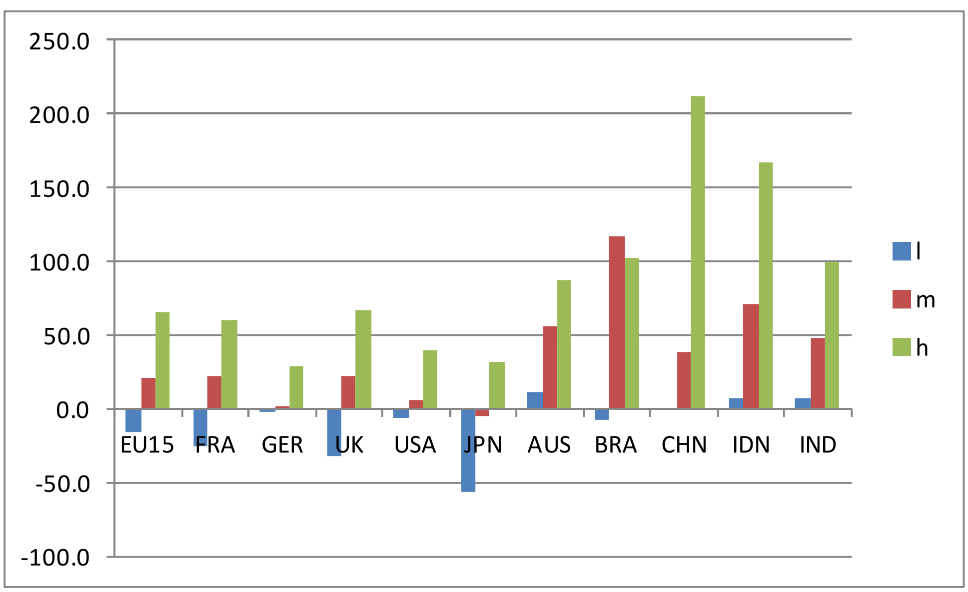
Source: Los *et al*. (2013)

Figure 2: Changes in demand for skills, Total Economy (1995-2008, in 000s of jobs)



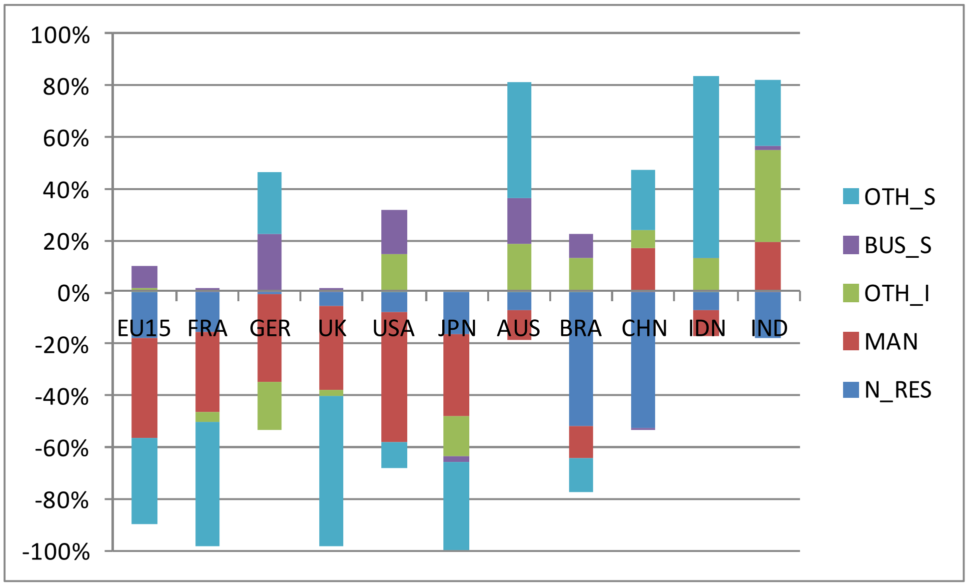
Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

Figure 3: Percentage changes in demand for skills, Total Economy (1995-2008)



Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

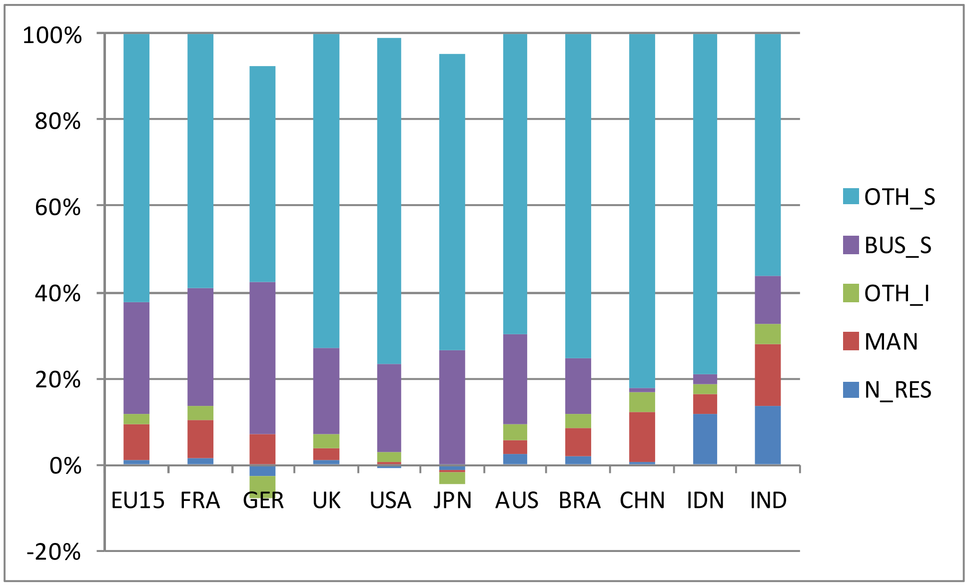
Figure 4a: Contributions of broad sectors to change in demand for low-skilled labor (1995-2008)



Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

N_RES: Natural resources industries; MAN: Manufacturing industries; OTH_I: Other industries; BUS_S: Business services industries; OTH_S: Other services industries

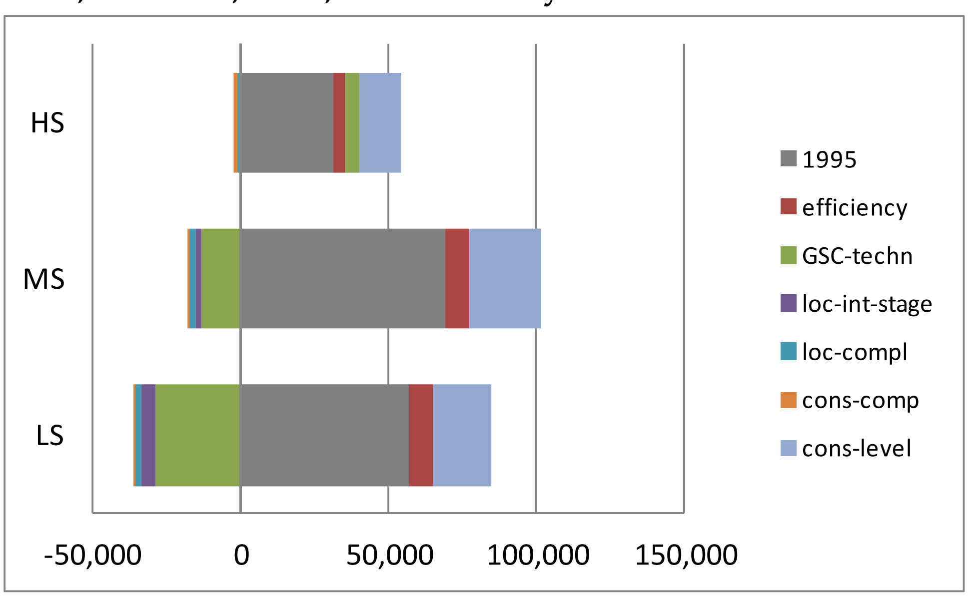
Figure 4b: Contributions of broad sectors to change in demand for high-skilled labor (1995-2008)



Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

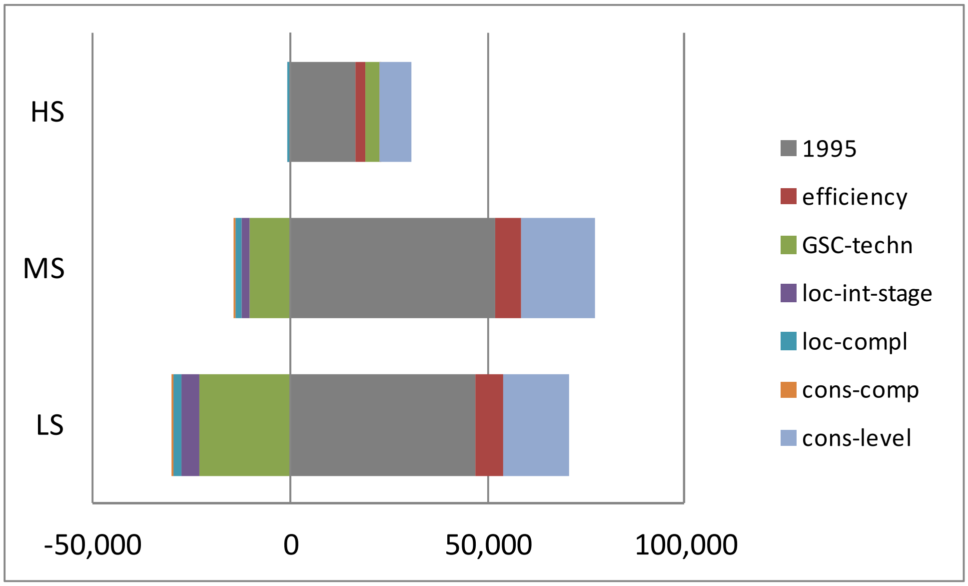
N_RES: Natural resources industries; MAN: Manufacturing industries; OTH_I: Other industries; BUS_S: Business services industries; OTH_S: Other services industries

Figure 5a: Six-effects decomposition of changes in demand for skills, 1995-2008, EU15, Total Economy



Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

Figure 5b: Six-effects decomposition of changes in demand for skills, 1995-2008, EU15, Market Economy



Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update)

Table 1: Contributions of determinants to changes in skills demand (total economy)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-16,782	-11,354	54,422	26,286	16.7
	l	-20,678	-6,499	18,537	-8,640	-15.2
	m	-5,075	-3,888	23,380	14,416	20.9
	h	8,972	-967	12,505	20,510	65.8
FRA	all	-3,382	-903	7,475	3,189	14.1
	l	-3,813	-586	2,342	-2,058	-25.3
	m	-860	-304	3,292	2,128	22.8
	h	1,291	-13	1,840	3,119	59.9
GER	all	-3,489	-1,493	7,657	2,675	7.1
	l	-1,173	-136	1,204	-105	-1.7
	m	-3,414	-910	4,693	369	1.6
	h	1,098	-448	1,760	2,410	29.1
UK	all	-5,751	-3,213	12,725	3,760	13.5
	l	-5,417	-1,592	3,898	-3,112	-32.1
	m	-1,817	-1,245	5,653	2,590	22.0
	h	1,483	-375	3,174	4,282	66.8
USA	all	-29,791	-7,997	55,552	17,763	13.3
	l	-4,789	-1,252	5,128	-913	-6.2
	m	-24,226	-4,698	34,399	5,475	6.4
	h	-776	-2,048	16,025	13,202	39.3
JPN	all	-5,008	-2,488	3,683	-3,813	-5.7
	l	-4,545	-1,376	45	-5,876	-56.0
	m	-3,949	-728	2,605	-2,071	-4.8
	h	3,487	-384	1,032	4,135	31.8
AUS	all	-1,014	-579	4,728	3,135	37.8
	l	-1,407	-324	2,206	476	11.4
	m	62	-179	1,706	1,589	55.5
	h	330	-76	816	1,071	86.6
BRA	all	-5,615	1,733	26,570	22,687	30.8
	l	-19,054	-36	15,229	-3,861	-7.7
	m	9,470	1,860	8,077	19,407	117.5
	h	3,969	-90	3,263	7,141	102.5
CHN	all	-869,796	212,768	751,179	94,150	13.8
	l	-582,447	139,202	437,710	-5,534	-1.1
	m	-275,751	66,174	276,131	66,554	38.7
	h	-11,599	7,391	37,338	33,130	211.8
IDN	all	-26,080	535	44,027	18,482	21.2
	l	-27,266	-954	33,460	5,239	7.3
	m	-507	1,039	8,191	8,723	70.3
	h	1,694	449	2,377	4,520	167.3
IND	all	-178,555	-24,230	285,376	82,591	21.7
	l	-137,630	-20,671	178,485	20,184	7.5
	m	-34,851	-4,587	83,960	44,522	47.9
	h	-6,073	1,028	22,931	17,886	99.7

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table 2: Contributions of determinants to changes in skills demand (manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-9,808	-3,849	11,059	-2,598	-8.7
	l	-6,357	-2,167	4,277	-4,246	-33.1
	m	-3,682	-1,368	5,002	-48	-0.4
	h	231	-314	1,780	1,697	44.0
FRA	all	-1,946	-56	1,483	-519	-14.0
	l	-1,090	-87	516	-661	-44.6
	m	-791	-23	685	-129	-7.7
	h	-65	54	282	271	48.1
GER	all	-2,740	-727	2,688	-779	-9.2
	l	-894	-91	510	-475	-27.3
	m	-1,714	-437	1,652	-499	-9.5
	h	-133	-199	526	195	13.2
UK	all	-1,650	-1,438	1,668	-1,419	-31.9
	l	-1,025	-615	606	-1,034	-57.5
	m	-632	-617	746	-503	-25.9
	h	7	-206	317	118	16.9
USA	all	-7,807	-2,686	6,401	-4,092	-22.0
	l	-1,475	-529	778	-1,226	-42.5
	m	-5,310	-1,662	4,060	-2,913	-24.2
	h	-1,022	-495	1,563	46	1.3
JPN	all	-4,170	-515	1,443	-3,242	-23.7
	l	-1,597	-378	140	-1,835	-59.5
	m	-2,257	-61	930	-1,388	-16.3
	h	-316	-75	373	-18	-0.9
AUS	all	-297	-245	554	12	1.1
	l	-243	-122	273	-92	-15.7
	m	-61	-97	228	69	15.9
	h	8	-26	53	35	36.9
BRA	all	-738	632	3,092	2,986	31.3
	l	-2,429	-129	1,661	-897	-14.0
	m	1,514	747	1,140	3,401	138.8
	h	177	14	292	482	69.8
CHN	all	-212,436	103,701	149,085	40,350	38.6
	l	-136,492	65,838	88,869	18,215	27.6
	m	-72,895	34,721	56,457	18,284	49.6
	h	-3,049	3,141	3,759	3,852	224.6
IDN	all	-5,155	1,318	4,695	857	7.3
	l	-4,889	596	3,508	-785	-8.5
	m	-270	652	1,052	1,434	67.5
	h	4	70	135	208	79.6
IND	all	-23,555	-7,213	46,300	15,531	38.1
	l	-17,235	-4,794	28,122	6,093	23.8
	m	-6,052	-2,216	15,149	6,881	53.0
	h	-267	-204	3,029	2,557	112.7

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table 3: Contributions of determinants to changes in skills demand (market services)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-3,098	-3,065	26,866	20,702	32.1
	l	-7,435	-1,822	8,737	-521	-2.3
	m	-798	-1,134	12,182	10,250	33.4
	h	5,135	-109	5,947	10,973	103.2
FRA	all	-840	-317	3,754	2,597	28.4
	l	-1,357	-221	1,100	-478	-14.6
	m	-314	-97	1,619	1,207	30.7
	h	832	0	1,036	1,868	95.7
GER	all	32	228	3,385	3,645	24.1
	l	8	184	476	667	28.6
	m	-733	57	2,159	1,483	14.7
	h	757	-13	750	1,495	55.4
UK	all	-2,632	-1,142	6,986	3,212	26.4
	l	-2,419	-638	2,196	-861	-19.0
	m	-952	-447	3,306	1,907	34.3
	h	740	-58	1,484	2,166	103.9
USA	all	-16,350	-4,368	32,511	11,792	17.8
	l	-2,063	-445	3,195	686	9.5
	m	-13,228	-2,564	20,435	4,643	10.9
	h	-1,058	-1,359	8,881	6,464	39.9
JPN	all	-978	-940	2,108	190	0.6
	l	-1,485	-485	181	-1,789	-50.4
	m	-1,743	-384	1,340	-787	-3.7
	h	2,250	-71	587	2,766	45.4
AUS	all	-712	-230	2,638	1,697	40.5
	l	-844	-122	1,387	421	17.8
	m	-88	-92	888	709	52.1
	h	220	-16	363	566	123.8
BRA	all	1,188	615	12,457	14,260	46.9
	l	-5,896	-26	6,313	391	2.1
	m	5,702	671	4,616	10,989	124.8
	h	1,381	-30	1,528	2,880	92.4
CHN	all	-199,005	49,787	226,643	77,425	57.3
	l	-69,945	18,286	75,674	24,015	51.1
	m	-123,558	26,388	131,277	34,106	42.7
	h	-5,502	5,114	19,692	19,303	233.3
IDN	all	-5,447	1,419	17,470	13,443	61.5
	l	-6,608	563	11,828	5,783	35.9
	m	435	624	4,394	5,453	115.8
	h	727	232	1,248	2,207	216.1
IND	all	-46,131	10,810	64,747	29,426	47.7
	l	-27,163	4,177	29,139	6,153	19.1
	m	-16,051	4,399	27,273	15,621	64.9
	h	-2,917	2,235	8,334	7,652	140.6

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.1a: Contributions of determinants to changes in skills demand (natural resources)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-2,790	-1,092	2,104	-1,778	-21.3
	l	-2,292	-934	1,333	-1,893	-35.7
	m	-538	-136	610	-63	-2.6
	h	40	-23	161	178	32.9
FRA	all	-475	-49	276	-248	-22.5
	l	-365	-82	121	-326	-56.9
	m	-126	27	129	29	6.4
	h	16	7	25	48	67.2
GER	all	-377	-135	179	-333	-26.1
	l	-17	-21	29	-9	-4.9
	m	-289	-80	117	-253	-29.8
	h	-71	-33	33	-72	-29.1
UK	all	-155	-190	262	-84	-12.6
	l	-167	-135	125	-177	-47.6
	m	-5	-37	95	54	26.0
	h	17	-19	42	40	46.9
USA	all	-890	-466	883	-473	-14.1
	l	-234	-147	182	-199	-25.7
	m	-482	-221	546	-157	-7.8
	h	-174	-98	155	-117	-20.3
JPN	all	-1,235	-171	-247	-1,653	-33.8
	l	-670	-232	-61	-963	-64.0
	m	-523	48	-153	-627	-22.3
	h	-42	13	-33	-63	-10.9
AUS	all	-61	-105	214	49	9.7
	l	-91	-97	136	-52	-14.4
	m	19	-8	64	76	62.2
	h	11	0	14	25	111.5
BRA	all	-9,192	1,520	5,723	-1,949	-10.1
	l	-9,835	1,016	5,144	-3,676	-20.1
	m	618	471	510	1,598	167.9
	h	25	34	70	129	76.6
CHN	all	-344,350	62,194	230,355	-51,801	-14.1
	l	-328,428	57,552	214,934	-55,942	-16.0
	m	-15,617	4,579	15,080	4,042	23.0
	h	-305	63	341	99	29.3
IDN	all	-14,996	671	15,923	1,599	3.9
	l	-15,824	326	14,973	-525	-1.3
	m	534	233	836	1,603	97.4
	h	295	112	114	520	455.3
IND	all	-113,601	2,280	125,613	14,292	5.9
	l	-105,681	1,042	99,169	-5,470	-2.8
	m	-8,363	1,148	24,574	17,359	42.0
	h	443	90	1,870	2,403	91.2

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.1b: Contributions of determinants to changes in skills demand (manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-9,808	-3,849	11,059	-2,598	-8.7
	l	-6,357	-2,167	4,277	-4,246	-33.1
	m	-3,682	-1,368	5,002	-48	-0.4
	h	231	-314	1,780	1,697	44.0
FRA	all	-1,946	-56	1,483	-519	-14.0
	l	-1,090	-87	516	-661	-44.6
	m	-791	-23	685	-129	-7.7
	h	-65	54	282	271	48.1
GER	all	-2,740	-727	2,688	-779	-9.2
	l	-894	-91	510	-475	-27.3
	m	-1,714	-437	1,652	-499	-9.5
	h	-133	-199	526	195	13.2
UK	all	-1,650	-1,438	1,668	-1,419	-31.9
	l	-1,025	-615	606	-1,034	-57.5
	m	-632	-617	746	-503	-25.9
	h	7	-206	317	118	16.9
USA	all	-7,807	-2,686	6,401	-4,092	-22.0
	l	-1,475	-529	778	-1,226	-42.5
	m	-5,310	-1,662	4,060	-2,913	-24.2
	h	-1,022	-495	1,563	46	1.3
JPN	all	-4,170	-515	1,443	-3,242	-23.7
	l	-1,597	-378	140	-1,835	-59.5
	m	-2,257	-61	930	-1,388	-16.3
	h	-316	-75	373	-18	-0.9
AUS	all	-297	-245	554	12	1.1
	l	-243	-122	273	-92	-15.7
	m	-61	-97	228	69	15.9
	h	8	-26	53	35	36.9
BRA	all	-738	632	3,092	2,986	31.3
	l	-2,429	-129	1,661	-897	-14.0
	m	1,514	747	1,140	3,401	138.8
	h	177	14	292	482	69.8
CHN	all	-212,436	103,701	149,085	40,350	38.6
	l	-136,492	65,838	88,869	18,215	27.6
	m	-72,895	34,721	56,457	18,284	49.6
	h	-3,049	3,141	3,759	3,852	224.6
IDN	all	-5,155	1,318	4,695	857	7.3
	l	-4,889	596	3,508	-785	-8.5
	m	-270	652	1,052	1,434	67.5
	h	4	70	135	208	79.6
IND	all	-23,555	-7,213	46,300	15,531	38.1
	l	-17,235	-4,794	28,122	6,093	23.8
	m	-6,052	-2,216	15,149	6,881	53.0
	h	-267	-204	3,029	2,557	112.7

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.1c: Contributions of determinants to changes in skills demand (other industry)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-502	-404	2,671	1,765	13.8
	l	-1,110	-191	1,436	135	2.4
	m	300	-171	939	1,068	18.6
	h	307	-41	296	562	39.5
FRA	all	136	-43	239	332	20.2
	l	-159	-20	95	-84	-12.0
	m	213	-19	124	319	40.2
	h	82	-4	20	98	68.8
GER	all	-622	-129	-378	-1,129	-31.3
	l	-168	-31	-71	-270	-42.9
	m	-391	-73	-248	-712	-30.8
	h	-64	-25	-59	-147	-22.3
UK	all	-315	-81	760	364	18.4
	l	-266	-29	218	-77	-11.9
	m	-85	-43	432	304	28.0
	h	36	-9	110	137	55.0
USA	all	608	-156	1,451	1,902	24.7
	l	124	-26	257	355	25.2
	m	326	-103	997	1,220	22.9
	h	158	-27	197	327	33.7
JPN	all	310	-88	-2,071	-1,849	-25.1
	l	-512	-35	-373	-920	-57.1
	m	490	-44	-1,249	-803	-18.5
	h	332	-10	-449	-126	-8.9
AUS	all	157	12	317	486	71.4
	l	10	3	128	141	47.6
	m	122	8	173	303	84.8
	h	25	0	16	42	153.2
BRA	all	920	13	1,642	2,575	54.3
	l	-317	-5	1,234	911	22.6
	m	1,106	16	334	1,457	265.1
	h	131	2	74	207	124.4
CHN	all	-63,365	2,241	78,355	17,232	44.0
	l	-40,977	948	47,120	7,092	29.5
	m	-21,891	1,076	29,394	8,578	59.5
	h	-496	218	1,840	1,562	214.2
IDN	all	-110	-60	1,728	1,557	39.4
	l	-263	-26	1,298	1,009	31.4
	m	107	-30	364	441	70.4
	h	46	-4	65	107	94.1
IND	all	-7,867	592	24,635	17,360	113.3
	l	-6,417	431	17,059	11,073	102.8
	m	-1,335	130	6,655	5,450	136.3
	h	-114	31	920	837	152.3

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.1d: Contributions of determinants to changes in skills demand (business services)

	skill	technology	trade	consumption	total	total(%)
EU15	all	3,522	14	6,515	10,052	82.9
	l	-267	-148	1,376	961	33.7
	m	1,220	91	2,528	3,840	75.7
	h	2,569	71	2,611	5,251	125.0
FRA	all	136	-153	1,335	1,318	53.8
	l	-214	-67	314	33	4.9
	m	19	-33	443	428	52.6
	h	331	-53	578	856	89.9
GER	all	1,084	389	1,047	2,520	88.3
	l	91	87	133	312	84.8
	m	443	215	545	1,203	78.3
	h	550	87	368	1,005	106.0
UK	all	274	12	1,172	1,457	81.5
	l	-142	-59	257	55	11.3
	m	81	41	410	532	86.3
	h	335	30	505	870	127.6
USA	all	-2,355	-1,393	8,273	4,524	30.5
	l	-114	-33	570	423	43.2
	m	-2,041	-674	4,048	1,334	17.6
	h	-201	-687	3,655	2,767	44.2
JPN	all	936	-1	1,158	2,093	45.2
	l	-191	-52	79	-163	-37.8
	m	326	40	676	1,042	37.6
	h	800	11	403	1,214	84.9
AUS	all	62	-13	485	534	74.8
	l	-54	-5	195	136	43.0
	m	25	-1	152	175	79.6
	h	91	-6	139	224	125.1
BRA	all	1,102	31	2,191	3,324	68.4
	l	95	29	582	707	51.8
	m	681	66	931	1,678	85.8
	h	325	-64	678	939	61.0
CHN	all	-3,916	-39	4,019	64	1.8
	l	-1,983	344	1,582	-57	-4.1
	m	-1,798	-304	1,810	-293	-17.6
	h	-134	-79	627	414	92.4
IDN	all	-34	-130	474	310	117.4
	l	-27	-25	104	53	84.0
	m	-28	-63	226	135	105.1
	h	20	-42	144	121	168.4
IND	all	-3,659	3,039	3,986	3,367	188.6
	l	-548	437	549	438	175.2
	m	-1,766	1,096	1,553	882	115.5
	h	-1,344	1,507	1,884	2,047	265.3

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.1e: Contributions of determinants to changes in skills demand (other services)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-9,577	-3,651	32,073	18,845	20.0
	l	-11,770	-1,943	10,115	-3,597	-11.8
	m	-3,278	-1,402	14,300	9,620	22.6
	h	5,471	-307	7,658	12,822	60.7
FRA	all	-1,395	-440	4,141	2,306	16.7
	l	-2,051	-265	1,296	-1,020	-21.7
	m	-254	-177	1,911	1,481	26.4
	h	909	1	935	1,845	53.0
GER	all	-1,542	-184	4,122	2,396	11.2
	l	-325	59	603	337	10.9
	m	-1,841	-157	2,627	629	4.7
	h	624	-86	892	1,430	28.8
UK	all	-4,129	-1,293	8,863	3,442	18.1
	l	-3,895	-676	2,692	-1,879	-29.4
	m	-1,270	-498	3,970	2,203	27.7
	h	1,036	-120	2,201	3,117	66.3
USA	all	-19,301	-3,341	38,544	15,902	17.8
	l	-3,075	-532	3,341	-266	-3.1
	m	-16,727	-2,030	24,748	5,990	10.2
	h	501	-778	10,456	10,179	46.1
JPN	all	-1,619	-943	3,400	838	2.3
	l	-1,787	-469	260	-1,995	-51.7
	m	-2,296	-400	2,401	-295	-1.2
	h	2,464	-75	739	3,128	41.6
AUS	all	-807	-296	3,157	2,054	38.9
	l	-992	-140	1,474	342	13.0
	m	-16	-107	1,089	966	55.9
	h	201	-49	594	746	81.5
BRA	all	1,362	469	13,921	15,752	44.9
	l	-7,460	-54	6,608	-906	-4.5
	m	5,578	533	5,162	11,273	106.3
	h	3,244	-9	2,150	5,385	122.3
CHN	all	-252,527	51,469	289,364	88,306	53.4
	l	-78,442	18,396	85,205	25,159	48.8
	m	-165,121	27,673	173,390	35,943	35.5
	h	-8,964	5,400	30,769	27,205	219.1
IDN	all	-8,874	1,826	21,207	14,160	47.2
	l	-8,934	846	13,576	5,487	27.4
	m	-1,290	687	5,713	5,110	64.8
	h	1,351	293	1,918	3,563	166.5
IND	all	-61,805	9,004	84,842	32,041	38.8
	l	-30,208	4,672	33,585	8,049	21.7
	m	-25,632	3,553	36,030	13,950	41.2
	h	-5,965	779	15,228	10,042	85.7

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2a: Contributions of determinants to changes in skills demand (agriculture)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-2,699	-847	1,935	-1,611	-20.6
	l	-2,273	-808	1,264	-1,818	-35.5
	m	-482	-45	539	13	0.6
	h	56	6	132	194	42.4
FRA	all	-465	-32	269	-227	-21.6
	l	-362	-70	119	-313	-56.5
	m	-123	28	126	31	7.2
	h	20	9	25	54	84.2
GER	all	-321	-36	139	-219	-20.3
	l	-9	7	22	19	13.8
	m	-249	-24	90	-183	-25.4
	h	-63	-19	27	-55	-25.3
UK	all	-146	-145	229	-62	-10.9
	l	-162	-114	116	-160	-46.7
	m	-3	-23	83	56	32.6
	h	19	-8	31	42	75.0
USA	all	-889	-332	578	-643	-23.4
	l	-225	-105	138	-193	-28.6
	m	-498	-156	353	-301	-18.3
	h	-166	-71	87	-150	-34.1
JPN	all	-1,254	-99	-250	-1,603	-33.4
	l	-684	-190	-62	-936	-63.8
	m	-527	74	-154	-608	-22.0
	h	-43	18	-34	-59	-10.4
AUS	all	-53	-130	156	-27	-6.4
	l	-84	-102	108	-77	-24.5
	m	21	-24	40	37	41.8
	h	10	-4	8	14	90.7
BRA	all	-9,141	1,527	5,632	-1,982	-10.4
	l	-9,771	1,081	5,092	-3,598	-19.9
	m	610	422	481	1,513	167.2
	h	19	24	59	103	70.0
CHN	all	-322,649	59,228	214,662	-48,760	-13.7
	l	-314,362	55,549	205,583	-53,231	-15.5
	m	-8,133	3,745	8,978	4,590	36.1
	h	-155	-66	101	-120	-60.2
IDN	all	-15,121	525	16,004	1,408	3.5
	l	-15,910	269	15,039	-603	-1.5
	m	503	158	848	1,509	98.4
	h	286	98	117	502	575.0
IND	all	-111,376	2,959	122,960	14,544	6.1
	l	-103,884	1,420	97,272	-5,191	-2.7
	m	-7,998	1,432	23,967	17,401	42.7
	h	506	107	1,721	2,334	93.0

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2b: Contributions of determinants to changes in skills demand (mining)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-102	-233	169	-167	-32.8
	l	-34	-110	69	-75	-39.7
	m	-54	-93	71	-76	-32.6
	h	-14	-30	29	-15	-18.0
FRA	all	-11	-16	6	-21	-40.9
	l	-6	-10	2	-13	-66.6
	m	-3	-2	3	-2	-9.0
	h	-3	-4	1	-5	-68.4
GER	all	-57	-97	40	-114	-58.5
	l	-11	-25	8	-28	-71.1
	m	-39	-57	27	-69	-54.5
	h	-7	-15	6	-16	-58.6
UK	all	-14	-40	33	-22	-22.9
	l	-7	-20	9	-17	-57.4
	m	-3	-12	12	-3	-7.7
	h	-5	-8	11	-2	-5.2
USA	all	-7	-127	305	170	27.7
	l	-12	-38	44	-6	-6.3
	m	17	-66	193	144	38.5
	h	-11	-23	67	33	23.7
JPN	all	-5	-47	3	-50	-51.9
	l	0	-28	1	-27	-73.6
	m	-5	-16	2	-19	-38.2
	h	0	-4	0	-4	-40.1
AUS	all	-9	27	58	75	88.7
	l	-8	6	28	26	57.3
	m	-2	16	24	39	116.5
	h	1	4	6	11	155.7
BRA	all	-43	-15	91	33	12.7
	l	-63	-67	52	-78	-40.1
	m	15	41	28	85	181.7
	h	5	10	11	26	121.6
CHN	all	-21,866	3,131	15,693	-3,041	-23.6
	l	-13,814	1,751	9,352	-2,711	-34.3
	m	-7,935	1,285	6,102	-548	-11.2
	h	-117	95	240	218	158.2
IDN	all	124	147	-81	191	22.9
	l	78	65	-66	78	11.2
	m	37	70	-12	94	84.1
	h	10	12	-3	19	69.8
IND	all	-2,127	-777	2,653	-251	-9.4
	l	-1,699	-476	1,897	-278	-14.4
	m	-374	-275	607	-42	-6.9
	h	-54	-27	150	69	54.4

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2c: Contributions of determinants to changes in skills demand (food manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-710	-156	795	-72	-1.9
	l	-707	-84	326	-465	-28.9
	m	-175	-56	334	103	6.3
	h	171	-17	135	289	59.5
FRA	all	-166	21	164	19	3.6
	l	-141	4	57	-80	-36.0
	m	-56	10	75	30	12.6
	h	31	7	32	70	91.7
GER	all	-57	28	78	49	5.4
	l	-44	5	14	-25	-13.4
	m	-56	19	49	11	1.8
	h	44	4	15	63	43.0
UK	all	-158	-130	148	-140	-25.4
	l	-116	-47	50	-113	-52.0
	m	-52	-57	66	-43	-18.0
	h	11	-26	31	16	16.5
USA	all	-314	-120	373	-62	-3.4
	l	-111	-23	76	-58	-14.8
	m	-186	-76	234	-27	-2.3
	h	-18	-22	63	23	7.8
JPN	all	20	20	-149	-108	-6.9
	l	-104	1	-28	-131	-36.8
	m	90	17	-100	6	0.6
	h	35	3	-20	17	8.7
AUS	all	-2	-28	45	15	8.0
	l	-18	-13	22	-10	-9.9
	m	10	-12	19	18	23.9
	h	6	-3	4	7	46.4
BRA	all	-6	270	445	709	42.9
	l	-365	130	266	31	2.7
	m	342	130	154	626	156.6
	h	17	10	25	52	60.1
CHN	all	-12,575	2,641	14,070	4,136	39.0
	l	-7,910	1,462	8,165	1,717	27.2
	m	-4,589	1,035	5,557	2,003	48.9
	h	-76	144	348	416	225.2
IDN	all	-2,775	-4	937	-1,842	-48.9
	l	-2,387	-16	712	-1,691	-56.4
	m	-352	14	200	-139	-20.3
	h	-35	-3	25	-12	-14.5
IND	all	-7,458	338	6,253	-867	-8.9
	l	-5,923	264	4,512	-1,147	-15.8
	m	-1,474	58	1,546	130	5.6
	h	-60	15	196	151	61.7

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2d: Contributions of determinants to changes in skills demand (other nondurables manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-2,595	-1,365	1,950	-2,010	-24.0
	l	-1,719	-811	846	-1,684	-42.4
	m	-935	-452	811	-576	-16.7
	h	59	-101	292	250	26.0
FRA	all	-493	-48	243	-297	-31.5
	l	-267	-39	87	-219	-56.9
	m	-204	-15	111	-108	-25.7
	h	-22	6	45	29	21.0
GER	all	-646	-228	242	-632	-35.6
	l	-181	-45	45	-180	-48.8
	m	-410	-141	151	-400	-36.1
	h	-55	-43	46	-52	-17.3
UK	all	-388	-272	285	-376	-36.5
	l	-227	-117	101	-243	-59.5
	m	-158	-116	129	-145	-31.7
	h	-3	-40	55	12	7.1
USA	all	-2,362	-1,113	1,400	-2,076	-36.0
	l	-557	-309	231	-635	-54.2
	m	-1,535	-642	876	-1,301	-36.1
	h	-270	-163	293	-140	-14.1
JPN	all	-797	-412	-321	-1,530	-43.9
	l	-415	-158	-106	-680	-71.8
	m	-341	-212	-201	-754	-35.4
	h	-40	-41	-14	-95	-23.5
AUS	all	-63	-80	144	1	0.2
	l	-59	-42	70	-31	-16.5
	m	-8	-31	59	21	14.9
	h	4	-7	14	11	35.8
BRA	all	-301	242	922	863	18.2
	l	-1,111	-39	508	-643	-20.0
	m	772	259	332	1,363	112.3
	h	39	22	81	142	44.0
CHN	all	-63,871	50,284	35,983	22,396	63.4
	l	-45,665	34,182	24,759	13,277	52.9
	m	-17,567	15,123	10,828	8,385	83.8
	h	-640	979	396	734	301.9
IDN	all	-1,052	555	2,252	1,755	35.8
	l	-1,311	251	1,676	617	15.8
	m	216	272	510	998	111.9
	h	42	32	65	140	127.2
IND	all	-7,700	-5,614	26,514	13,200	71.1
	l	-7,180	-4,347	17,271	5,744	47.1
	m	-853	-1,184	8,309	6,272	109.1
	h	334	-83	934	1,184	192.9

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2e: Contributions of determinants to changes in skills demand (refining; chemicals manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-1,545	-458	1,648	-355	-7.6
	l	-998	-287	651	-633	-32.0
	m	-576	-167	725	-18	-0.9
	h	29	-5	272	296	48.1
FRA	all	-325	40	232	-54	-9.9
	l	-172	1	81	-90	-41.9
	m	-132	20	106	-6	-2.5
	h	-21	19	44	43	50.3
GER	all	-403	-147	338	-212	-15.6
	l	-136	-17	63	-90	-32.2
	m	-254	-98	210	-141	-16.6
	h	-13	-32	64	19	8.5
UK	all	-300	-211	302	-209	-24.6
	l	-187	-96	106	-177	-52.2
	m	-120	-96	138	-77	-20.2
	h	6	-19	58	45	34.7
USA	all	-954	-380	910	-424	-15.8
	l	-164	-62	102	-124	-36.2
	m	-632	-220	558	-295	-17.5
	h	-158	-98	251	-5	-0.7
JPN	all	-626	-18	146	-497	-26.7
	l	-204	-68	15	-256	-63.6
	m	-357	44	92	-220	-19.4
	h	-65	6	39	-21	-6.3
AUS	all	-43	-34	67	-11	-7.1
	l	-33	-17	33	-18	-22.5
	m	-10	-14	27	4	6.6
	h	0	-3	6	3	25.9
BRA	all	-153	65	495	407	30.9
	l	-375	-82	264	-193	-22.0
	m	184	134	179	497	150.0
	h	38	13	51	103	92.8
CHN	all	-48,390	15,610	35,434	2,653	10.0
	l	-32,374	9,859	22,457	-58	-0.3
	m	-15,420	5,171	12,269	2,019	22.0
	h	-596	580	709	693	163.7
IDN	all	-733	254	1,058	578	29.7
	l	-736	111	789	165	10.6
	m	0	125	238	363	102.4
	h	3	18	30	51	117.0
IND	all	-3,342	-1,046	5,932	1,544	25.2
	l	-2,158	-459	3,759	1,141	30.5
	m	-958	-493	1,592	141	7.9
	h	-225	-94	581	261	44.4

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2f: Contributions of determinants to changes in skills demand (machinery and metal prods. manuf.)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-2,316	-609	3,084	159	2.2
	l	-1,534	-352	1,175	-712	-24.0
	m	-877	-215	1,429	337	10.0
	h	95	-42	480	534	56.7
FRA	all	-492	12	394	-86	-9.3
	l	-273	-12	136	-149	-40.7
	m	-201	6	182	-13	-3.0
	h	-18	17	76	75	51.9
GER	all	-688	-180	848	-20	-0.8
	l	-248	-11	160	-100	-20.4
	m	-439	-119	527	-31	-2.1
	h	0	-50	161	110	27.4
UK	all	-355	-344	344	-355	-36.6
	l	-222	-144	125	-240	-60.7
	m	-135	-152	155	-133	-31.2
	h	2	-48	64	18	12.1
USA	all	-1,356	-515	1,320	-551	-14.5
	l	-270	-59	169	-160	-30.6
	m	-1,027	-362	945	-444	-16.2
	h	-59	-94	206	53	9.9
JPN	all	-1,170	-7	502	-675	-19.4
	l	-477	-76	91	-462	-56.9
	m	-617	85	316	-216	-10.1
	h	-76	-15	94	3	0.6
AUS	all	-129	-58	166	-21	-7.9
	l	-91	-24	82	-33	-23.3
	m	-36	-26	68	6	5.6
	h	-2	-8	15	6	24.7
BRA	all	-202	56	720	574	50.8
	l	-396	-66	386	-76	-10.2
	m	149	125	260	534	188.0
	h	45	-3	74	116	122.1
CHN	all	-49,256	16,054	34,351	1,150	5.7
	l	-29,589	9,875	19,172	-542	-4.7
	m	-18,873	5,691	14,200	1,019	12.3
	h	-794	489	979	674	147.8
IDN	all	-182	224	94	135	29.5
	l	-179	149	68	38	10.4
	m	-5	68	23	85	102.1
	h	2	7	3	12	116.7
IND	all	-3,302	-586	4,643	755	16.3
	l	-1,635	-191	1,979	152	7.6
	m	-1,604	-399	2,117	114	5.2
	h	-62	3	547	488	110.5

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2g: Contributions of determinants to changes in skills demand (electrical products manufacturing)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-1,668	-861	2,189	-340	-10.3
	l	-787	-419	772	-434	-34.7
	m	-768	-325	1,055	-38	-2.4
	h	-113	-118	363	132	27.6
FRA	all	-311	-46	282	-75	-17.8
	l	-145	-26	98	-73	-45.1
	m	-138	-21	132	-27	-14.0
	h	-28	1	52	25	38.3
GER	all	-613	-196	725	-83	-7.1
	l	-170	-33	140	-63	-26.2
	m	-367	-100	438	-28	-4.1
	h	-75	-63	147	9	3.8
UK	all	-227	-353	359	-220	-40.6
	l	-133	-152	139	-147	-64.3
	m	-87	-145	156	-76	-33.1
	h	-6	-56	65	3	3.3
USA	all	-2,024	-361	1,749	-636	-25.3
	l	-219	-48	140	-127	-56.5
	m	-1,350	-244	1,016	-577	-37.9
	h	-456	-68	593	69	9.0
JPN	all	-1,239	-240	997	-482	-23.0
	l	-237	-81	121	-197	-64.4
	m	-837	-106	648	-295	-21.7
	h	-166	-52	227	9	2.0
AUS	all	-16	-34	59	9	15.0
	l	-13	-17	29	-1	-4.1
	m	-4	-13	24	7	32.0
	h	1	-4	5	3	55.9
BRA	all	5	-82	261	183	51.7
	l	-60	-83	122	-21	-10.4
	m	54	12	108	174	154.8
	h	11	-11	31	30	79.1
CHN	all	-24,137	16,794	15,822	8,479	121.6
	l	-13,324	8,888	7,854	3,418	95.3
	m	-10,218	7,080	7,164	4,026	128.7
	h	-595	826	804	1,034	399.4
IDN	all	-48	77	159	188	152.9
	l	-33	30	117	113	115.7
	m	-13	41	37	66	294.7
	h	-2	6	5	9	323.2
IND	all	-1,984	-212	2,225	28	2.6
	l	-375	-5	431	51	25.6
	m	-1,158	-121	1,221	-59	-9.8
	h	-452	-85	573	36	13.1

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2h: Contributions of determinants to changes in skills demand (transport equipment manuf.)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-1,012	-361	1,394	21	0.8
	l	-643	-184	508	-319	-30.5
	m	-370	-134	648	144	12.3
	h	1	-43	238	196	52.7
FRA	all	-157	-36	167	-25	-7.6
	l	-96	-10	57	-49	-38.3
	m	-60	-23	78	-5	-3.3
	h	-1	-3	32	29	55.6
GER	all	-359	21	458	119	13.9
	l	-118	14	87	-17	-9.4
	m	-203	16	277	90	17.7
	h	-39	-10	93	45	27.3
UK	all	-199	-150	231	-119	-23.8
	l	-136	-63	84	-114	-54.3
	m	-67	-65	102	-30	-14.2
	h	3	-22	45	25	32.5
USA	all	-758	-234	649	-344	-17.2
	l	-145	-37	61	-121	-53.8
	m	-553	-147	431	-268	-20.0
	h	-61	-51	157	45	10.6
JPN	all	-397	179	268	51	4.4
	l	-172	17	46	-109	-41.9
	m	-216	132	174	91	12.5
	h	-9	30	48	69	38.8
AUS	all	-31	-23	73	19	20.5
	l	-25	-11	36	0	0.5
	m	-7	-9	30	14	38.2
	h	0	-2	7	5	63.3
BRA	all	-42	43	249	250	73.8
	l	-122	13	114	5	2.6
	m	64	36	106	206	191.9
	h	15	-6	29	38	105.2
CHN	all	-15,493	3,605	13,425	1,536	33.5
	l	-7,942	1,884	6,461	403	17.9
	m	-7,162	1,556	6,439	833	38.1
	h	-388	164	525	300	201.6
IDN	all	-179	26	195	42	8.9
	l	-167	-6	145	-27	-7.1
	m	-12	28	44	60	70.0
	h	-1	4	6	9	82.2
IND	all	143	-4	733	871	137.6
	l	-27	8	170	151	92.7
	m	-23	-58	363	282	78.2
	h	193	46	199	438	400.4

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2i: Contributions of determinants to changes in skills demand (other industry)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-502	-404	2,671	1,765	13.8
	l	-1,110	-191	1,436	135	2.4
	m	300	-171	939	1,068	18.6
	h	307	-41	296	562	39.5
FRA	all	136	-43	239	332	20.2
	l	-159	-20	95	-84	-12.0
	m	213	-19	124	319	40.2
	h	82	-4	20	98	68.8
GER	all	-622	-129	-378	-1,129	-31.3
	l	-168	-31	-71	-270	-42.9
	m	-391	-73	-248	-712	-30.8
	h	-64	-25	-59	-147	-22.3
UK	all	-315	-81	760	364	18.4
	l	-266	-29	218	-77	-11.9
	m	-85	-43	432	304	28.0
	h	36	-9	110	137	55.0
USA	all	608	-156	1,451	1,902	24.7
	l	124	-26	257	355	25.2
	m	326	-103	997	1,220	22.9
	h	158	-27	197	327	33.7
JPN	all	310	-88	-2,071	-1,849	-25.1
	l	-512	-35	-373	-920	-57.1
	m	490	-44	-1,249	-803	-18.5
	h	332	-10	-449	-126	-8.9
AUS	all	157	12	317	486	71.4
	l	10	3	128	141	47.6
	m	122	8	173	303	84.8
	h	25	0	16	42	153.2
BRA	all	920	13	1,642	2,575	54.3
	l	-317	-5	1,234	911	22.6
	m	1,106	16	334	1,457	265.1
	h	131	2	74	207	124.4
CHN	all	-63,365	2,241	78,355	17,232	44.0
	l	-40,977	948	47,120	7,092	29.5
	m	-21,891	1,076	29,394	8,578	59.5
	h	-496	218	1,840	1,562	214.2
IDN	all	-110	-60	1,728	1,557	39.4
	l	-263	-26	1,298	1,009	31.4
	m	107	-30	364	441	70.4
	h	46	-4	65	107	94.1
IND	all	-7,867	592	24,635	17,360	113.3
	l	-6,417	431	17,059	11,073	102.8
	m	-1,335	130	6,655	5,450	136.3
	h	-114	31	920	837	152.3

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2j: Contributions of determinants to changes in skills demand (market services)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-3,098	-3,065	26,866	20,702	32.1
	l	-7,435	-1,822	8,737	-521	-2.3
	m	-798	-1,134	12,182	10,250	33.4
	h	5,135	-109	5,947	10,973	103.2
FRA	all	-840	-317	3,754	2,597	28.4
	l	-1,357	-221	1,100	-478	-14.6
	m	-314	-97	1,619	1,207	30.7
	h	832	0	1,036	1,868	95.7
GER	all	32	228	3,385	3,645	24.1
	l	8	184	476	667	28.6
	m	-733	57	2,159	1,483	14.7
	h	757	-13	750	1,495	55.4
UK	all	-2,632	-1,142	6,986	3,212	26.4
	l	-2,419	-638	2,196	-861	-19.0
	m	-952	-447	3,306	1,907	34.3
	h	740	-58	1,484	2,166	103.9
USA	all	-16,350	-4,368	32,511	11,792	17.8
	l	-2,063	-445	3,195	686	9.5
	m	-13,228	-2,564	20,435	4,643	10.9
	h	-1,058	-1,359	8,881	6,464	39.9
JPN	all	-978	-940	2,108	190	0.6
	l	-1,485	-485	181	-1,789	-50.4
	m	-1,743	-384	1,340	-787	-3.7
	h	2,250	-71	587	2,766	45.4
AUS	all	-712	-230	2,638	1,697	40.5
	l	-844	-122	1,387	421	17.8
	m	-88	-92	888	709	52.1
	h	220	-16	363	566	123.8
BRA	all	1,188	615	12,457	14,260	46.9
	l	-5,896	-26	6,313	391	2.1
	m	5,702	671	4,616	10,989	124.8
	h	1,381	-30	1,528	2,880	92.4
CHN	all	-199,005	49,787	226,643	77,425	57.3
	l	-69,945	18,286	75,674	24,015	51.1
	m	-123,558	26,388	131,277	34,106	42.7
	h	-5,502	5,114	19,692	19,303	233.3
IDN	all	-5,447	1,419	17,470	13,443	61.5
	l	-6,608	563	11,828	5,783	35.9
	m	435	624	4,394	5,453	115.8
	h	727	232	1,248	2,207	216.1
IND	all	-46,131	10,810	64,747	29,426	47.7
	l	-27,163	4,177	29,139	6,153	19.1
	m	-16,051	4,399	27,273	15,621	64.9
	h	-2,917	2,235	8,334	7,652	140.6

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.

Table B.2k: Contributions of determinants to changes in skills demand (nonmarket services)

	skill	technology	trade	consumption	total	total(%)
EU15	all	-3,231	-297	11,723	8,194	19.6
	l	-4,751	-119	2,755	-2,116	-20.9
	m	-1,333	-104	4,646	3,210	19.0
	h	2,852	-74	4,322	7,100	48.3
FRA	all	-490	-206	1,722	1,027	14.5
	l	-943	-75	510	-508	-24.0
	m	63	-97	735	702	28.2
	h	390	-34	477	834	33.6
GER	all	-551	39	1,783	1,271	13.9
	l	-279	1	260	-18	-1.7
	m	-683	19	1,013	349	7.2
	h	411	19	510	940	29.2
UK	all	-1,288	-74	3,048	1,687	19.5
	l	-1,681	-34	753	-962	-41.0
	m	-233	-13	1,074	828	27.6
	h	626	-27	1,222	1,821	55.3
USA	all	-5,507	-166	14,307	8,634	22.6
	l	-1,217	-29	716	-529	-22.2
	m	-5,598	-81	8,360	2,681	11.4
	h	1,308	-55	5,230	6,482	53.4
JPN	all	317	-26	2,450	2,741	27.4
	l	-514	-14	159	-369	-49.5
	m	-197	-7	1,737	1,534	23.9
	h	1,027	-6	554	1,576	55.2
AUS	all	-48	-64	1,004	891	49.4
	l	-207	-18	282	57	9.7
	m	93	-13	352	432	73.6
	h	66	-33	370	403	63.3
BRA	all	1,277	-116	3,655	4,815	50.7
	l	-1,429	-39	877	-591	-20.3
	m	530	-46	1,478	1,962	52.2
	h	2,176	-30	1,299	3,444	121.8
CHN	all	-56,740	944	66,741	10,945	32.5
	l	-10,263	237	11,113	1,087	18.3
	m	-42,898	519	43,923	1,544	6.7
	h	-3,579	189	11,705	8,315	181.1
IDN	all	-3,671	486	4,212	1,027	12.2
	l	-2,326	231	1,853	-243	-6.2
	m	-1,906	154	1,544	-208	-6.3
	h	561	101	815	1,477	124.1
IND	all	-19,049	949	24,081	5,982	26.3
	l	-3,341	680	4,995	2,334	45.5
	m	-11,294	196	10,309	-789	-7.5
	h	-4,414	72	8,778	4,436	62.9

Source: Authors' calculations on World Input-Output Database (April 2012 and September 2012 update). Numbers of jobs are in 000s, percentage growth rates are expressed relative to skills demand in 1995.