Productivity Growth and International Competitiveness

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Paper Prepared for the IARIW 33rd General Conference

Rotterdam, the Netherlands, August 24-30, 2014

Session 4C

Time: Tuesday, August 26, Afternoon

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by

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Abstract

This paper presents estimates of effective multifactor productivity (MFP) growth for Canada, the United States, Australia, Japan and selected EU countries. Effective MFP growth captures the impact of the productivity gains in upstream industries on the production of final demand products such as consumption, investment and export products, thereby providing an appropriate measure of productivity growth and international competitiveness in their production. A substantial portion of MFP growth, especially for small, open economies is attributable to gains in the production of intermediate inputs in foreign countries. Productivity growth tends to be higher in investment and export products than for production of consumption products. Technical progress and productivity growth in foreign countries have made a larger contribution to production growth in investment and export products than in consumption products.

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JEL code: O4, F1, F6

Keywords: productivity, global value chain, offshoring, competitiveness

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We would like to thank John Baldwin, Andrew Sharpe, Larry Shute, Aaron Sydor, Jianmin Tang, Hui Wei, and participants at the IARIW-UNSW Special Conference on "Productivity Measurement, Drivers and Trend" in Syndey, Australia for helpful discussions and detailed comments.

1 Introduction

As firms and industries take advantage of differences in production costs and technologies across countries, their supply chains have become global. Increasingly, firms and industries depend on accessing imports of goods and services to improve productivity and competitiveness (OECD, 2012).[1] Altomonte and Ottaviano (2011), for instance, find that the competitiveness of firms and industries is positively associated with international production-sharing and purchases of imported intermediate inputs. In addition, the literature on international R&D and technology spillovers since Coe and Helpman (1995) has found that through the import of intermediate inputs, foreign technical progress contributes to the productivity growth and international competiveness of domestic industries.

However, the rise of global production poses challenges to analyses of countries' competitiveness. Measures such as gross exports are based on the assumption that all production activities take place in individual economies, and are, therefore, less informative for the policy debate. Consequently, new measures are being developed. For example, Johnson and Noguera (2011) and Koopman et. al. (2012) propose a measure of domestic value-added content of exports. Timmer et. al. (2012a) and van Ark et. al. (2013) propose a measure of "global value chain income" that is based on the value-added by countries along the international production chain.

Similarly, the current measure of multifactor productivity (MFP) growth fails to capture the impact that productivity gains in the production of intermediate inputs have on the productivity gains of domestic industries.[2] This is because it measures only gains originating in a

1. Yakabuski (2013) contends that the success of NAFTA (North American Free Trade Agreement) in 1994 lies in the overwhelming business case for supply-chain integration within North America. Linking their economies makes all three NAFTA countries richer, more competitive and better-positioned to conquer global markets.
2. The standard measure of industry multifactor growth is constructed as the growth in output that is not accounted for by the growth in capital, labour and intermediate inputs in the industry, using the growth accounting framework (see for example, Jorgenson and Griliches 1967, Diewert, 1978).

particular industry. On the other hand, an alternate measure—the effective rate of MFP growth—captures the impact of productivity gains in upstream industries (at home and abroad) supplying intermediate inputs on the growth and international competiveness of a domestic industry. This paper argues that the latter is a more appropriate measure of international competiveness.

The effective rate of MFP growth was proposed by Domar (1961), Rymes (1971), Hulten (1978), Cas and Rymes (1991), and has been used in a number of studies (Durand 1996; Aulin-Ahmavaara 1999). However, in those studies, the measure was developed in a closed economy. This paper extends that work to develop an effective MFP growth measure in an open economy, in which industries and firms source their intermediate inputs both domestically and abroad.

Rymes (1971) and Hulten (1978) contend that the evolution and growth of a sector are reflected in the effective rate of MFP growth, which captures the impact of productivity gains in earlier or upstream stages of production on the final sector, rather than just the gains originating in a particular sector, which are captured by the standard industry MFP measure that are currently produced.

The two measures serve different purposes. If the focus of analysis is the efficiency with which domestic industries use inputs in production, standard MFP growth, which considers industries in isolation, is the proper measure. However, to assess the competitiveness and growth of industries, the appropriate measure is the effective rate of productivity growth, which assesses the gains along the entire chain involved in producing goods and services for final use. The effective rate of productivity growth is also useful for understanding international competitiveness, because, as will be shown, it is more closely related to export growth and product prices.[3]

This paper has a number of objectives.

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[3] The effective MFP growth can be thought of as measuring productivity growth in the production of goods and services while standard MFP growth measuring productivity growth in the production of individual industries.

First, it provides estimates of the effective rate of productivity growth for the production of final goods and services in Canada, the United States, Australia, Japan and selected EU countries over the 1995-to-2007 period. It estimates the effective rate of MFP growth in the production of consumption goods, investment goods, and exports and compares the rates in those countries.

Second, the effective rates of productivity growth are decomposed into the contributions of individual countries and industries to determine the origins of the gains and to examine the contribution of trends toward sourcing intermediate inputs abroad or offshoring to productivity growth.[4]

Third, the correlation between the effective rate of productivity growth and the price of output across industries is estimated and compared with the correlation between standard MFP growth and product prices across industries. This demonstrates that the effective rate of productivity growth is a more informative measure of competitiveness, compared with standard MFP growth.

This paper is related to previous studies of differences in MFP growth in the production of investment and consumption goods and their implications for economic growth. Oliner and Sichel (2000, 2002) and Oliner, Sichel, and Stiroh (2007) constructed a measure of MFP growth for the production of final demand goods and services in the United States, with a focus on the role of production of ICT investment goods. The measure in those papers can be thought of as the effective rate of MFP growth for the production of investment goods and other final demand commodities. However, those papers assume that combined input growth is the same for the production of different types of final demand products. By contrast, the present study shows that a measure of effective MFP growth in the production of investment goods and consumption

4. This paper considers only the impact of productivity gains in foreign intermediate inputs on productivity growth in the domestic production of final demand products. It does not consider the effect of gains in the production of imported capital on domestic production. Such analysis requires a departure from the standard growth accounting framework by treating capital as produced goods, as in Cas and Rymes (1991) and Durand (1996). In the standard growth accounting framework, the effect of imported capital is captured through its effect on labour productivity growth from capital deepening.

goods must account for differences in the growth of capital and labour inputs used directly and indirectly in their production.

The present study is also related to a paper by Basu and Fernald (2010) that estimated MFP growth in the production of investment and consumption goods for the United States. Similar to this paper, Basu and Fernald (2002) estimated MFP growth for the production of investment and consumption goods as the difference in output growth and the growth in combined capital and labour inputs embodied in their production. However, they captured the impact of productivity gains from imports on domestic production through the terms of trade. By contrast, in this analysis, the treatment of productivity gains from imports follows the traditional growth accounting framework as developed (Jorgenson and Griliches 1967; Diewert 1976); productivity gains in intermediate imports are calculated as the difference between import growth and the combined input growth used in foreign countries to produce the imports.

In the past, Statistics Canada has calculated the effective rate of productivity growth using a measure called the inter-industry productivity growth estimate (Statistics Canada 1994, Durand 1996). Based on that measure, Gu and Whewell (2005) showed that after implementation of the Canada-US Free Trade Agreement (CUFTA) in 1989, effective MFP growth accelerated in the production of export goods, compared with other goods and services, and thus, inferred that the CUFTA raised the productivity of Canadian industries exposed to international trade.

The rest of paper is organized as follows. Section 2 presents the methodology for constructing the effective rate of MFP growth. This requires the world I-O tables and the World KLEMS database, which became available as a result of two major international initiatives: World IO and World KLEMS. Section 3 describes the data used for empirical analysis. Section 4 focuses on the decomposition results and presents empirical evidence that the effective rate of MFP growth is more appropriate as a measure of industry competiveness for Canada. Section 5 concludes the paper.

2 Methodology

Introduced by Hulten (1976), the concept of the effective rate of MFP growth accounts for the fact that efficiency and competitiveness in producing final demand products (for instance, automobiles) depend not only on technical change originating in a particular sector, but also on technical progress in the production of intermediate inputs to the sector (such as steel, rubber and plastics).

The effective rate of productivity growth measures technical progress in an integrated production processes or production sector. The concept of an integrated production sector for estimating the effective MFP growth was introduced by Domar (1961). The integrated production sector includes the industry directly involved in producing the final demand output and all upstream industries producing intermediate inputs used in the production of final demand output. The output of the integrated production sector is the final demand output delivered to final demand uses such as consumers, businesses, government and exports. Input for the integrated production sector includes not only capital and labour directly employed in the production of final goods, but also those employed indirectly in industries that produce intermediate inputs.

Hulten (1976) shows that the weighted sum of the effective MFP growth rates across final demand sectors is equal to standard MFP growth in the total economy.[5] The weights for the aggregation are estimated as the nominal share of final demand output in total nominal value of final demand and sum to one. By contrast, in the Domar aggregation of standard MFP growth across industries, weights are estimated as the ratio of industry gross output in total value of final demand, and sum to more than one, because part of industry gross output is used as intermediate inputs (Domar, 1961).

5. This is true only in a closed economy, where the industries purchase intermediate inputs only from other domestic industries, as shown in section 2.

While the term "effective rate of MFP growth" was introduced by Hulten (1976), the distinction between the effective rate of MFP growth and standard MFP growth is also apparent in the Domar aggregation of industry MFP growth. Domar (1961) showed that the contribution of an industry to aggregate MFP growth in the production of final demand outputs depends not only on its direct contribution to gains in the production of final demand outputs, but also on an indirect contribution through productivity gains for intermediate inputs used by other industries.

The rest of this section presents an example of a production process adapted from Domar to illustrate the difference between effective and standard MFP growth. The effective rate of MFP growth is then presented using the IO production framework, and is shown to be more closely related to the competitiveness of industries.

2.1 An example

This example is taken from Domar (1961). Let an economy consist of two industries. Industry one produces final goods Y_1 using capital K_1, labour L_1, and intermediate inputs M_2. Industry two produces intermediate inputs M_2 for industry one, using capital K_2 and labour L_2. The two industries have the following production function with constant return to scale:

$$Y_1 = A_1 F_1(K_1, L_1, M_2), \tag{1}$$

$$M_2 = A_2 F_2(K_2, L_2). \tag{2}$$

Standard MFP growth for the two industries, which measures shifts in the production function, can be estimated as:

$$\Delta \ln A_1 = \Delta \ln Y_1 - (\alpha_1 \Delta \ln K_1 + \beta_1 \Delta \ln L_1 + \gamma_1 \Delta \ln M_2), \tag{3}$$

$$\Delta \ln A_2 = \Delta \ln M_2 - (\alpha_2 \Delta \ln K_2 + \beta_2 \Delta \ln L_2). \tag{4}$$

$\alpha_1, \beta_1 \ \gamma_1 \ \alpha_2 \ \beta_2$ in the two equations are the nominal share of capital, labour and intermediate inputs in the value of total gross output, averaged over two periods.

Substituting (2) into (1) yields a production function for an integrated production process that relates capital inputs and labour inputs to the production of final goods. Taking logarithms of the resulting production function for the integrated production process and differentiating with respect to time, the effective rate of MFP growth for the production of final goods is obtained:

$$\Delta \ln A = \Delta \ln A_1 + \gamma_1 \Delta \ln A_{2.} \tag{5}$$

The effective rate of MFP growth for a particular integrated production sector is the weighted sum of MFP growth in the two industries that comprise the integrated production sector that processes the final goods, where the weights are the ratio of industry gross output to the value of output of final product. This is the Domar aggregation.

The effective rate of MFP growth in equation (5) is the sum of technical process originating in the industry producing the final product and technical progress in the upstream industry producing intermediate input for the final product-producing sector. Effective MFP growth captures productivity gains in both industries in the production of the final product. By contrast, standard MFP growth shown in equations (3) and (4) measures productivity gains that originate in those two industries.

This example pertains to a closed economy, but can be extended to an open economy. Suppose that intermediate inputs are produced abroad and that the domestic economy consists of one industry that purchases the intermediate inputs from the foreign country. The standard estimate of MFP growth is measured using equation (3); the effective rate of MFP growth, given in equation (5), is the weighted sum of MFP growth in the domestic production industry and MFP growth in the foreign production of intermediate inputs. The effective rate of MFP growth exceeds the standard MFP growth by the amount of MFP growth “imported” through the purchase of intermediate inputs.

2.2 Effective rate of multifactor productivity growth

In the section above, the effective rate of MFP productivity growth was presented in a simple case of integration. For a complex case, where industries use parts of each other's outputs as intermediate inputs, the effective rate of MFP growth is a weighted sum of standard MFP growth in all industries involved in the production of final goods, where weights are complex function of various substitution elasticities and commodity shares (Hulten 1976). To simplify the calculation, Cas and Rymes (1991), Durand (1996), and Aulin-Ahmavaara (1999) assume that the production function can be characterized by Leontief technologies (Leontief,1936 1941). Using the input-output framework, they show that the weights can be derived using the "Leontief inverse." The effective rate of MFP growth in those studies is estimated in a closed economy.

By contrast, in the present analysis, the measure is extended to an open economy to assess the effect of gains in the production of intermediate inputs in other countries on productivity growth and international competiveness of domestic industries. To that end, single-country IO tables are extended to a multi-country setting (Timmer et al. 2012b).

Figure 1 presents a schematic outline of a world input-output table with three regions. A world input-output table is a combination of national input-output tables in which the use of products is broken down by their origin. For each country, flows of products for intermediate and final use are split into those produced domestically and those that are imported.

The rows in the table present the use of output from a particular industry in a country. This can be intermediate use in the country itself (use of domestic output) or by other countries, in which case it is exported. Output can also be for final use, either by the country itself (final use of domestic output) or by other countries, in which case it is exported. The columns present the amounts of intermediate and factor inputs needed for production. The intermediates can be sourced from domestic industries or imported.

The world input-output table can be presented in matrix form. It is assumed that there are S sectors, F production factors and N countries. Output in each country-sector is produced using domestic production factors and intermediate inputs, which may be sourced domestically or from foreign suppliers. Output may be used to satisfy final demand (at home or abroad) or used as intermediate input in production (again, at home or abroad). Final demand consists of household and government consumption, investment and exports.

Let x be the vector of production of dimension (SNx1), which is obtained by stacking output levels in each country-sector. Define y as the vector of dimension (SNx1) that is constructed by stacking world final demand for output from each country-sector. A global intermediate input coefficients matrix A of dimension (SNxSN) is further defined:[6]

$$\mathrm{A}=\begin{bmatrix} \mathrm{A}_{11} & \mathrm{A}_{12}\ldots & \mathrm{A}_{1\mathrm{N}} \\ \mathrm{A}_{21} & \mathrm{A}_{22}\ldots & \mathrm{A}_{2\mathrm{N}} \\ \vdots & \vdots & \vdots \\ \mathrm{A}_{\mathrm{N}1} & \mathrm{A}_{\mathrm{N}2}\ldots & \mathrm{A}_{\mathrm{NN}} \end{bmatrix}. \tag{6}$$

The elements, or input-output coefficients, $a_{ij}(s,t)=m_{ij}(s,t)/x_j(t)$ describe the output from sector s in country I used as intermediate input by sector t in country j as a share of output in the latter sector. The matrix A describes how the products of each country-sector are produced using a combination of domestic and foreign intermediate products.

A fundamental accounting identity is that total use of output in a row equals total output of the same industry as indicated in the respective column. Using the matrix notation as outlined above, this can be written as:

$$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_N \end{bmatrix}=\begin{bmatrix} \mathrm{A}_{11} & \mathrm{A}_{12}\ldots & \mathrm{A}_{1\mathrm{N}} \\ \mathrm{A}_{21} & \mathrm{A}_{22}\ldots & \mathrm{A}_{2\mathrm{N}} \\ \vdots & \vdots & \vdots \\ \mathrm{A}_{\mathrm{N}1} & \mathrm{A}_{\mathrm{N}2}\ldots & \mathrm{A}_{\mathrm{NN}} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_N \end{bmatrix}+\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}. \tag{7}$$

6. We use lower case letters to denote column vectors and upper case letters to denote matrices.

where x_i represents column vector of dimension S with production levels in country i, and y_i is column vector of dimension S with global final demand for the product of country i. This input-output system can also be written in a compact form:

$$x = Ax + y. \tag{8}$$

Rearranging Equation (8), we have the fundamental input-output identify:

$$x = (I - A)^{-1} y. \tag{9}$$

where I is an (SNxSN) identity matrix with ones on the diagonal and zeros elsewhere. $(I - A)^{-1}$ is known as the Leontief inverse (Leontief, 1936). The element in row m and column n of this matrix gives the total production value of sector m needed for production of one unit of final product n. The column n of the matrix with dimension SN gives the total production values of S sectors in N countries for the production of one unit of output of final product n.

Let v be the column vector of standard MFP growth based on gross output of dimension (SNx1), and e be the column vector of effective rate of MFP growth of dimension (SNx1) for the production of final product, which are both obtained by stacking MFP growth in each country-sector.

Standard MFP growth, estimated using the growth accounting framework, is estimated as the difference between output growth and the combined growth of capital, labour and intermediate inputs.

Effective MFP growth in producing final product n can be calculated as the difference between the difference in the growth in the output of final product and the growth in the combined capital and labour inputs used directly and indirectly to produce the final product, where the weights are shares of direct and indirect capital and labour costs.

Let z_n be a column vector with the nth element representing the value of the global final demand for product n, while all the remaining elements are zero. The capital input per unit of gross output produced in sector s in country i is defined as $c_i(s)$, and the stacked SN-vector c containing these "direct" capital input coefficients is created. To take "indirect' contributions into account, the SN-vector of the volume of capital inputs k_n used to produce the output of final product z_n is derived by pre-multiplying the gross outputs needed for production of this final product by the capital input coefficients vector c:

$$k_n = \hat{c}(I - A)^{-1} z_n, \tag{10}$$

in which a hat indicates a diagonal matrix with the elements of c on the diagonal.

The calculation method outlined above can be used to estimate the quantity and costs of direct and indirect labour inputs and the costs of direct and indirect labour costs used for the production of a particular final product n.

The effective rate of MFP growth denoted by scalar e_n for the production of the output of final product n is then estimated as:

$$e_n = d \ln z_n - s_{kn}^{'} d \ln k_n - s_{ln}^{'} d \ln l_n \tag{11}$$

where the ' symbol denotes the transpose of a vector, i is an SN summation vector of ones, s_{nk} is an SN vector of total capital cost shares in total costs, and s_{nl} is an SN vector of total labour cost shares in total costs.

The effective rate of MFP growth for the production of final product can be estimated as a function of standard MFP growth (Cas and Rymes 1991, Durand 1996, and Aulin-Ahmavaara (1999):

$$e^{'} = v^{'} (I - A)^{-1} \tag{12}$$

As discussed above, column n of the Leontief inverse with dimension SN gives the total production values of S sectors in N countries for the production of one unit of output of final product n. The effective rate of MFP growth for production of final product n shown in equation

(12) is the weighted sum of standard MFP growth of the SN sectors, where weights equal to the total production values of S sectors in N countries for the production of one unit of output of final product n. Because the sum of value added in the total production is equal to the value of output of the final product (Timmer et al. 2012b), the sum of weights used for aggregation in equation (13) exceeds one. This is similar to Domar aggregation (Domar 1961, Jorgenson et al. 2007).

Equation (12) also decomposes the effective rate of MFP growth into a portion coming from domestic industries and a portion coming from foreign industries. The weighted sum of standard MFP growth over all sectors in a region represents the contribution of that region to the effective MFP growth in the production of final product n.

The effective rate of MFP growth for the production of final demand such as investment, consumption, and exports is the weighted sum of the effective rates of MFP growth across industries that produce those final demand products, where the weights for aggregation are estimated as share of industry deliveries to the final demand in the value of the final demand.

The effective rate of MFP growth for the production of total final demand is equal to standard MFP growth in the aggregate sector in a closed economy. To demonstrate this, it is assumed that there is one country (N=1) in the above framework. The effective rate of MFP growth (EMFP) for the production of total final demand is:

$$EMFP = v^{'} (I - A)^{-1} \left(y \Big/ \sum_{s} y_{s} \right), \tag{13}$$

where $\left(y \Big/ \sum_{s} y_{s} \right)$ is the column vector of S that gives the share of industry deliveries to the final demand in the value of the final demand. Substituting (9) in equation (13), yields:

$$EMFP = v^{'} \left(x \Big/ \sum_{s} y_{s} \right). \tag{14}$$

In a closed economy, the value of final demand is equal to the sum of value-added across industries. The term on the right of the equation is the Domar aggregation of standard MFP growth across industries, where the weights are given as the ratio of industry gross output to aggregate value-added. Because the Domar aggregation of standard MFP growth across industries is equal to standard MFP growth in the total economy, Equation (14) provides a proof that effective MFP growth for the production of final demand is equal to standard aggregate MFP growth in a closed economy.[7]

If industries source intermediate inputs from domestic industries, effective MFP growth for the production of final demands will generally be equal to standard MFP growth in the total economy. The two will diverge if domestic industries purchase intermediate inputs from foreign countries, and if productivity growth differs for domestic and foreign production of intermediate inputs. Effective MFP growth will surpass standard aggregate MFP growth if productivity growth is higher for the foreign intermediate inputs. On the other hand, effective MFP growth will be lower if productivity growth is lower in the foreign production of intermediate inputs.

2.3 Multifactor productivity growth and international competiveness

International competiveness can be defined as the relative output price between two countries (Jorgenson and Nishimizu 1978, Ball et. al. 2010, Lee and Tang, 2000). The international competitiveness of a domestic industry improves when its the output price declines relative to that in other countries. To be a good indicator of international competiveness, MFP growth should be significantly and negatively correlated with the change in output price.

In previous empirical studies, the standard estimate of MFP growth has been negatively related to the change in output price across industries. For example, Baldwin et al. (2001) found

[7] The discussion also shows that the effective MFP growth for the production of final demand products in a closed economy is equal to aggregate MFP growth calculated from aggregation of industry MFP growth or the bottom-up approach. For a discussion about the bottom-up approach as compared to the top-down approach, see Jorgenson et al. (2007), Diewert (2012), Gu (2012), and Schreyer (2012).

that Canadian industries with relatively high productivity growth rates are also those whose output prices fall relative to the aggregate price deflators. In this paper, it is argued that the correlation of output price changes with effective MFP growth tends to be stronger than its correlation with standard MFP growth. This is interpreted as evidence that effective MFP growth is a more informative measure of international competitiveness.

To see why this is the case, the dual approach for measuring productivity growth is used (for a survey, see Diewert 1987). According to the dual approach, MFP growth is the difference between changes in input prices and changes in output prices. Alternatively, changes in output prices can be written as the difference between changes in input prices and changes in MFP from the dual approach:

$$\Delta \ln p_n = \sum_i s_{n,i} d \ln w_{n,i} - d \ln mfp_n + \varepsilon_n, \qquad (15)$$

where s_i is the cost share of input I; w_i is the price of input; p_n is the output price of industry n; and ε_n is error term.

In general, the correlation between MFP growth and changes in output price is minus one (-1) if changes in input prices are not correlated with MFP growth across industries. The correlation will be different from minus one if input prices are correlated with MFP growth. The direction of the difference depends on whether the correlation is positive or negative.[8]

Standard MFP growth can be estimated as the difference in changes in the prices of capital, labour and intermediate inputs and changes in output prices. The strong correlation (close to minus 1) between standard MFP growth and output price changes requires the assumption that all input prices, including those of capital, labour and intermediate inputs, are invariant to or uncorrelated with MFP growth. This is highly implausible, because the price of intermediate inputs tends to be negatively correlated with productivity growth in producing them. For

8. This is similar to the bias in coefficient estimates due to omitted variables in the regression. For a discussion on the omitted variable bias, see Wooldridge (2002).

example, the price of semiconductors fell dramatically because of rapid technical progress in their manufacture.

Effective MFP growth in producing a product can be estimated as the difference in changes in the prices of capital and labour inputs used directly and indirectly in production and changes in the output price. The strong correlation (close to minus one) between standard MFP growth and output price changes requires only the assumption that the prices of capital and labour inputs are invariant to or uncorrelated with MFP growth; it does not require the assumption that the price of intermediate inputs is invariant to MFP growth. By contrast, effective MFP growth captures the effect of technical change in the production of intermediate inputs, and so the price of intermediate inputs is allowed to vary with productivity growth.

3 Data

This analysis uses two databases: the World Input-Output Database (WIOD) (Timmer et al. 2012b) and EU KLEMS database (O'Mahony and Timmer, 2009).

The world input-output table is an extension of the national input output table, which shows the use of products for intermediate or final use. The difference from the national table is that the use of products is broken down by country of origin. For a country, flows of products for both intermediate and for final use are split into those that are domestically produced or those that are imported. In addition, the world input-output table shows in which foreign industry the product is produced. Because information on the division of intermediate inputs and final use between domestically produced and imported is not available in the published national input-output tables, the "import proportionality assumption"—applying a product's economy-wide import share to three separate use categories (intermediate, investment and consumption)—is used to estimate the division for the world input-output tables.[9]

The world input-output tables cover 35 industries and 6 final demand categories in each of 40 countries for the 1995-to-2009 period. The WIOD is used to calculate the Leontief inverse matrix, as well as product expenditure shares, within each demand category (total final demand, consumption, investment and export).

The EU KLEMS provides data on economic growth and productivity for 25 of the 27 EU member states, as well as for Australia, Canada, Japan and the United States. It covers as many as 72 industries from 1970 to the present. The gross output measure of productivity is used in this paper. In cases where this measure is not available, it was derived by using value-added productivity adjusted by a ratio of value-added to gross output.

The industrial classification in the WIOD and the EU KLEMS databases are consistent with the European NACE 2 industry classification. Linking the two industry lists in the two databases yields a final total of 31 industries. Based on the availability of productivity data in the EU KLEMS, six country categories were defined: Canada, the United States, Australia, Japan, the EU, and the rest of the world (ROW). The EU group includes only the 10 member countries for which productivity measures are available: Austria, Belgium, Denmark, Finland, France, Germany, Italy, The Netherlands, Spain, and The United Kingdom. Because of the unavailability of data, productivity growth for the rest of the world is assumed to be zero. This assumption does not affect the main results in the study, because trade with the rest of world accounts for a small share of total trade for Canada, the United States, Australia, Japan, and the EU.

[9] The import proportionality assumption used in the construction of world input-output tables improves upon the more restrictive proportionality assumption employed in previous studies. Those studies apply a product's economy-wide import share for all use categories, which, as shown in Feenstra and Jensen (2012) and Baldwin et al. (2014), can generate biased estimates.

4 Empirical evidence

This section presents estimates of effective MFP growth in the production of final demand products for Canada, the United States, Australia, Japan, and selected EU countries during the 1995-to-2000 and 2000-to-2007 periods. These periods were chosen because pre- and post-2000 economic conditions varied sharply: the 1990s were marked by strong growth, but after 2000, most of these countries experienced deep recessions.

4.1 Country origins of intermediate inputs

The extent to which production in the various countries/regions is globally integrated puts the estimates of effective MFP in context. Averaged over the years 1995, 2000 and 2007, the share of intermediate inputs in gross output ranged from 45% to 52% across countries. However, the imported share of total intermediate inputs varied: 23% for Canada, 9% for the United States, 12% for Australia, 7% for Japan, 10% for the EU countries and 13% for the rest of the world (Table 1). Canada is highly integrated into upstream industries in the United States, from which it imports an average of 14% of all its intermediate inputs.

4.2 Standard versus effective multifactor productivity growth for the total economy

Standard and effective MFP growth estimates in the production of final demand products differ by country/region (Table 2). For Canada’s total economy, effective MFP growth was lower than standard MFP growth during the 1995-to-2000 period, but higher after 2000. The lower effective MFP growth estimate before 2000 reflects the fact that Canadian industries source most imported intermediate inputs from the United States, and productivity growth in the United States was lower than in Canada during that period. The higher effective MFP growth estimate for Canada after 2000 reflects greater productivity growth for intermediate inputs in the United States in those years.

In the United States, effective MFP growth exceeded standard MFP growth during the 1995-to-2000 period, because American industries purchase intermediate inputs from countries whose productivity growth for intermediate inputs tended to be high. After 2000, effective MFP growth was lower than standard MFP growth, because countries that supplied intermediate inputs had lower productivity growth at that time.

For the EU countries, the two measures were similar for the 1995-to-2000 period, but after 2000, effective MFP growth was lower than standard MFP growth.

The estimates of effective MFP growth presented here may be biased because it is assumed that no MFP growth occurred in countries not included in this analysis. If the share of intermediate inputs imported from those countries is small, this bias should be negligible, but if the share becomes large, the bias could be substantial.

To examine the size of the bias, effective MFP growth is re-estimated based on the assumption that MFP growth in the rest of world equaled that in American industries (Appendix Table 11). Under this assumption, the estimate of effective MFP growth rose by about 0.1 percentage points, and exceeded standard MFP growth in all countries except Japan.

4.3 Country origins of multifactor productivity growth in total economy

To determine the extent to which nations have benefited from productivity growth abroad, effective MFP growth in the production of final products is decomposed into contributions of countries (Table 3). Domestic gains were the main driver of productivity growth, but differences across countries and time periods were sizeable. For example, between 1995 and 2000, 0.65 percentage points or three quarters of 0.86 percentage point annual growth in MFP in Canada was domestic, and about 0.19 percentage points came from productivity growth in the United States. By comparison, almost all productivity growth in the United States came from the within-country component.

For some nations, the country origins of MFP growth changed over time. Canada's within-country contribution declined from three-quarters in the pre-2000 period to around one-third after 2000, as the contribution from the United States rose from about one-fifth to just over half. By contrast, for the United States, the within-country contribution accounted for almost all productivity growth in both periods.

Canada benefited more from productivity gains in the production of intermediate inputs in foreign countries than did the United States, Australia, Japan or the EU countries. This was because Canada imported a larger share of intermediate inputs than did those countries, and productivity growth in the foreign supplier industries (notably, the United States) was higher.

4.4 Multifactor productivity growth by final demand categories

Productivity growth and technical progress for the production of investment and consumption products have had different economic trajectories over time. For example, Basu and Fernald (2010) found that in the United States, productivity growth for investment products was negatively related to increases in hours, investment, consumption and output, whereas productivity growth for consumption products was positively related to increases in those variables.

Productivity growth tended to be higher in the production of investment and export products than in the production of consumption products (Table 3).[10] [11] For instance, in the United States, MFP growth in the production of investment, export and consumption products was 1.6%, 3.2% and 0.8%, respectively, in the pre-2000 period, and 0.04%, 2.1% and 0.4% after 2000. This can be attributed to relatively high productivity growth in industries that produce investment and export products (such as electrical and optical equipment, transport equipment),

10. Basu and Fernald (2010) found similar results for the United States.

11. Effective MFP growth for the production of final demand products is the weighted sum of effective MFP growth across industries using nominal share of industries in total final demand products as weights. The industry shares of final demand products are presented in Appendix Tables 3 and 4.

and slower growth in consumption-producing industries (such as real estate activities, public administration and health/social work) (Appendix Tables 12 to 15).

The country origins of productivity gains differ across consumption, investment, and export products (Table 3). In general, technical progress and productivity growth in foreign countries made a larger contribution to production growth in investment and export products than in consumption products. This was because industries producing investment and export products are more integrated with industries in foreign countries and tend to have higher productivity growth than do consumption-product industries. For example, during the 1995-to-2000 period, technical progress in foreign industries contributed 0.14 percentage points to productivity growth for consumption products in Canada, but 0.47 and 0.37 percentage points to productivity growth for investment and export products.

4.5 Offshoring and multifactor productivity growth

Effective MFP growth differs in the production of goods and services (Tables 4 and 5). For the 1995-to-2000 period, due to large gains in the production of information and communication technologies, MFP growth in the production of goods was higher than in the production of services for all countries in the analysis except Australia. After 2000, in Canada and the United States, productivity growth tended to be higher in the production of services, an outcome often attributed to the adoption of information and communication technologies (Jorgenson et al. 2007; van Ark 2008).

As a result of declining communications cost and trade costs, outsourcing and offshoring have increased in developed countries over the last 20 years (Baldwin and Gu, 2008). Industries in developed countries purchase growing amounts of service and material intermediate inputs from other domestic industries (outsourcing) and from foreign countries (offshoring).

To examine the contribution of offshoring to productivity growth, the foreign and domestic components of aggregate productivity growth were decomposed into gains arising from intermediate service inputs and gains arising from intermediate goods inputs. The contributions to aggregate MFP growth were small, but the contributions of goods offshoring tended to be higher. For example, during the 1995-to-2000 period, services offshoring contributed 0.1 percentage points per year to MFP growth in Canada, while material offshoring (of purchase of goods as intermediate inputs from other countries) contributed 0.3 percentage points per year to MFP growth in goods production.

4.6 Multifactor productivity growth by industry in Canada and the United States

This section presents estimates of standard and effective MFP growth by industry for Canada (Tables 6 and 7) and the United States (Tables 8 and 9). At the industry level, effective MFP growth tended to be higher than standard MFP growth.

Tables 6 to 9 also show effective MFP growth for Canadian and American industries by the domestic and foreign contribution. Productivity gains in foreign countries made a larger contribution to effective MFP growth in manufacturing than non-manufacturing industries. This reflects the higher degree of integration of manufacturing industries into the world economy.

4.7 Productivity growth and international competiveness

It can be argued that the effective rate of productivity growth calculated at the industry level is a more appropriate measure of international competitiveness. For example, De Juan and Febrero (2000) show that, in Spain, effective MFP growth is more closely related to changes in output prices across industries Spain than is standard MFP growth.

To examine the relationship between MFP growth and international competiveness, a regression that expresses changes in gross output prices in industry i over a period t ($\Delta \ln P_{i,t}$) is estimated as a function of standard MFP ($v_{i,t}$), and another regression that expresses changes in gross output prices is estimated as function of effective productivity growth ($e_{i,t}$):

$$\Delta \ln P_{i,t} = \alpha_0 + \alpha_t + \alpha_1 v_{i,t}, \quad (16)$$

$$\Delta \ln P_{i,t} = \beta_0 + \beta_t + \beta_1 e_{i,t}, \quad (17)$$

where α_t and β_t are period dummies.

The sample for the estimation consists of a pool of 31 industries over two periods: 1995 to 2000 and 2000 to 2007. The equation is estimated separately for each country or region.

It is hypothesized that the coefficient β_1 on the effective MFP growth variable will be close to minus one than the coefficient α_1 on the standard MFP growth variable. R-squared should be higher for the regression on effective MFP growth.

The results in Table 10 show that, except for the EUcountries, the R-squared from the regression on effective MFP growth (β_1) is higher than the R-squared from the regression on standard MFP growth (α_1). For the EU countries, the R-squared is similar for the two regressions. The greatest improvement in R-squared is for Canada—R-squared increased from 0.17 for the regression on standard MFP to 0.32 for the regression on effective MFP.

The evidence from the coefficient estimates on the MFP growth variables for Canada, the United States and Japan is consistent with the hypothesis that effective MFP growth is a better indicator of international competitiveness. The correlation between effective MFP growth and change in output price is closer to minus one than is the correlation between standard MFP growth and change in output price. For example, the correlation of output price with effective MFP growth is -0.95 across Canadian industries; the correlation with standard MFP growth is -0.78.

Nonetheless, the results vary across countries. For Australia, the correlations with output price are similar for effective and standard MFP growth rates. For the EU countries, the change in output price is more closely related to standard MFP growth.

5 Conclusion

To capture the impact that productivity gains in upstream industries supplying intermediate inputs have on productivity growth and international competitiveness in domestic industries, this paper estimates the effective rate of MFP growth for Canada, the United States, Australia, Japan, and selected EU countries. The effective rate of productivity growth accounts for productivity gains originating in upstream industries (both domestic and foreign) that supply intermediate material used in production. By contrast, the standard estimate of MFP growth measures only productivity gains originating in the final production stage.

This analysis shows that a substantial portion of MFP growth, especially for small, open economies like Canada's, originates from gains in the production of intermediate inputs in foreign countries. Because Canada imported a larger share of intermediate inputs from foreign countries than did the other countries, and productivity growth in supplier industries (notably, in the United States) was higher, Canada benefited more from productivity gains in foreign countries than did the other countries in the analysis. The foreign contribution to Canada's MFP growth increased from 25% in the 1995-to-2000 period, to 67% in the 2000-to-2007 period.

Most of the foreign contribution to productivity growth is from imports of material inputs (material offshoring) rather than services (services offshoring). This reflects a higher share of material inputs in total intermediate imports, and relatively high productivity growth in the production of material inputs.

Technical progress and productivity growth in foreign countries made a larger contribution to MFP growth for investment and export products, compared with consumption products. This is because domestic industries producing investment and exports are more integrated with industries in foreign countries and tend to have higher productivity growth than do consumption-product industries.

As a result of more extensive integration of manufacturing industries into the world economy, productivity gains in foreign countries made a larger contribution to effective MFP growth in manufacturing than in non-manufacturing industries.

This paper provides empirical evidence consistent with the hypothesis that effective MFP growth is a more appropriate indicator of international competitiveness than are standard estimates of MFP growth, because the former is more closely related to the decline in output price across industries.

This analysis is based on the EU KLEMS and World IO tables. The measure of effective MFP growth in this paper depends on the quality of underlying industry level data in those sources. Improvement of the KLEMS database and input/output tables by national statistical agencies, international statistical agencies and international research initiatives such World KLEMS (Jorgenson, 2012) and World IO tables (Timmer et al. 2012b) is essential for a better understating of international competitiveness and productivity growth.

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Table 1
Country origins of intermediate inputs, selected countries, averaged over 1995, 2000 and 2007

	Canada	United States	Australia	Japan	European Union	Rest of world
			percent			
Share of intermediate inputs in gross output, averaged over 1995, 2000, 2007	46	45	51	47	48	52
Imported share of intermediate inputs, averaged over 1995, 2005 and 2007	23	9	12	7	10	13
Country origins of intermediate inputs–average country share of total intermediate inputs,1995, 2000, 2007						
Canada	77	2	0	0	0	0
United States	14	91	2	1	2	4
Australia	0	0	88	0	0	0
Japan	1	1	1	93	0	2
European Union	3	2	3	1	90	6
Rest of world	5	5	6	5	8	87
Total	100	100	100	100	100	100
			percentage point			
Changes in country share of intermediate inputs between 1995 and 2007						
Canada	2	0	0	0	0	0
United States	-4	-3	0	0	0	-1
Australia	0	0	-1	0	0	0
Japan	-1	0	0	-6	0	-1
European Union	-1	0	-1	0	-4	0
Rest of world	3	3	3	5	4	2

Source: Statistics Canada; authors' tabulations from world input-output database.

Table 2
Average annual standard and effective multifactor productivity (MFP) growth for final demand products, by country/region, 1995 to 2000 and 2000 to 2007

	Standard MFP growth	Effective MFP growth
	percent	
1995 to 2000		
Canada	0.94	0.86
United States	0.85	0.92
Australia	0.97	0.89
Japan	0.31	0.27
European Union	0.38	0.35
2000 to 2007		
Canada	-0.04	0.23
United States	0.45	0.37
Australia	-0.53	-0.2
Japan	1.34	1.18
European Union	0.35	0.26

Sources: Statistics Canada; authors' tabulation from world input-output tables and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Table 3
Country origins of effective multifactor productivity (EMFP) growth, by type of product, 1995 to 2000 and 2000 to 2007

Type of product and country	1995 to 2000					2000 to 2007				
	Canada	United States	Australia	Japan	European Union	Canada	United States	Australia	Japan	European Union
	percentage points									
EMFP growth in the production of										
Final demand product										
Canada	0.65	0.02	0.00	0.00	0.00	0.08	-0.01	0.00	0.00	0.00
United States	0.19	0.90	0.04	0.02	0.04	0.12	0.36	0.03	0.02	0.03
Australia	0.00	0.00	0.81	0.00	0.00	0.00	0.00	-0.26	-0.01	0.00
Japan	0.01	0.01	0.01	0.24	0.01	0.02	0.01	0.02	1.16	0.01
European Union	0.02	0.00	0.02	0.00	0.31	0.02	0.01	0.02	0.01	0.22
Total	0.86	0.92	0.89	0.27	0.35	0.23	0.37	-0.20	1.18	0.26
Consumption products										
Canada	0.39	0.01	0.00	0.00	0.00	0.09	-0.01	0.00	0.00	0.00
United States	0.12	0.73	0.04	0.01	0.03	0.09	0.43	0.03	0.01	0.03
Australia	0.00	0.00	0.84	0.00	0.00	0.00	0.00	-0.47	-0.01	0.00
Japan	0.01	0.01	0.01	0.10	0.01	0.01	0.01	0.01	1.09	0.01
European Union	0.01	0.00	0.02	0.00	0.33	0.01	0.01	0.01	0.00	0.19
Total	0.53	0.75	0.90	0.13	0.37	0.20	0.43	-0.41	1.09	0.22
Investment products										
Canada	1.47	0.03	0.00	0.00	0.00	0.05	0.00	-0.01	0.00	-0.01
United States	0.41	1.49	0.06	0.04	0.06	0.22	0.01	0.03	0.03	0.04
Australia	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.34	-0.01	0.00
Japan	0.03	0.02	0.02	0.57	0.01	0.04	0.02	0.02	1.38	0.02
European Union	0.03	0.01	0.03	0.01	0.19	0.03	0.01	0.02	0.01	0.32
Total	1.94	1.55	0.82	0.63	0.27	0.33	0.04	0.41	1.41	0.37
Export products										
Canada	1.31	0.03	0.00	0.00	0.00	-0.42	-0.01	-0.01	0.00	0.00
United States	0.33	3.10	0.04	0.07	0.07	0.20	2.05	0.03	0.05	0.05
Australia	0.00	0.00	0.94	0.00	0.00	-0.01	0.00	-1.30	-0.02	0.00
Japan	0.02	0.02	0.01	1.17	0.01	0.03	0.03	0.02	2.43	0.02
European Union	0.02	0.01	0.02	0.01	0.64	0.03	0.02	0.02	0.01	0.72
Total	1.68	3.17	1.02	1.26	0.73	-0.16	2.09	-1.25	2.48	0.78

Sources: Statistics Canada; authors' tabulations from world input-output tables and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Table 4
Country and industry origins of effective multifactor productivity growth, 1995 to 2000

	Within country		Outside country		Total
	Within industry	Outside industry	Within industry	Outside industry	
	percentage points				
Canada					
Goods	1.23	0.19	0.33	0.07	1.82
Services	0.08	0.08	0.02	0.08	0.26
All	0.52	0.12	0.14	0.08	0.86
United States					
Goods	1.12	0.38	0.07	0.00	1.57
Services	0.55	0.11	0.00	0.02	0.68
All	0.71	0.19	0.02	0.01	0.92
Australia					
Goods	0.38	0.38	0.09	0.01	0.86
Services	0.82	0.02	0.01	0.05	0.90
All	0.66	0.15	0.04	0.04	0.89
Japan					
Goods	0.41	0.12	0.05	0.01	0.59
Services	0.03	0.04	0.00	0.01	0.08
All	0.18	0.07	0.02	0.01	0.27
European Union					
Goods	0.49	0.03	0.06	0.02	0.60
Services	0.10	0.07	0.00	0.02	0.20
All	0.25	0.05	0.03	0.02	0.35

Sources: Statistics Canada, authors' tabulations from world input-output tables and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Table 5
Country and industry origins of effective multifactor productivity growth, 2000 to 2007

	Within country		Outside country		Total
	Within industry	Outside industry	Within industry	Outside industry	
	percentage points				
Canada					
Goods	-0.22	0.15	0.22	0.05	0.21
Services	0.20	-0.03	0.02	0.06	0.25
All	0.04	0.04	0.10	0.06	0.23
United States					
Goods	0.10	0.22	0.02	0.01	0.35
Services	0.34	0.04	0.00	0.01	0.38
All	0.27	0.09	0.01	0.01	0.37
Australia					
Goods	0.03	-0.07	0.06	0.02	0.03
Services	-0.31	-0.06	0.01	0.04	-0.32
All	-0.20	-0.06	0.03	0.03	-0.20
Japan					
Goods	1.15	0.25	0.02	0.01	1.42
Services	0.94	0.10	0.00	0.00	1.04
All	1.01	0.15	0.01	0.00	1.18
European Union					
Goods	0.45	0.05	0.04	0.01	0.56
Services	0.01	0.05	0.01	0.02	0.08
All	0.17	0.05	0.02	0.02	0.26

Sources: Statistics Canada; authors' tabulations from world input-output tables and European Union -KLEMS (Capital, Labour, Energy, Materials and Services).

Table 6
Country origin of multifactor productivity growth, by industry, Canada, 1995 to 2000

World input-output database (WIOD), industry name and code	MFP	EMFP	Country contribution to EMFP				
			Canada	United States	Australia	Japan	European Union
	percent						
Agriculture, hunting, forestry and fishing (AtB)	1.5	2.3	2.2	0.1	0.0	0.0	0.0
Mining and quarrying (C)	-1.6	-1.4	-1.5	0.1	0.0	0.0	0.0
Food products, beverages and tobacco (15t16)	0.2	1.2	1.0	0.1	0.0	0.0	0.0
Textiles, textile products, leather and footwear (17t19)	1.1	1.8	1.6	0.2	0.0	0.0	0.0
Wood and products of wood and cork (20)	1.5	2.8	2.6	0.1	0.0	0.0	0.0
Pulp, paper, paper products, printing and publishing (21t22)	1.2	1.9	1.8	0.1	0.0	0.0	0.0
Coke, refined petroleum products and nuclear fuel (23)	0.1	-0.2	-0.2	0.0	0.0	0.0	0.0
Chemical and chemical products (24)	1.4	1.8	1.8	0.0	0.0	0.0	0.0
Rubber and plastic products (25)	1.3	1.9	1.8	0.1	0.0	0.0	0.0
Other non-metallic mineral products (26)	1.8	2.3	2.2	0.1	0.0	0.0	0.0
Basic metals and fabricated metal products (27t28)	1.3	2.1	1.9	0.2	0.0	0.0	0.0
Machinery, nec (29)	1.0	2.1	1.5	0.5	0.0	0.0	0.0
Electrical and optical equipment (30t33)	2.8	4.8	3.2	1.4	0.0	0.1	0.1
Transport equipment (34t35)	0.9	2.0	1.4	0.5	0.0	0.0	0.0
Manufacturing nec, recycling (36t37)	2.7	3.6	3.3	0.2	0.0	0.0	0.0
Electricity, gas and water supply (E)	0.3	0.4	0.4	0.0	0.0	0.0	0.0
Construction (F)	0.9	1.6	1.3	0.3	0.0	0.0	0.0
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	1.4	2.0	1.7	0.3	0.0	0.0	0.0
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	2.0	2.1	2.1	0.0	0.0	0.0	0.0
Hotels and restaurants (H)	0.5	0.8	0.8	0.1	0.0	0.0	0.0
Transport and storage (60t63)	-0.1	0.1	0.0	0.1	0.0	0.0	0.0
Post and telecommunications (64)	0.8	1.0	0.9	0.0	0.0	0.0	0.0
Financial intermediation (J)	-1.4	-1.3	-1.4	0.1	0.0	0.0	0.0
Real estate activities (70)	0.1	0.2	0.2	0.0	0.0	0.0	0.0
Renting of machinery and equipment and other business activities (71t74)	0.5	0.8	0.8	0.1	0.0	0.0	0.0
Public admin and defence, compulsory social security (L)	0.2	0.5	0.4	0.1	0.0	0.0	0.0
Education (M)	-0.5	-0.4	-0.4	0.0	0.0	0.0	0.0
Health and social work (N)	-0.4	-0.1	-0.3	0.2	0.0	0.0	0.0
Other community, social and personal services (O)	-0.5	-0.2	-0.4	0.1	0.0	0.0	0.0
Private households with employed persons (P)	6.2	6.2	6.2	0.0	0.0	0.0	0.0

Table 7
Country origin of multifactor productivity growth, by industry, Canada, 2000 to 2007

World input-output database (WIOD), industry name and code			Country contribution to EMFP				
	MFP	EMFP	Canada	United States	Australia	Japan	European Union
	percent						
Agriculture, hunting, forestry and fishing (AtB)	0.8	1.2	1.1	0.1	0.0	0.0	0.0
Mining and quarrying (C)	-3.3	-3.3	-3.4	0.0	0.0	0.0	0.0
Food products, beverages and tobacco (15t16)	0.0	0.5	0.4	0.1	0.0	0.0	0.0
Textiles, textile products, leather and footwear (17t19)	-0.9	-0.6	-0.8	0.2	0.0	0.0	0.0
Wood and products of wood and cork (20)	1.3	2.0	1.9	0.1	0.0	0.0	0.0
Pulp, paper, paper products, printing and publishing (21t22)	0.2	0.6	0.5	0.1	0.0	0.0	0.0
Coke, refined petroleum products and nuclear fuel (23)	-0.6	-2.0	-2.0	0.0	0.0	0.0	0.0
Chemical and chemical products (24)	0.0	0.1	-0.1	0.1	0.0	0.0	0.0
Rubber and plastic products (25)	0.0	0.3	0.1	0.1	0.0	0.0	0.0
Other non-metallic mineral products (26)	0.7	0.7	0.7	0.0	0.0	0.0	0.0
Basic metals and fabricated metal products (27t28)	0.4	0.4	0.5	-0.1	0.0	0.0	0.0
Machinery, nec (29)	0.3	0.9	0.5	0.3	0.0	0.0	0.0
Electrical and optical equipment (30t33)	-1.5	-0.6	-1.4	0.6	0.0	0.1	0.1
Transport equipment (34t35)	-0.1	0.7	0.0	0.5	0.0	0.1	0.1
Manufacturing nec, recycling (36t37)	-0.3	0.2	0.0	0.2	0.0	0.0	0.0
Electricity, gas and water supply (E)	0.6	0.4	0.4	0.0	0.0	0.0	0.0
Construction (F)	0.0	0.2	0.1	0.1	0.0	0.0	0.0
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	1.9	2.0	2.0	0.0	0.0	0.0	0.0
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	1.3	1.6	1.4	0.2	0.0	0.0	0.0
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	0.9	1.0	1.0	0.0	0.0	0.0	0.0
Hotels and restaurants (H)	-0.1	0.1	0.1	0.0	0.0	0.0	0.0
Transport and storage (60t63)	0.1	0.1	0.0	0.1	0.0	0.0	0.0
Post and telecommunications (64)	2.4	2.5	2.5	0.0	0.0	0.0	0.0
Financial intermediation (J)	0.1	0.3	0.2	0.0	0.0	0.0	0.0
Real estate activities (70)	-0.3	-0.2	-0.2	0.0	0.0	0.0	0.0
Renting of machinery and equipment and other business activities (71t74)	-0.2	0.1	0.0	0.1	0.0	0.0	0.0
Public admin and defence, compulsory social security (L)	0.1	0.2	0.1	0.1	0.0	0.0	0.0
Education (M)	0.2	0.3	0.2	0.0	0.0	0.0	0.0
Health and social work (N)	-0.6	-0.3	-0.5	0.1	0.0	0.0	0.0
Other community, social and personal services (O)	-0.3	-0.1	-0.2	0.1	0.0	0.0	0.0
Private households with employed persons (P)	-0.3	-0.3	-0.3	0.0	0.0	0.0	0.0

Table 8
Country origin of multifactor productivity growth, by industry, United States, 1995 to 2000

World input-output database (WIOD), industry name and code			Country contribution to EMFP				
	MFP	EMFP	Canada	United States	Australia	Japan	European Union
			percent				
Agriculture, hunting, forestry and fishing (AtB)	1.8	2.7	0.0	2.7	0.0	0.0	0.0
Mining and quarrying (C)	-2.0	-1.9	0.0	-1.9	0.0	0.0	0.0
Food products, beverages and tobacco (15t16)	-0.7	0.4	0.0	0.3	0.0	0.0	0.0
Textiles, textile products, leather and footwear (17t19)	0.9	1.9	0.0	1.8	0.0	0.0	0.0
Wood and products of wood and cork (20)	-0.1	1.0	0.1	0.9	0.0	0.0	0.0
Pulp, paper, paper products, printing and publishing (21t22)	-0.3	0.3	0.0	0.2	0.0	0.0	0.0
Coke, refined petroleum products and nuclear fuel (23)	0.0	-0.5	0.0	-0.4	0.0	0.0	0.0
Chemical and chemical products (24)	-0.9	-0.4	0.0	-0.5	0.0	0.0	0.0
Rubber and plastic products (25)	1.0	1.7	0.0	1.6	0.0	0.0	0.0
Other non-metallic mineral products (26)	0.4	0.8	0.0	0.8	0.0	0.0	0.0
Basic metals and fabricated metal products (27t28)	0.7	1.7	0.0	1.6	0.0	0.0	0.0
Machinery, nec (29)	-0.8	0.6	0.0	0.5	0.0	0.0	0.0
Electrical and optical equipment (30t33)	9.2	11.5	0.0	11.4	0.0	0.1	0.0
Transport equipment (34t35)	0.1	1.6	0.1	1.5	0.0	0.0	0.0
Manufacturing nec, recycling (36t37)	2.4	3.4	0.1	3.3	0.0	0.0	0.0
Electricity, gas and water supply (E)	0.1	-0.1	0.0	-0.1	0.0	0.0	0.0
Construction (F)	-0.8	0.0	0.0	0.0	0.0	0.0	0.0
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	0.8	1.4	0.0	1.4	0.0	0.0	0.0
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	5.0	5.2	0.0	5.2	0.0	0.0	0.0
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	3.1	3.3	0.0	3.3	0.0	0.0	0.0
Hotels and restaurants (H)	0.4	0.8	0.0	0.8	0.0	0.0	0.0
Transport and storage (60t63)	0.1	0.3	0.0	0.3	0.0	0.0	0.0
Post and telecommunications (64)	-0.7	-0.5	0.0	-0.5	0.0	0.0	0.0
Financial intermediation (J)	1.2	1.6	0.0	1.6	0.0	0.0	0.0
Real estate activities (70)	0.1	0.2	0.0	0.2	0.0	0.0	0.0
Renting of machinery and equipment and other business activities (71t74)	-0.9	-0.8	0.0	-0.8	0.0	0.0	0.0
Public admin and defence, compulsory social security (L)	-0.4	-0.1	0.0	-0.1	0.0	0.0	0.0
Education (M)	-0.8	-0.6	0.0	-0.6	0.0	0.0	0.0
Health and social work (N)	-1.1	-0.7	0.0	-0.7	0.0	0.0	0.0
Other community, social and personal services (O)	-0.6	-0.5	0.0	-0.5	0.0	0.0	0.0
Private households with employed persons (P)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 9

Country origin of multifactor productivity growth, by industry, United States, 2000 to 2007

World input-output database (WIOD), industry name and code	Country contribution to EMFP						
	MFP	EMFP	Canada	United States	Australia	Japan	European Union
	percent						
Agriculture, hunting, forestry and fishing (AtB)	0.6	1.0	0.0	1.0	0.0	0.0	0.0
Mining and quarrying (C)	-2.3	-2.3	0.0	-2.3	0.0	0.0	0.0
Food products, beverages and tobacco (15t16)	-0.6	-0.2	0.0	-0.2	0.0	0.0	0.0
Textiles, textile products, leather and footwear (17t19)	1.3	2.1	0.0	2.0	0.0	0.0	0.0
Wood and products of wood and cork (20)	0.7	1.4	0.0	1.3	0.0	0.0	0.0
Pulp, paper, paper products, printing and publishing (21t22)	0.1	0.6	0.0	0.5	0.0	0.0	0.0
Coke, refined petroleum products and nuclear fuel (23)	0.1	-0.7	-0.2	-0.6	0.0	0.0	0.0
Chemical and chemical products (24)	0.4	0.7	0.0	0.7	0.0	0.0	0.0
Rubber and plastic products (25)	0.1	0.6	0.0	0.6	0.0	0.0	0.0
Other non-metallic mineral products (26)	-0.5	-0.4	0.0	-0.4	0.0	0.0	0.0
Basic metals and fabricated metal products (27t28)	-0.8	-0.7	0.0	-0.7	0.0	0.0	0.0
Machinery, nec (29)	1.1	1.7	0.0	1.6	0.0	0.0	0.0
Electrical and optical equipment (30t33)	6.7	7.8	0.0	7.7	0.0	0.1	0.0
Transport equipment (34t35)	1.1	2.0	0.0	1.9	0.0	0.1	0.0
Manufacturing nec, recycling (36t37)	1.9	2.4	0.0	2.3	0.0	0.0	0.0
Electricity, gas and water supply (E)	0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0
Construction (F)	-2.5	-2.2	0.0	-2.2	0.0	0.0	0.0
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	-0.8	-0.4	0.0	-0.5	0.0	0.0	0.0
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	1.4	1.6	0.0	1.6	0.0	0.0	0.0
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	0.6	0.8	0.0	0.8	0.0	0.0	0.0
Hotels and restaurants (H)	0.4	0.6	0.0	0.6	0.0	0.0	0.0
Transport and storage (60t63)	0.9	1.2	0.0	1.2	0.0	0.0	0.0
Post and telecommunications (64)	2.8	3.3	0.0	3.3	0.0	0.0	0.0
Financial intermediation (J)	0.0	0.2	0.0	0.2	0.0	0.0	0.0
Real estate activities (70)	0.6	0.6	0.0	0.6	0.0	0.0	0.0
Renting of machinery and equipment and other business activities (71t74)	0.1	0.4	0.0	0.3	0.0	0.0	0.0
Public admin and defence, compulsory social security (L)	-0.2	0.0	0.0	0.0	0.0	0.0	0.0
Education (M)	-1.0	-0.8	0.0	-0.8	0.0	0.0	0.0
Health and social work (N)	-0.3	0.0	0.0	0.0	0.0	0.0	0.0
Other community, social and personal services (O)	-0.7	-0.5	0.0	-0.5	0.0	0.0	0.0
Private households with employed persons (P)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 10
Explanation of changes in output prices by standard versus effective productivity growth measures

	Canada	United States	Australia	Japan	European Union
Estimation of equation 16					
Coefficient–alpha 1	-0.78 *	-1.20 *	-1.20 *	-1.25 *	-0.90 *
R-Square	0.17	0.66	0.31	0.43	0.26
t-Statistics	-3.49	-9.78	-3.67	-6.38	-4.11
Number of observations	62	60	60	60	60
Estimation of equation 17					
Coefficient–beta 1	-0.95 *	-1.13 *	-1.21 *	-1.09 *	-0.77 *
R-Square	0.32	0.74	0.33	0.46	0.25
t-Statistics	-5.29	-12.31	-4.07	-6.77	-4.07
Number of observations	62	62	62	60	62

*.. $p < 0.05$
Sources: World Input-Output Database and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Figure 1
Schematic Outline of World Input-Output Table, three regions

	Country A Intermediate Industry	**Country B Intermediate Industry**	**RoW C Intermediate Industry**	**Country A Final Domestic**	**Country B Final Domestic**	**RoW C Final Domestic**	**Total**
Country A Industry	Intermediate use of domestic output	Intermediate use by B of exports from A	Intermediate use by C of exports from A	Final use of domestic output	Final use by B of exports from A	Final use by C of exports from A	Output in A
Country B Industry	Intermediate use by A of exports from B	Intermediate use of domestic output	Intermediate use by C of exports from B	Final use by A of exports from B	Final use of domestic output	Final use by C of exports from B	Output in B
RoW C Industry	Intermediate use by A of exports from Row	Intermediate use by B of exports from RoW	Intermediate use of domestic output	Final use by A of exports from Row	Intermediate use by B of exports from RoW	Final use of domestic output	Output in RoW
	Value added	Value added	Value added				
	Output in A	Output in B	Output in RoW				

Source: Adapted from Timmer et al. (2012b).

Appendix Table 11

Average annual growth in standard and effective multifactor productivity (MFP) growth for final demand products, assuming MFP for rest of world equals that of United States, by country, 1995 to 2000 and 2000 to 2007

	Standard MFP growth	Effective MFP growth
	percent	
1995 to 2000		
Canada	0.94	0.96
United States	0.85	1.01
Australia	0.97	0.98
Japan	0.31	0.31
European Union	0.38	0.44
2000 to 2007		
Canada	-0.04	0.34
United States	0.45	0.47
Australia	-0.53	-0.09
Japan	1.34	1.23
European Union	0.35	0.37

Sources: Statistics Canada; authors' tabulations from world input-output tables and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Appendix Table 12

Effective multifactor productivity (EMFP) growth and expenditure shares, by industry, Canada, 1995 to 2000

World input-output database (WIOD), industry name and code	EMFP growth	Share of imported intermediates in gross output	Expenditure share by industry			
			Total final demand	Consumption	Investment	Export
			percent			
Agriculture, hunting, forestry and fishing (AtB)	2.30	0.06	0.01	0.01	0.00	0.03
Mining and quarrying (C)	-1.37	0.04	0.01	0.01	0.00	0.10
Food products, beverages and tobacco (15t16)	1.19	0.06	0.05	0.07	0.00	0.04
Textiles, textile products, leather and footwear (17t19)	1.82	0.14	0.01	0.01	0.00	0.02
Wood and products of wood and cork (20)	2.79	0.04	0.00	0.00	0.00	0.04
Pulp, paper, paper products, printing and publishing (21t22)	1.90	0.08	0.01	0.01	0.01	0.08
Coke, refined petroleum products and nuclear fuel (23)	-0.17	0.23	0.01	0.01	0.00	0.02
Chemical and chemical products (24)	1.84	0.12	0.01	0.01	0.00	0.05
Rubber and plastic products (25)	1.94	0.15	0.01	0.00	0.01	0.03
Other non-metallic mineral products (26)	2.34	0.10	0.00	0.00	0.00	0.01
Basic metals and fabricated metal products (27t28)	2.08	0.15	0.01	0.00	0.02	0.08
Machinery, nec (29)	2.11	0.15	0.01	0.00	0.04	0.03
Electrical and optical equipment (30t33)	4.78	0.25	0.02	0.00	0.08	0.08
Transport equipment (34t35)	1.97	0.26	0.09	0.04	0.24	0.24
Manufacturing nec, recycling (36t37)	3.56	0.13	0.01	0.01	0.01	0.03
Electricity, gas and water supply (E)	0.40	0.03	0.02	0.02	0.00	0.01
Construction (F)	1.60	0.11	0.10	0.00	0.47	0.00
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	0.18	0.02	0.00	0.00	0.00	0.00
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	2.05	0.10	0.02	0.02	0.02	0.00
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	2.14	0.03	0.04	0.04	0.02	0.01
Hotels and restaurants (H)	0.84	0.03	0.04	0.05	0.00	0.02
Transport and storage (60t63)	0.10	0.05	0.03	0.04	0.01	0.03
Post and telecommunications (64)	0.99	0.02	0.01	0.02	0.00	0.00
Financial intermediation (J)	-1.30	0.03	0.07	0.09	0.01	0.01
Real estate activities (70)	0.21	0.01	0.10	0.13	0.01	0.01
Renting of machinery and equipment and other business activities (71t74)	0.84	0.03	0.01	0.01	0.02	0.03
Public admin and defence, compulsory social security (L)	0.49	0.04	0.14	0.18	0.00	0.00
Education (M)	-0.36	0.01	0.06	0.08	0.00	0.00
Health and social work (N)	-0.07	0.03	0.05	0.07	0.00	0.00
Other community, social and personal services (O)	-0.19	0.07	0.04	0.05	0.00	0.01
Private households with employed persons (P)	6.23	0.00	0.00	0.00	0.00	0.00

Sources: Statistics Canada; authors' tabulations from WIOD and European Union-KLEMS (Capital, Labour, Energy, Materials and Services).

Appendix Table 13
Effective multifactor productivity (EMFP) growth and expenditure shares, by industry, Canada, 2000 to 2007

World input-output database (WIOD), industry name and code	EMFP growth	Share of imported intermediates in gross output	Expenditure share by industry			
			Total final demand	Consumption	Investment	Export
			percent			
Agriculture, hunting, forestry and fishing (AtB)	1.21	0.07	0.01	0.01	0.00	0.03
Mining and quarrying (C)	-3.30	0.03	0.01	0.01	0.00	0.14
Food products, beverages and tobacco (15t16)	0.49	0.07	0.05	0.06	0.00	0.04
Textiles, textile products, leather and footwear (17t19)	-0.60	0.17	0.01	0.01	0.00	0.02
Wood and products of wood and cork (20)	2.00	0.05	0.00	0.00	0.00	0.03
Pulp, paper, paper products, printing and publishing (21t22)	0.60	0.09	0.01	0.01	0.01	0.05
Coke, refined petroleum products and nuclear fuel (23)	-2.00	0.21	0.01	0.02	0.00	0.03
Chemical and chemical products (24)	0.10	0.16	0.01	0.01	0.00	0.05
Rubber and plastic products (25)	0.32	0.18	0.01	0.00	0.01	0.03
Other non-metallic mineral products (26)	0.69	0.09	0.00	0.00	0.00	0.01
Basic metals and fabricated metal products (27t28)	0.39	0.21	0.01	0.00	0.02	0.09
Machinery, nec (29)	0.85	0.17	0.01	0.00	0.04	0.04
Electrical and optical equipment (30t33)	-0.61	0.24	0.02	0.00	0.07	0.07
Transport equipment (34t35)	0.71	0.31	0.08	0.04	0.19	0.21
Manufacturing nec, recycling (36t37)	0.16	0.14	0.01	0.01	0.01	0.03
Electricity, gas and water supply (E)	0.45	0.04	0.01	0.02	0.00	0.01
Construction (F)	0.23	0.11	0.12	0.00	0.51	0.00
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	2.00	0.02	0.00	0.00	0.00	0.00
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	1.64	0.10	0.03	0.02	0.03	0.00
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	0.99	0.03	0.04	0.05	0.02	0.01
Hotels and restaurants (H)	0.13	0.04	0.04	0.05	0.00	0.02
Transport and storage (60t63)	0.12	0.05	0.03	0.03	0.01	0.03
Post and telecommunications (64)	2.53	0.02	0.01	0.02	0.00	0.00
Financial intermediation (J)	0.27	0.03	0.07	0.09	0.02	0.01
Real estate activities (70)	-0.22	0.01	0.09	0.12	0.02	0.01
Renting of machinery and equipment and other business activities (71t74)	0.09	0.03	0.02	0.01	0.03	0.03
Public admin and defence, compulsory social security (L)	0.24	0.04	0.13	0.17	0.00	0.00
Education (M)	0.26	0.01	0.06	0.07	0.00	0.00
Health and social work (N)	-0.30	0.04	0.05	0.07	0.00	0.00
Other community, social and personal services (O)	-0.08	0.09	0.05	0.06	0.00	0.01
Private households with employed persons (P)	-0.27	0.00	0.00	0.00	0.00	0.00

Appendix Table 14

Effective multifactor productivity (EMFP) growth and expenditure shares by industry, United States, 1995 to 2000

World input-output database (WIOD), industry name and code	EMFP growth	Share of imported intermediates in gross output	Expenditure share by industry			
			Total final demand	Consumption	Investment	Export
			percent			
Agriculture, hunting, forestry and fishing (AtB)	2.73	0.03	0.00	0.01	0.00	0.03
Mining and quarrying (C)	-1.86	0.04	0.00	0.00	0.01	0.01
Food products, beverages and tobacco (15t16)	0.36	0.05	0.04	0.04	0.00	0.04
Textiles, textile products, leather and footwear (17t19)	1.90	0.06	0.01	0.01	0.00	0.02
Wood and products of wood and cork (20)	1.04	0.04	0.00	0.00	0.01	0.01
Pulp, paper, paper products, printing and publishing (21t22)	0.26	0.05	0.01	0.01	0.02	0.03
Coke, refined petroleum products and nuclear fuel (23)	-0.47	0.27	0.01	0.01	0.00	0.01
Chemical and chemical products (24)	-0.44	0.07	0.01	0.01	0.00	0.07
Rubber and plastic products (25)	1.69	0.07	0.00	0.00	0.00	0.02
Other non-metallic mineral products (26)	0.84	0.05	0.00	0.00	0.00	0.01
Basic metals and fabricated metal products (27t28)	1.68	0.08	0.00	0.00	0.01	0.04
Machinery, nec (29)	0.61	0.09	0.02	0.00	0.08	0.08
Electrical and optical equipment (30t33)	11.54	0.11	0.03	0.01	0.09	0.18
Transport equipment (34t35)	1.59	0.10	0.03	0.02	0.10	0.12
Manufacturing nec, recycling (36t37)	3.39	0.07	0.01	0.01	0.02	0.02
Electricity, gas and water supply (E)	-0.06	0.06	0.01	0.02	0.00	0.00
Construction (F)	0.03	0.05	0.08	0.00	0.45	0.00
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	1.45	0.04	0.01	0.02	0.00	0.00
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	5.22	0.01	0.04	0.03	0.05	0.10
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	3.31	0.02	0.08	0.10	0.02	0.00
Hotels and restaurants (H)	0.80	0.02	0.04	0.05	0.00	0.00
Transport and storage (60t63)	0.26	0.02	0.02	0.02	0.01	0.07
Post and telecommunications (64)	-0.48	0.02	0.02	0.02	0.00	0.01
Financial intermediation (J)	1.58	0.01	0.06	0.07	0.00	0.06
Real estate activities (70)	0.19	0.01	0.11	0.12	0.03	0.00
Renting of machinery and equipment and other business activities (71t74)	-0.76	0.02	0.03	0.02	0.09	0.06
Public admin and defence, compulsory social security (L)	-0.10	0.06	0.17	0.22	0.00	0.01
Education (M)	-0.60	0.00	0.01	0.01	0.00	0.00
Health and social work (N)	-0.72	0.01	0.10	0.12	0.00	0.00
Other community, social and personal services (O)	-0.46	0.01	0.04	0.05	0.00	0.01
Private households with employed persons (P)	0.00	0.00	0.00	0.00	0.00	0.00

Appendix Table 15

Effective multifactor productivity (EMFP) growth and expenditure shares, by industry, United States, 2000 to 2007

World input-output database (WIOD), industry name and code	EMFP growth	Share of imported intermediates in gross output	Expenditure share by industry			
			Total final demand	Consumption	Investment	Export
			percent			
Agriculture, hunting, forestry and fishing (AtB)	0.97	0.04	0.00	0.01	0.00	0.02
Mining and quarrying (C)	-2.28	0.06	0.01	0.00	0.03	0.01
Food products, beverages and tobacco (15t16)	-0.15	0.05	0.03	0.04	0.00	0.03
Textiles, textile products, leather and footwear (17t19)	2.05	0.07	0.00	0.00	0.00	0.01
Wood and products of wood and cork (20)	1.41	0.04	0.00	0.00	0.00	0.00
Pulp, paper, paper products, printing and publishing (21t22)	0.57	0.06	0.01	0.01	0.02	0.03
Coke, refined petroleum products and nuclear fuel (23)	-0.72	0.32	0.01	0.01	0.00	0.02
Chemical and chemical products (24)	0.75	0.09	0.01	0.01	0.00	0.07
Rubber and plastic products (25)	0.62	0.09	0.00	0.00	0.00	0.02
Other non-metallic mineral products (26)	-0.36	0.05	0.00	0.00	0.00	0.01
Basic metals and fabricated metal products (27t28)	-0.70	0.10	0.00	0.00	0.01	0.04
Machinery, nec (29)	1.70	0.11	0.02	0.00	0.07	0.08
Electrical and optical equipment (30t33)	7.77	0.12	0.02	0.01	0.07	0.16
Transport equipment (34t35)	2.00	0.13	0.03	0.02	0.09	0.13
Manufacturing nec, recycling (36t37)	2.36	0.08	0.01	0.00	0.02	0.02
Electricity, gas and water supply (E)	-0.14	0.11	0.01	0.02	0.00	0.00
Construction (F)	-2.15	0.06	0.09	0.00	0.45	0.00
Sales, maintenance and repair of motor vehicles and motorcycles, retail sale of fuel (50)	-0.42	0.04	0.01	0.02	0.00	0.00
Wholesale trade and commission trade, except of motor vehicles and motorcycles (51)	1.58	0.02	0.04	0.03	0.05	0.10
Retail trade, except of motor vehicles and motorcycles, repair of household goods (52)	0.76	0.02	0.08	0.09	0.02	0.00
Hotels and restaurants (H)	0.58	0.03	0.04	0.05	0.00	0.00
Transport and storage (60t63)	1.18	0.03	0.02	0.02	0.01	0.07
Post and telecommunications (64)	3.29	0.02	0.02	0.02	0.00	0.01
Financial intermediation (J)	0.23	0.02	0.06	0.07	0.00	0.07
Real estate activities (70)	0.63	0.01	0.11	0.12	0.03	0.00
Renting of machinery and equipment and other business activities (71t74)	0.35	0.02	0.04	0.02	0.11	0.07
Public admin and defence, compulsory social security (L)	-0.03	0.08	0.17	0.21	0.00	0.01
Education (M)	-0.80	0.00	0.01	0.01	0.00	0.00
Health and social work (N)	0.03	0.01	0.10	0.12	0.00	0.00
Other community, social and personal services (O)	-0.52	0.02	0.04	0.05	0.00	0.01
Private households with employed persons (P)	0.00	0.00	0.00	0.00	0.00	0.00