Measuring the Canada-U.S. Productivity Gap: Industry Dimensions

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CANADA IS ONE OF THE RICHEST ECONOMIES in the world. According to the 2004 United Nations Human Development Index, Canada ranks fourth among all countries in terms of quality of life (UNDP, 2004). The rich endowment of natural resources, the large investments in physical and knowledge infrastructure, physical and human capital and innovation, outward orientation of the Canadian economy and the sound micro- and macro-economic policies have all contributed to Canada's prosperity and high quality of life.

In addition to the high levels of standard of living and quality of life, the Canadian economy has performed extremely well since 1995. Between 1995 and 2003, real per capita income in Canada increased at an average annual rate of 2.5 per cent, compared to only 0.6 per cent per year in the first five years of the 1990s, one of the best performances among OECD countries. Strong growth in employment and labour productivity contributed equally to the strong growth in real income. Moreover, Canada's progress on the inflation and fiscal fronts has been exceptional. Similarly, Canada's performance on the trade front has been excellent. Canada has enjoyed considerable surpluses in its trade and current accounts.

However, Canada's labour productivity growth has generally lagged that in the United States since 1995, especially in the last three years. During 2000-2003, output per hour in the Canadian business sector increased at only 1.3 per cent per year, compared to 2.2 per cent in the second half of the 1990s. In three of the four major sectors — primary, construction and manufacturing — labour productivity growth declined between the 1995-2000 and 2000-2003 periods, although the service sector productity growth rate increased somewhat. On the other hand, labour productivity growth in the U.S. business sector actually accelerated significantly, averaging 2.7 per cent per year in 1995-2000 and 3.8 per cent per year in 2000-2003. Consequently, the Canada-U.S. labour productivity gap has widened significantly. In 2003, Canada's labour productivity level for the business sector was about 23 per cent below the U.S. level.

Labour productivity growth in the Canadian manufacturing sector, the battleground of fierce international competition, has been considerably lower than in the United States since 1995. The recent large appreciation of the Canadian dollar vis-à-vis the U.S. currency has eroded sig-

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nificantly the cost position of Canadian exporters in general, and manufacturers in particular.

Canada has actively participated in the globalization process. Exports of goods and services account for over 40 per cent of Canada's GDP and their importance is growing. Similarly, the importance of imports is also growing. Canada is both a major exporter and importer of capital. Its inward and outward foreign direct investment (FDI) orientations are the second highest among G7 countries, after the United Kingdom, and are increasing. Canada has been a net exporter of direct investment since 1996 and the gap between the inward and outward FDI stocks is widening.

Factors of production, including human capital, are footloose. This means that a small open economy like Canada needs to be highly competitive vis-à-vis its trading partners, especially the United States, our largest trading partner and one of the most innovative and dynamic economies in the world. Otherwise, Canada will not be able to retain and attract physical and human capital and innovation activities, creating a vicious cycle of low productivity and real income growth, weak investment in physical and human capital and innovation, and the widening of the Canada-U.S. productivity and real income level gaps.

In this context, a detailed industry analysis of Canada-U.S. productivity levels and their time profile is crucial for four main reasons:

- First, future productivity growth prospects partly depend upon the current gap with the productivity leader, the United States. The higher the level gap, the larger the scope for a faster productivity growth in Canada due to catch-up, and vice versa.
- Second, the cost competitive position of each Canadian industry, other things being equal, depends on the productivity gap. Cost competitiveness and the productivity gap are expected to be negatively related.
- Third, Canada's ability to offer competitive rewards to factors of production depends on the labour and total factor productivity gaps. The higher the gap, the lower will be Canada's capacity to compete effectively with other countries for factors of production, and vice versa.
- Finally, Canada-U.S. productivity level differences help shed light on Canada's long-term comparative advantage position. The industries in which Canada's productivity levels are consistently above the U.S. levels, other things being equal, are expected to have a comparative advantage vis-à-vis their U.S counterparts, and vice versa.

The objective of this article is to develop estimates of Canada-U.S. labour productivity and multifactor productivity (MFP) gaps for 31 industries. Using benchmark estimates for Canada-U.S. bilateral expenditure purchasing power parities (PPPs) for 1999, we develop PPPs for gross output, intermediate inputs, value added, and investment by industry. These in turn are used to estimate the benchmark (1999) estimates for the labour productivity, capital intensity and multifactor productivity (MFP) gaps for all the industries. Using the benchmark estimates of the productivity gaps and the productivity growth rates in the two countries, we develop time series for the two productivity gaps for each industry for the period 1997-2001.

According to our estimates, labour productivity in the Canadian business sector was 18 per cent below the U.S. level in 1999 and the gap has widened significantly since 2000. With the exception of construction, Canada's labour productivity levels are considerably lower in three other major sectors: primary, manufacturing and services. However, within the manufacturing sector, Canada enjoys a significant productivity advantage in many resource-based and transportation equipment industries. On the other hand, the productivity gap is quite large in the machinery and computer industry and in the electronics

and electrical equipment industry. Nevertheless, in 2001, service industries accounted for over three quarters of the Canada-U.S. business sector labour productivity gap. The industry contributions to the MFP gap are similar to those to the labour productivity gap. The capital intensity gap's contribution to the business sector labour productivity gap increased from 20 per cent in 1997 to 30 per cent in 2001, while it accounted for 50 per cent of the manufacturing sector labour productivity gap in 2001.

We organize the article in the following way. In the first section, we discuss various difficulties in estimating Purchasing Power Parity (PPP) and productivity gaps at the industry level. We also discuss data sources and the PPP estimates in this section. We present labour productivity levels in the second section, together with the capital intensity and the MFP gaps. In addition, we examine the contributions of each industry to the aggregate business sector labour productivity and MFP gaps, as well as the contribution of capital intensity to the labour productivity gap in each major industry. In the last section, we summarize the main findings of our study and examine their implications for policy and future research.

Conceptual and Measurement Issues

General Issues

Estimates of productivity growth rates and productivity levels by industry are fraught with many conceptual and measurement difficulties. In addition, inter-firm, inter-industry, inter-regional and inter-temporal comparisons are challenging. More importantly, international comparisons are extremely difficult because of data comparability problems and serious conceptual issues. Therefore, productivity comparisons should be interpreted and used with considerable care.

When we talk about productivity, there are two principal categories: partial productivity and multifactor or total factor productivity (MFP). Measures such as labour and capital productivities are partial measures. They are not only influenced by the efficiency with which all factors are combined in the production process but also by the relative use of all other factors of production. On the other hand, MFP is the weighted sum of the productivities of all inputs.

The most comprehensive measure of productivity is MFP, because it measures the efficiency of all inputs. But labour productivity is often used for two main reasons. First, labour productivity is a direct determinant of per capita GDP, a measure of living standards. Second, it is easy to understand, easy to calculate and easy to update. On the other hand, estimates of MFP entail higher data demands and are sometimes more difficult to calculate for the most recent period. In this article we use both measures.

The next issue is the concept of output. At the economy or the business sector level, the most appropriate measure of output is GDP or value added. On the other hand, at the firm or sector level, one could use either gross output or value added. Although the gross output measure might be conceptually more appealing, its use poses two main difficulties. First, inter-firm, inter-industry and international comparisons are more difficult with gross output based productivity, because of large differences in the intensity of use of intermediate inputs. These could be the result of differences in outsourcing (domestic as well as foreign). Second, industry results are not easy to reconcile with the aggregate data because at the economy level intermediate inputs should be netted out, unless they are imported from foreign sources. In this article, to avoid these difficulties, we use value added as the output measure.

Another issue in computing labour productivity is the concept of labour input. One could use either

employment or hours as the labour input. Because of large and growing differences in average hours worked per employed person across firms, industries, countries and time, a labour productivity measure based on persons employed will not necessarily accurately reflect true labour productivity differences and could lead to misleading conclusions. Hence, in this paper we use total hours worked as the labour input. However, we do not adjust for education and experience.

For computing MFP, we also need data on capital input. The concept of capital is more complicated than labour input. The measurement of capital stock and capital services has been the subject of lively and intensive discussion among economists. Depreciation rates and the user cost of capital are the key parameters in computing capital input. Statistics Canada produces different measures of capital stock, with different assumptions about depreciation. In this article, we use the Statistics Canada capital stock measure for Canada that is based on the methodology closest to that used by the U.S. Bureau of Economic Analysis (BEA), because we use BEA capital stock estimates for the United States.

Issues related to International Comparisons

In this article, we focus our analysis on Canada-U.S. comparisons for two key reasons. First, we have reasonably comparable data on outputs and inputs by industry for the two countries. Second, Canada-U.S. comparisons are crucial because the United States is our largest trading partner and the two countries compete vigorously for physical and human capital and innovation activities. We restrict our Canada-U.S. comparisons to the business sector rather than the total economy because competitiveness and comparative advantage are mainly influenced by business sector productivity performance.[2] Moreover, measured labour productivity growth in the non-business sector is expected to be close to zero, because growth in real output is conventionally proxied by the growth in labour input in non-business sector industries.

Despite a fair degree of comparability of industries and data on outputs and inputs between the two countries, productivity growth comparisons by industry should be used cautiously because some of the differences in productivity growth in the two countries might be simply a reflection of differences in product composition.

Canada-U.S. productivity level comparisons are much more difficult than growth comparisons for two main reasons. First, obtaining comparable data on outputs and inputs in levels is a tedious task. If they are not based on comparable concepts in the benchmark year, we could reach misleading conclusions about Canada's productivity record. Second, we need to convert the data on output and capital in the two countries into a common currency. But the market exchange rate is not suitable because it fluctuates a great deal over time and does not necessarily reflect the true purchasing power in the two countries. Instead, we need industry-specific purchasing power parity (PPP) exchange rates. But computing industry-specific PPPs is a complex task. Therefore, reliability of the productivity gap estimates critically depends on the accuracy of the PPPs. We will discuss later on in this section the methodology we use to compute PPPs by industry for gross output, intermediate inputs, value added and two types of investment by industry.

Data Sources

To compute labour productivity and MFP levels by industry in the benchmark year of 1999, we need data on value added in current dollars, total hours, capital stock and input incomes for all 31 industries in the two countries. For Can-

2 The business sector in this study excludes the household sector but includes private health and education services for both countries.

ada, we have obtained nominal GDP data by industry at basic prices from the Statistics Canada GDP by Industry accounts. These are converted to factor cost by "peeling off" net indirect taxes on production. Data on total hours worked are from the Productivity Program of Statistics Canada. The two types of non-residential net capital stock data, based on the geometric (infinite) depreciation scheme, are produced by the Investment and Capital Stock Division of Statistics Canada. Data on labour compensation and capital income (nominal value added at factor cost net of labour compensation) by industry for the two countries are derived from the input-output tables. All Canadian data are based on the North American Industry Classification System (NAICS), but have been reclassified into the 31 industries presented in this article.[3]

Data on U.S. GDP by industry at factor cost and input prices are obtained from the Bureau of Economic Analysis (BEA). Data on total hours worked for the 1997-2000 period are from the Jorgenson productivity data base (see Ho, Rao and Tang, 2004).[4] They are extended to 2001 using the growth rate of full-time equivalent employees from the BEA. Data on non-residential capital stock (two types) are also from the BEA. All the U.S. data are based on the U.S. 1987 Standard Industrial Classification, but have been reclassified into the 31 industries presented in this article.

The data comparability problems between the two countries for nominal GDP by industry, input prices and employment are not very serious. However, there has been a great deal of discussion and disagreement about the comparability of data on average hours worked by each employed person. It is commonly agreed that, on average, American workers work longer hours in a year compared to Canadian workers. Our data confirm this. In 2001, average annual hours worked in the Canadian business sector were about 7 per cent lower than in the United States. This difference in average hours in the two countries underscores the importance of using total hours as the measure of labour input for Canada-U.S. productivity level comparisons. The use of employment would seriously underestimate Canada's productivity levels relative to their U.S. counterparts.

Estimates of Industry PPPs

The basic data on expenditure-based bilateral PPPs in 1999 for 221 basic expenditure categories, aggregated over 2000 commodities, were developed jointly by Statistics Canada and the U.S. Bureau of Labor Statistics (BLS). However, since the expenditure-based PPPs are available only for commodities used for final consumption, we have no PPPs for commodities that are used primarily as intermediate inputs. To fill this data gap, we use the Canada-U.S. market exchange rate as a proxy for the PPP rate for commodities that are traded internationally, such as grains, copper, steel and precious metals. PPPs for other commodities which are used as intermediate inputs in the manufacturing sector, such as chemicals, rubber and plastic products and non-metallic minerals, are proxied by the unit value ratios (UVRs) obtained from van Ark, Inklaar and Timmer (2000).

The expenditure-based commodity PPPs are at purchasers' prices. They are converted into production-based PPPs at producers' prices by adjusting with margins, calculated using the input-output tables of the two countries. These in turn are used to develop PPPs for gross output, intermediate input, and two types of investment

3 Output, hours and capital stock data for Canada can be accessed from CANSIM Tables 379-0023, 383-0010 and 031-0002 respectively.

4 The U.S. hours worked estimates are based on estimates of hours paid from the BEA. For each industry these estimates are scaled to hours worked using information from the Survey of Hours at Work of the U.S. Bureau of Labor Statistics.

Table 1
Industry Canada-U.S. PPPs for Gross Output, Intermediate Input, Value Added, and Investment, 1999

Industry	Gross Output	Intermed. Input	Value Added	Total Investment	M&E	Structures
Primary Industries	**1.43**	**1.34**	**1.56**	**1.23**	**1.38**	**1.03**
Agriculture	1.48	1.38	1.66	1.29	1.37	1.03
Mining	1.36	1.30	1.46	1.22	1.39	1.03
Construction	**1.03**	**1.17**	**0.87**	**1.34**	**1.37**	**1.03**
Manufacturing Industries	**1.37**	**1.36**	**1.40**	**1.40**	**1.49**	**1.03**
Food, beverage and tobacco	1.34	1.33	1.37	1.40	1.50	1.03
Textile and clothing	1.52	1.42	1.70	1.41	1.47	1.03
Wood products	1.49	1.40	1.65	1.39	1.50	1.03
Paper	1.26	1.33	1.14	1.49	1.55	1.03
Printing and publishing	1.13	1.27	0.97	1.33	1.38	1.03
Petroleum and coal products	1.34	1.44	1.25	1.35	1.53	1.03
Chemicals	1.18	1.28	1.03	1.36	1.47	1.03
Plastic and rubber products	1.44	1.26	1.72	1.46	1.52	1.03
Non-metallic mineral products	1.18	1.30	1.05	1.46	1.51	1.03
Primary metal	1.30	1.33	1.20	1.48	1.56	1.03
Fabricated metal	1.67	1.37	2.07	1.48	1.56	1.03
Machinery and computer	1.55	1.42	1.71	1.38	1.46	1.03
Machinery	1.59	1.45	1.75	1.38	1.46	1.03
Computer	1.44	1.31	1.59	1.35	1.41	1.03
Electronic and electrical equip.	1.46	1.33	1.68	1.35	1.41	1.03
Communications equipment	1.47	1.32	1.66	1.35	1.41	1.03
Other electronic equipment	1.44	1.33	1.63	1.35	1.41	1.03
Electrical equipment	1.49	1.33	1.79	1.35	1.41	1.03
Motor vehicles	1.38	1.42	1.28	1.42	1.50	1.03
Other transportation equipment	1.37	1.40	1.33	1.42	1.50	1.03
Furniture and related products	1.46	1.34	1.59	1.40	1.51	1.03
Miscellaneous manufacturing	1.33	1.30	1.36	1.31	1.38	1.03
Services Industries	**1.17**	**1.27**	**1.09**	**1.17**	**1.33**	**1.03**
Utilities	1.26	1.29	1.25	1.20	1.40	1.03
Wholesale trade	1.18	1.24	1.15	1.27	1.32	1.03
Retail trade	1.18	1.21	1.16	1.22	1.39	1.03
Transportation	1.18	1.41	1.00	1.26	1.36	1.03
Information and cultural industries	1.17	1.25	1.09	1.21	1.28	1.03
FIRE	1.13	1.19	1.09	1.19	1.34	1.03
Business services	1.20	1.24	1.18	1.26	1.30	1.03
Other services	1.00	1.31	0.73	1.11	1.31	1.04
Business Sector	**NA**	**NA**	**1.14**	**1.20**	**1.37**	**1.03**

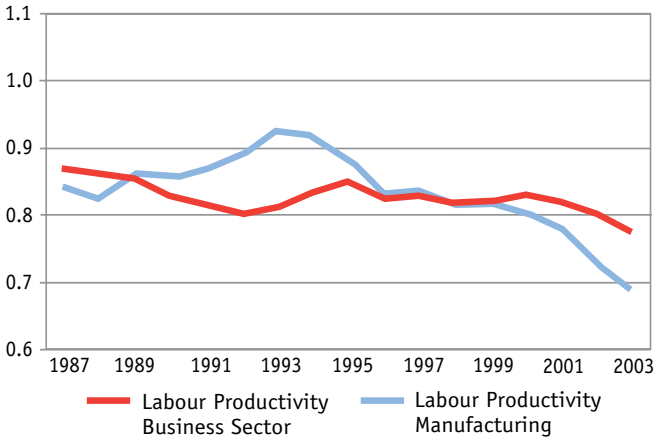
for 1999, disaggregated by industry. These PPP estimates are shown in Table 1.

The value added PPPs are derived residually from the gross output and intermediate input PPPs. Within the manufacturing sector, the value added PPPs vary considerably across industries, from a low of 0.97 (almost parity) in printing and publishing to a high of 2.07 in fabricated metals. On the other hand, the variation among most service industries is quite small,

with a range between 1.00 and 1.25. However, for the other services industry (which includes repair and maintenance, personal and laundry services and religious, civic and professional organizations), the PPP is only 0.73. In the construction industry also the value added PPP is less than one.

The M&E PPPs are well above parity in all industries and the variation across industries is not large. They range from a low of 1.28 in the information and cultural industry to a high of 1.56 in the primary and fabricated metals industries. For the business sector as a whole, the M&E investment PPP was 1.37 in 1999, very close to the market exchange rate. On the other hand, the business sector PPP for structures is very close to parity (1.03) and is virtually the same across all industries.

Chart 1
Relative Labour Productivity in Canada, 1987-2003
(United States=1.0)



Notes: Labour productivity is defined as real GDP per hour worked, PPP based. The series are derived by extending the estimates for 1999 from Table 2 using official productivity growth rates from Statistics Canada and the U.S. Bureau of Labor Statistics.

The Canada-U.S. Productivity Gaps

Estimates of Labour Productivity Gaps

Using industry data on nominal GDP, total hours and the estimates of value added PPPs, we compute estimates of Canada-U.S. labour productivity gaps for 31 industries in the benchmark year of 1999. These benchmark estimates in conjunction with labour productivity growth rates in individual industries in both countries are used to develop a time series of the productivity gaps for the period 1997-2001. These estimates are given in Table 2. In addition, using aggregate data on labour productivity growth in the business and manufacturing sectors in both countries, we have developed long time series (1987-2003) on the labour productivity level gap for these two sectors. These are displayed in Chart 1.

According to our estimates, the labour productivity (real GDP per hour) level in the Canadian business sector was 22.6 per cent below the U.S. level in 2003, and the gap between the two countries had widened significantly from 16.9 per cent in 2000 (Chart 1). The widening of the labour productivity gap in the manufacturing sector is much more pronounced. The gap widened from 7.6 per cent in 1993 to 31.1 per cent in 2003. Our gap estimate for the business sector is similar to other available estimates for the total economy by OECD (2003a), Conference Board of Canada (2003) and Lafortune and Lee (2004). However, a recent Statistics Canada draft paper estimates the gap for the business sector to be only between 6 and 15 per cent for 1999, depending on the assumptions about the PPP rate.

Our estimates show a significant productivity gap in the primary, manufacturing and services sectors, but a large productivity advantage in construction (Table 2). Nevertheless, the productivity gap varies a great deal across the 31 industries. In 2001, it varied from a 50 per cent productivity advantage in the primary metals industry to a 54 per cent disadvantage in the electronic and electrical equipment industry. Labour productivity was lower in all Canadian service industries in 2001 than in their U.S. counterparts, except

Table 2
Relative Labour Productivity in Canada, 1997, 1999, and 2001

Industry	Relative Labour Productivity Level (United States = 1.00)		
	1997	1999	2001
Primary Industries	**0.78**	**0.84**	**0.87**
Agriculture	0.74	0.80	0.84
Mining	0.99	1.07	0.98
Construction	**1.15**	**1.20**	**1.29**
Manufacturing Industries	**0.84**	**0.82**	**0.80**
Food, beverage and tobacco	0.75	0.77	0.99
Textile and clothing	0.68	0.68	0.62
Wood products	1.03	1.11	1.31
Paper	1.07	1.17	1.23
Printing and publishing	1.14	1.02	1.27
Petroleum and coal products	0.68	0.48	0.61
Chemicals	0.80	0.86	1.06
Plastic and rubber products	0.76	0.74	0.77
Non-metallic mineral products	1.06	1.14	1.38
Primary metal	1.37	1.34	1.50
Fabricated metal	0.47	0.51	0.52
Machinery and computers	0.85	0.70	0.63
Electronic and electrical equip.	0.66	0.63	0.44
Motor vehicles	0.98	1.09	1.03
Other transportation equipment	1.28	1.13	1.27
Furniture and related products	0.67	0.71	0.73
Miscellaneous manufacturing	0.58	0.58	0.56
Services Industries	**0.79**	**0.79**	**0.81**
Utilities	0.79	0.77	0.75
Wholesale trade	0.73	0.71	0.69
Retail trade	0.85	0.85	0.82
Transportation	0.99	0.98	1.04
Information and cultural industries	0.67	0.65	0.60
FIRE	0.60	0.58	0.55
Business services	0.78	0.79	0.86
Other services	0.83	0.83	0.90
Business Sector	**0.83**	**0.82**	**0.82**

Notes: Labour productivity is defined as value added per hour. The totals for the benchmark year 1999 are aggregated from their industries based on the trans-log aggregation formula. The benchmark estimates are then extended backward to 1997 and forward to 2001 using the annual labour productivity growth rates for both Canada and the United States for 1997-2001.

transportation. The gap ranges from a low of 14 per cent in business services to 45 per cent in finance, insurance and real estate.

Within the manufacturing sector, Canada enjoys a significant productivity advantage in resource-based industries such as wood products, paper, chemicals, non-metallic minerals and primary metals. In addition, Canada's labour productivity level is also higher in printing and publishing, motor vehicles and other transportation equipment. In most of these industries, the productivity advantage strengthened between 1997 and 2001. On the other hand, the productivity gap is large in labour intensive industries such as textiles and clothing as well as in fabricated metals, the machinery and computers industry, and the electronic and electrical equipment industry. The gap widened considerably in these latter two industries between 1997 and 2001.

Industry Contributions to the Business Sector Labour Productivity Gap

The service sector's contribution to the Canada-U.S. business sector labour productivity gap increased from 81.6 per cent in 1997 to 85.3 per cent in 2001 (Table 3). The finance, insurance and real estate industry is one of the major contributors to the productivity gap. Its share in the business sector productivity gap increased by 6.6 percentage points between 1997 and 2001, reaching 26.9 per cent in 2001. The contribution of the manufacturing sector to the business sector productivity gap increased from 16.4 per cent to 22.2 per cent during this period. The machinery and computers industry, the electronics and electrical equipment industry and the fabricated metals industry accounted for virtually all of the manufacturing productivity gap in 2001. These industries were also responsible for most of the widening of the sector's productivity gap between 1997 and 2001.

Capital Contribution to the Labour Productivity Gap

What has been the role of the capital intensity gap in the Canada-U.S. labour productivity gap

Table 3
Industry Contributions to the Canada-U.S. Aggregate Labour Productivity Gap, 1997, 1999, and 2001

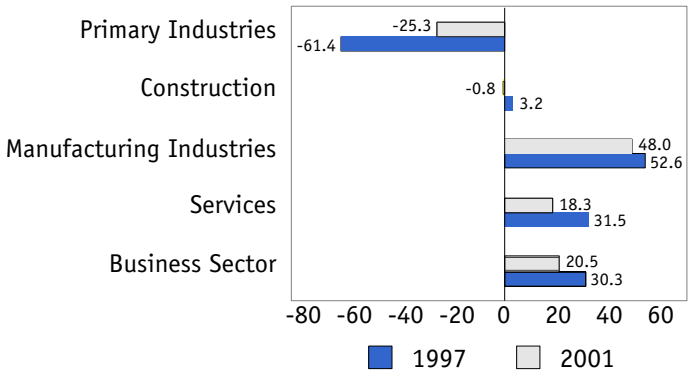
	Contribution to the Labour Productivity Gap (per cent)		
Industry	**1997**	**1999**	**2001**
Primary Industries	**7.4**	**4.6**	**4.0**
Agriculture	7.3	4.9	3.9
Mining	0.1	-0.3	0.1
Construction	**-5.4**	**-7.3**	**-11.6**
Manufacturing Industries	**16.4**	**18.3**	**22.2**
Food, beverage and tobacco	2.6	2.5	0.2
Textile and clothing	2.4	2.3	4.1
Wood products	-0.1	-0.6	-1.9
Paper	-0.3	-0.6	-1.2
Printing and publishing	-1.0	-0.5	-3.4
Petroleum and coal products	0.3	0.5	0.5
Chemicals	1.0	0.7	-0.4
Plastic and rubber products	1.2	1.5	1.9
Non-metallic mineral products	-0.1	-0.3	-1.3
Primary metal	-1.2	-1.1	-2.2
Fabricated metal	5.0	4.9	7.7
Machinery and computers	1.4	3.1	6.0
Electronic and electrical equip.	2.7	3.1	8.2
Motor vehicles	0.1	-0.5	-0.2
Other transportation equipment	-0.9	-0.5	-1.3
Furniture and related products	1.2	1.2	1.7
Miscellaneous manufacturing	2.2	2.4	3.9
Services Industries	**81.6**	**84.4**	**85.3**
Utilities	0.9	0.9	1.1
Wholesale trade	11.2	11.3	14.1
Retail trade	12.7	12.3	16.6
Transportation	0.2	0.6	-1.0
Information and cultural industries	2.9	3.3	4.8
FIRE	20.3	21.4	26.9
Business services	11.8	12.5	8.9
Other services	21.6	22.1	13.9
Business Sector	**100.0**	**100.0**	**100.0**

Table 4
Relative Capital Intensity in Canada, 1997, 1999, and 2001

	Relative Capital Intensity Level (United States = 1.00)		
Industry	**1997**	**1999**	**2001**
Primary Industries	**1.10**	**1.17**	**1.15**
Agriculture	0.81	0.82	0.92
Mining	1.27	1.40	1.27
Construction	**1.00**	**1.04**	**1.04**
Manufacturing Industries	**0.81**	**0.77**	**0.73**
Food, beverage and tobacco	0.58	0.55	0.56
Textile and clothing	0.67	0.59	0.46
Wood products	1.67	1.60	1.67
Paper	1.62	1.50	1.36
Printing and publishing	0.59	0.49	0.49
Petroleum and coal products	1.14	1.08	0.98
Chemicals	0.83	0.85	0.92
Plastic and rubber products	0.68	0.63	0.55
Non-metallic mineral products	0.88	0.84	0.74
Primary metal	1.10	1.08	1.10
Fabricated metal	0.46	0.47	0.37
Machinery and computers	0.45	0.44	0.37
Electronic and electrical equip.	0.36	0.37	0.41
Motor vehicles	1.03	1.03	0.99
Other transportation equipment	0.63	0.55	0.56
Furniture and related products	0.53	0.51	0.48
Services Industries	**0.89**	**0.86**	**0.82**
Utilities	1.30	1.29	1.17
Wholesale trade	0.25	0.26	0.24
Retail trade	0.65	0.67	0.68
Transportation	1.01	1.04	1.05
Information and cultural industries	0.76	0.69	0.65
FIRE	0.50	0.50	0.47
Business services	0.42	0.39	0.40
Business Sector	**0.91**	**0.89**	**0.85**

Notes: Capital intensity is defined as total capital stock per hour worked. The totals for the benchmark year 1999 are aggregated from their industries based on the trans-log aggregation formula. Miscellaneous manufacturing and other services are excluded due to capital stock data quality concerns.

Chart 2
Capital Intensity Contribution to the Canada-U.S. Labour Productivity Gap
(per cent)



and the widening of the gap since 1997? Another interesting question is whether the industrial pattern of the Canada-U.S. labour productivity gap can be explained by the industrial pattern of the capital intensity gap. These two questions are answered by looking at the pattern of capital intensity and their trends over time. According to our estimates, the contribution of the capital intensity gap to the business sector labour productivity gap increased from 20.5 per cent in 1997 to 30.3 per cent in 2001 (Chart 2). In the manufacturing sector, the capital intensity gap explained 52.6 per cent of the productivity gap in 2001, compared to 48.0 per cent in 1997. Across the 29 industries, there is a significant positive correlation between the labour productivity and capital intensity gaps. In other words, the industries in which Canada has a productivity advantage are also generally the industries in which we have a capital intensity advantage, and vice versa (Table 4). The simple correlation coefficient between the two series is 0.74 in 2001, compared to 0.61 in 1997.

Estimates of the MFP gaps

Using the estimates of labour productivity and capital intensity gaps, we calculate the MFP gaps for 1997, 1999, and 2001. These are presented in Table 5. The trends and industrial pattern of the MFP gaps are generally similar to the labour productivity gaps. The MFP gaps are significantly smaller than the labour productivity gaps in the manufacturing and service sectors. For instance, at the business sector level, the MFP gap in 2001 was only 13 per cent, compared to 18 per cent for the labour productivity gap. This is of course generally explained by the capital intensity gap for these sectors. The MFP gap was only half of the labour productivity gap in the manufacturing sector in 2001. Like labour productivity, Canada's MFP levels are considerably above the U.S. levels in construction, resource-based manufacturing industries and other transportation equipment. On the other hand, Canada's MFP levels are significantly below the U.S. levels in the machinery and computers industry, the electronics and electrical equipment industry, the fabricated metal industry, utilities, and finance, insurance and real estate.

In addition, like labour productivity, service industries contributed over three quarters of the business sector MFP gap, but their contribution has declined since 1997 (Table 6). On the other hand, the contribution of the manufacturing sector increased from 13.8 per cent in 1997 to 19.8 per cent in 2001. Once again, machinery and computers, electronics and electrical equipment, and fabricated metals accounted for most of the manufacturing MFP gap.

The industrial pattern of labour productivity, capital intensity and MFP gaps are very similar, suggesting that capital intensity improves labour productivity directly, as well as indirectly via MFP.

Conclusions

The objective of this article has been to estimate the Canada-U.S. labour productivity and MFP gaps by industry. This has been a major and difficult task and the results need to be

Table 5
Relative Multifactor Productivity in Canada, 1997, 1999, and 2001
(United States = 1.00)

Industry	1997	1999	2001
Primary Industries	**0.73**	**0.76**	**0.79**
Agriculture	0.83	0.90	0.88
Mining	0.83	0.85	0.83
Construction	**1.15**	**1.19**	**1.28**
Manufacturing Industries	**0.91**	**0.91**	**0.90**
Food, beverage and tobacco	0.98	1.04	1.28
Textile and clothing	0.77	0.80	0.78
Wood products	0.84	0.92	1.10
Paper	0.89	0.99	1.08
Printing and publishing	1.32	1.28	1.51
Petroleum and coal products	0.64	0.47	0.62
Chemicals	0.89	0.93	1.11
Plastic and rubber products	0.86	0.86	0.93
Non-metallic mineral products	1.12	1.22	1.52
Primary metal	1.33	1.31	1.46
Fabricated metal	0.61	0.66	0.71
Machinery and computers	1.06	0.87	0.81
Electronic and electrical equip.	1.04	0.98	0.59
Motor vehicles	0.97	1.07	1.03
Other transportation equipment	1.45	1.36	1.55
Furniture and related products	0.81	0.86	0.90
Services Industries	**0.83**	**0.83**	**0.86**
Utilities	0.66	0.64	0.68
Wholesale trade	1.09	1.05	1.04
Retail trade	0.93	0.93	0.90
Transportation	0.99	0.97	1.02
Information and cultural industries	0.78	0.80	0.76
FIRE	0.88	0.86	0.84
Business services	0.97	0.96	1.02
Business Sector	**0.86**	**0.86**	**0.87**

interpreted with care. The estimates suggest that we still have a large labour productivity gap and the gap has widened significantly since 2000. The widening of the gap is more pronounced in the manufacturing sector than in

Table 6
Industry Contribution to the Canada-U.S. MFP Gap, 1997, 1999, and 2001

	Contribution to the MFP Gap (per cent)		
Industry	**1997**	**1999**	**2001**
Primary Industries	**12.9**	**10.6**	**15.3**
Agriculture	5.4	3.6	3.2
Mining	7.5	6.9	12.1
Construction	**-5.6**	**-7.7**	**-12.6**
Manufacturing Industries	**13.8**	**15.1**	**19.8**
Food, beverage and tobacco	0.8	-2.2	-2.9
Textile and clothing	4.0	4.7	6.2
Wood products	3.1	2.6	3.4
Paper	2.5	0.2	0.3
Printing and publishing	-8.2	-11.5	-15.1
Petroleum and coal products	2.7	6.5	8.6
Chemicals	4.7	3.5	4.6
Plastic and rubber products	2.5	3.7	4.8
Non-metallic mineral products	-1.1	-2.9	-3.8
Primary metal	-5.6	-7.4	-9.7
Fabricated metal	12.4	16.1	21.1
Machinery and computers	-1.9	6.6	8.7
Electronic and electrical equip.	-1.4	1.3	1.7
Motor vehicles	0.9	-4.6	-6.1
Other transportation equipment	-5.9	-8.0	-10.5
Furniture and related products	1.7	1.9	2.5
Services Industries	**78.9**	**82.0**	**77.5**
Utilities	11.4	10.5	9.1
Wholesale trade	-5.1	-3.0	-2.0
Retail trade	4.5	4.8	7.7
Transportation	0.4	1.3	-0.9
Information and cultural industries	6.2	5.7	7.3
FIRE	14.8	18.0	22.3
Business services	1.8	2.3	-1.3
Business Sector	**100.0**	**100.0**	**100.0**

Notes: Contributions at the industry level for the manufacturing and for the service sector do not sum to the total sector contributions due to the omission of the miscellaneous manufacturing industry and the other services industry respectively.

the businsss sector. In 2003, Canadian labour productivity in the business sector was 22.6 per cent below the U.S. level, compared to 31.1 per cent in the manufacturing sector.

Canada's labour productivity levels are significantly below the U.S. levels in three of the four major sectors: primary, manufacturing and services. On the other hand, Canada enjoys a significant productivity advantage in construction. Within the manufacturing sector, Canadian productivity levels are significantly above the U.S. levels in resource-based industries. On the other hand, the Canada-U.S. productivity gap is very large in the machinery and computers industry and the electronics and electrical equipment industry. The widening of the manufacturing labour productivity gap since 1997 is mostly due to the large deterioration in the relative position of these two industries.

In 2001, more than 85 per cent of the business sector labour productivity gap was due to the service sector productivity gap. This means that to close the real income gap with the United States we need to focus our efforts in closing the service sector labour productivity gap. The capital intensity gap, particularly the M&E gap, accounts for over 30 per cent of the labour productivity gap in the service sector and over half of the manufacturing productivity gap. Our results also suggest that the capital intensity and MFP gaps are positively correlated.

In other words, closing the capital intensity gap is very important for closing the productivity and real income gaps. Canada needs to be a highly competitive location for business investment. Competitive and flexible regulatory frameworks and a highly competitive corporate income tax structure would be very helpful in this regard.

In addition, our recent research suggests that inward FDI not only increases capital accumulation, but also exerts positive productivity spillovers. Therefore, retaining and attracting FDI would be highly beneficial to the Canadian economy. In this context, OECD (2003b) suggests that by bringing down its foreign investment regulations to U.K. levels which are lowest among the OECD countries, and reducing the product market regulations to the OECD average, Canada could double its FDI stock.

Future research should focus on an in-depth analysis of the reasons for the capital intensity and MFP gaps by industry. Such an analysis would provide more insights into the sources of the Canada-U.S. real income gap. Differences in product and labour market regulations, FDI restrictions, tax structure, skills, R&D support, competition, demographic structures and product composition could be considered explanatory variables.

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