Why are Americans More Productive than Canadians?

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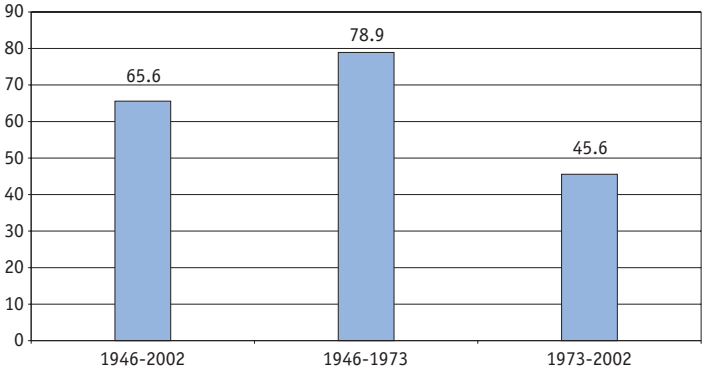
The issue of Canada's productivity performance has received much attention in recent years. The focus of the concern has been that Canada's productivity growth rate in the second half of the 1990s lagged that in the United States. Numerous policies have been advanced to remedy this situation. Less attention has been given the factors behind Canada's long-term lower level of labour productivity relative to that in the United States. The objective of this paper is to remedy this neglect of relative aggregate productivity levels and offer an explanation of why Americans have been and continue to be, on average, more productive than Canadians.

The paper is divided into four parts. The introduction provides a brief overview of productivity issues and developments to set the context for the paper. The second section provides a detailed examination of the current and historical evidence of the gap on aggregate productivity levels between Canada and the United States, looking at the measurement of labour and capital and providing estimates of labour, capital, and total factor productivity. The third part discusses and evaluates the contribution made by a large number of factors to the explanation of the labour productivity gap between the two countries. The fourth and final section concludes.

Productivity is defined as the ratio of output to input in a production process. Partial productivity measures such as labour productivity or capital productivity relate output to a single input. Total or multi-factor productivity measures relate output to an index of two or more inputs. Total factor productivity is particularly useful for gauging the efficiency of the use of resources. Labour productivity is crucial for determining the potential growth in living standards as higher levels of per capita income or output require more output to be produced per worker (Sharpe, 2000b).

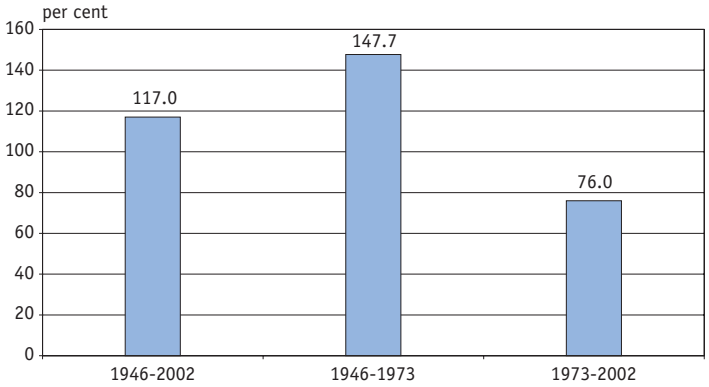
In discussion of productivity, it is very important to always specify whether one is referring to productivity levels, that is the amount of output per unit of input at a point in time, or to productivity growth rates, that is the per cent change in productivity levels between two points in time. This is because productivity is both a physical and value relationship. The physical dimension refers to changes over time in the amount of output produced by a unit of input measured in real terms, that is expressed in constant prices. This is what we have traditionally meant by productivity growth. The value dimension refers to the value, expressed in current dollars, of output produced by a unit of input. This

Chart 1
Contribution of GDP per Hour Worked Growth to Economic Growth in Canada, 1946-2002, Selected Periods
(productivity growth as a proportion of GDP growth)



Source: Tables 1 and 3 in the unabridged version of the paper.

Chart 2
Contribution of GDP per Hour Growth to Growth in GDP per Capita in Canada, 1946-2002, Selected Periods
(productivity growth as a proportion of GDP per capita growth)



Source: Tables 1 and 3 in the unabridged version of the paper.

measure is used to compare productivity levels across sectors as only prices can be used to aggregate heterogeneous physical goods.[1]

Before beginning discussion of productivity gaps, it is useful to review why productivity is important.[2] Economic growth can be decomposed into productivity growth and employment or labour force growth. Productivity growth has been the most important component of economic growth in Canada in the second half of the 20th century, accounting for two-thirds of output growth from 1946 to 2002 (Chart 1). In the golden age of postwar capitalism from 1946 to 1973 when productivity growth was particularly strong (3.91 per cent per year), productivity growth accounted for nearly four-fifths of output growth. After 1973, when output per hour growth slowed down (1.35 per cent per year), productivity growth accounted for only 46 per cent of economic growth.

Productivity growth is even more important from the perspective of growth in living standards, which factors in population growth and is defined as GDP per capita. Changes in per capita GDP over time are determined by trends in output per hour, average hours, the proportion of the population of working age (15 and over) in the total population, the labour force participation rate, and the unemployment rate. From 1946 to 2002, output per hour growth (2.53 per cent per year) accounted for 117 per cent of GDP per capita growth (2.16 per cent), due to negative contributions from the decline in average hours worked and a small increase in the unemployment rate (Charts 2 and 3). In the 1946-73 period, the contribution was 147.7 per cent, declining to 76 per cent in 1973-2002.

Equally, differences in the level of GDP per capita across countries can be accounted for by differences in the level of GDP per hour, working time, and the employment share in total population, in turn affected by the unemployment rate, the participation rate, and the demographic structure.[3]

Estimates of the Canada-US Aggregate Productivity Gap

This section presents estimates of the Canada-U.S. productivity gap for the total economy, including both the business and non-business sectors. Because of productivity measurement problems in the non-business sector, the discussion of productivity growth rates has focused on trends in the business sector. However, the definition of the business sector varies between

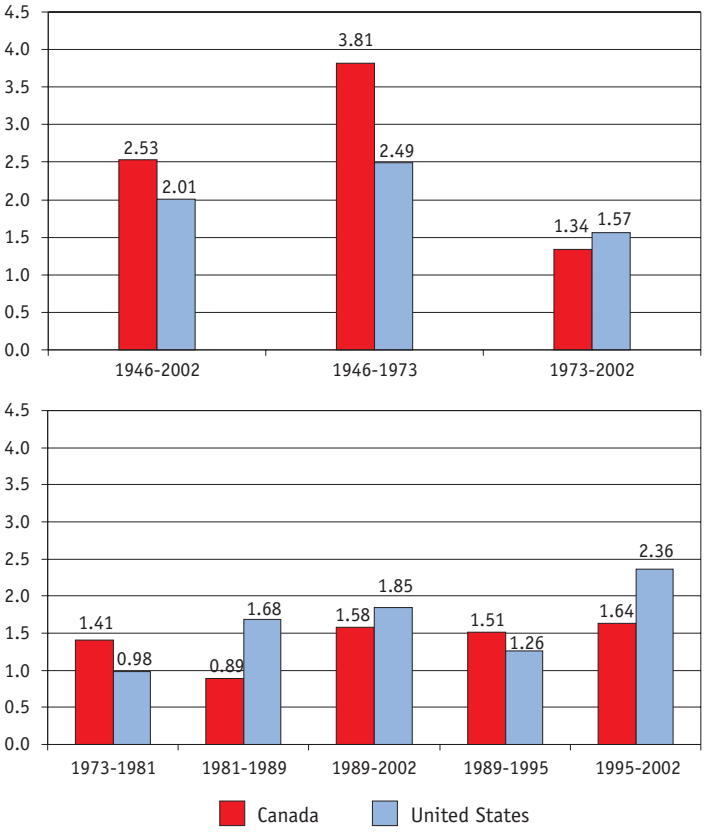
Canada and the United States. For example, many hospitals are part of the business sector in the United States, but almost all hospitals are included in the non-business sector in Canada. For this reason and also because of easier data availability for the total economy than for the business sector, the total economy or total GDP is taken as the unit of analysis for aggregate productivity performance in this paper.

Statistics Canada does not produce official estimates of Canada-US productivity gaps as it does for productivity growth rates. This means that there are different estimates of Canada's aggregate productivity level relative to that of the United States produced by different independent researchers based on different data sources.

Data Requirements for Productivity Level Comparisons

The basic data needed to derive estimates of levels of aggregate or total economy labour, capital and total factor productivity includes: output estimates, expressed in current prices or in constant prices (calculated from current price or nominal output data and output price indices); employment and average hours estimates; capital stock estimates, and purchasing power parity estimates for GDP.

Chart 3
Real GDP per Hour Worked in Canada and the United States
(Average annual rate of change)



Source: Tables 3 and 4 in the unabridged version of this paper.

Output estimates

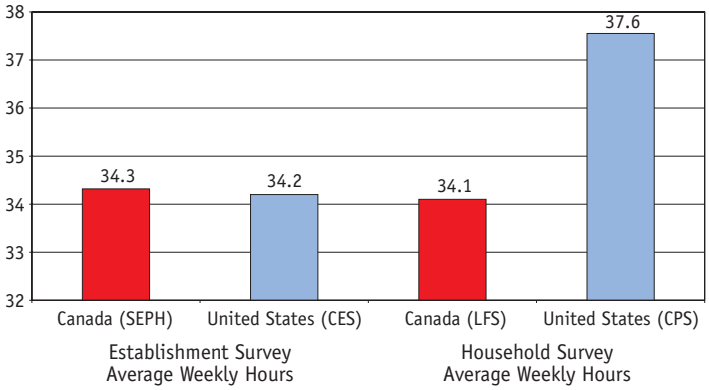
Statistics Canada and the U.S. Bureau of Economic Analysis produce estimates of Gross Domestic Product (GDP) at current prices, and at constant prices based on Fisher chain indexes. These estimates are based on national accounts definitions and conventions developed by the United Nations that have been adopted by all OECD countries. In principle, the methodologies used to compile the estimates are more or less comparable. This is particularly so since the Canadian national accounts followed the U.S. lead in adopting chain indexes and in treating software as an investment good.

Labour input

Data on labour input comes from both establishment-based and household-based surveys. The establishment-based survey in Canada is called the Survey of Employment, Payroll and Hours (SEPH) and in the United States the Current Employment Survey (CES). The household-based survey in Canada is named the Labour Force Survey (LFS) and in the United States the Current Population Survey (CPS).[4]

Chart 4

Average Weekly Hours in Canada and the United States, Establishment and Household Surveys, 2002



Source: Canada: SEPH estimates: CANSIM II Tables 281-0024, 281-0033 and 281-0038, on January 14, 2003. LFS estimates: Statistics Canada, CANSIM II series v2634367. United States: CES estimates: series EEU00500005(n) from Bureau of Labor Statistics website: www.bls.gov, on January 14, 2003. CPS estimates: series LFU123000000 from Bureau of Labor Statistics website: www.bls.gov, on January 14, 2003. Notes: The SEPH series is an average of average weekly hours for salaried employees and employees paid by the hour, weighted according to the respective employment shares. Household average hours in the United States is equal to total hours, which is the product of average hours for persons at work times number of persons at work, divided by total employment.

For employment estimates this paper uses household-based estimates for both countries. This is because household-based employment estimates are more comprehensive than establishment-based employment estimates, and include all industries and all classes of workers. Establishment-based employment surveys exclude agricultural workers and non-salaried workers (self-employed and unpaid family workers). From a labour productivity perspective, it is desirable to include all persons engaged in production in labour input.

The choice of actual hours worked data is considerably more difficult than the choice of employment data. This paper makes use of both establishment-based and household-based estimates as it focuses on average weekly hours. Total annual hours worked is calculated as the product of annual hours per person employed (average weekly hours multiplied by 52 weeks) and the estimate for household-based employment.

In Canada, household and establishment-based estimates give similar results on the number of hours worked. In 2002, average weekly hours per employee from SEPH was 34.3 (Chart 4). Average actual weekly hours from the LFS was 34.1, nearly identical to the SEPH estimate.

In the United States, the establishment-based and the household-based hours estimates reveal different stories about working time. In 2002, average weekly hours based on the CES was 34.2. This estimate is for production workers only. Estimates for non-production workers do not appear available and it is not know if average hours worked by non-production workers are greater or less than that of production workers. In contrast, average hours for all workers from the CPS was 37.6, 2.9 hours per week (151 per year) or 8.5 per cent more than the CES estimate.

Labour productivity levels measured on an hours basis are thus significantly lower when CPS hours estimates are used and higher when the CES hours estimates are used. The choice of hours data however makes little difference for productivity growth, and, in particular, for the productivity growth acceleration in the second half of the 1990s, as both measures of average weekly hours have remained stable over this period.

As shown above, both the SEPH and LFS estimates of average hours for Canada are very similar to the CES estimate for the United States at around 34 hours per week. This implies that there is very little difference between output per worker and output per hour estimates of labour productivity relatives between the two countries.

But the CPS hours estimate for the United States is significantly larger than both estimates for Canada. This implies that there is a significant difference between the output per worker and output per hour estimates of labour productivity relatives between the two countries when this data source is used. Thus, Canada's relative labour productivity level gap, based on hours

worked, is much smaller when CPS hours estimates are used.

BLS officials caution that the CPS hours estimate may be too high because it includes unpaid hours of work, which the BLS believes is overreported on the CPS (Eldridge et al., 2001).[5] On the other hand, it is noted that the CES hours estimate may be too low as it excludes non-production workers and the self-employed, many of whom work long hours both paid and unpaid.[6] Statistics Canada officials appears to have greater confidence in the LFS estimate of hours, even though it too includes unpaid hours worked.

Capital input

Both Statistics Canada and the Bureau of Economic Analysis (BEA) produce estimates of the capital stock based on the perpetual inventory methodology, which combines investment flows and assumptions of depreciation patterns and rates. In the past, depreciation assumptions differed significantly between countries, making the capital stock estimates not comparable (Coulombe, 2002). Statistics Canada has recently moved much closer to BEA methodology and assumptions so the capital stock estimates are now much more comparable.

Purchasing power parities

Purchasing power parity (PPP) estimates are needed to translate national currency estimates of GDP and expenditure categories into common currency (U.S. dollar) estimates. Statistics Canada produces official estimates of the bilateral PPP between Canada and the United States for current dollar GDP and expenditure categories for the 1992-2001 period (Kemp, 2002).[7] This paper has extrapolated forward and backward the series on the basis of the differences in trends in the GDP deflator in the two countries. In 2002, it is estimated that the GDP PPP was $0.85 U.S., compared to the actual exchange rate of $0.637 U.S.

There are two basic methodologies for converting national currency-denominated statistics into a common currency using PPPs (Smith, 2003). The first involves converting a nominal (not adjusted for price changes) series, that is, the nominal value in each year is converted using the PPP for that year. The second methodology involves converting a constant price series, that is the real value in each year is converted using the PPP for the base year of the constant price series. This paper presents both current price and constant price common currency (U.S. dollar) estimates for Canadian GDP based on the two methodologies.

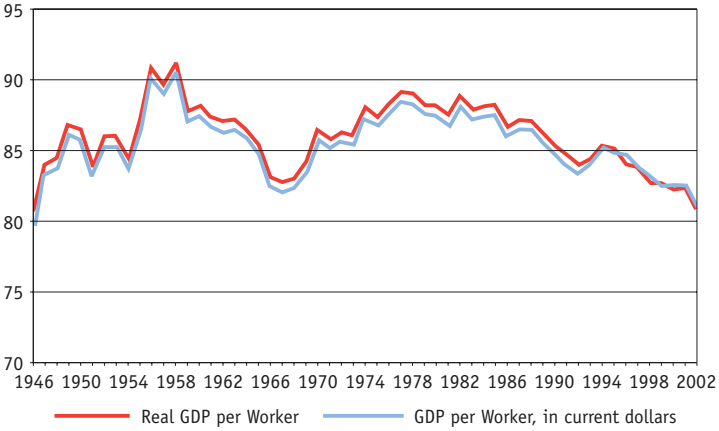
Estimates of Productivity Relatives

Labour productivity

The Centre for the Study of Living Standards (CSLS) has compiled estimates of GDP per worker and per hour worked for Canada (Table 3 in the unabridged version of the paper) and the United States (Table 4 in the unabridged version of the paper) for the 1946-2002 period in both nominal and real terms. Appendix Table 1 and Charts 5 and 6 present productivity relatives, that is GDP per worker and per hour in Canada as a proportion of the U.S. level. As the current and constant dollar relative estimates are virtually identical, only the current dollar estimates will be discussed.[8]

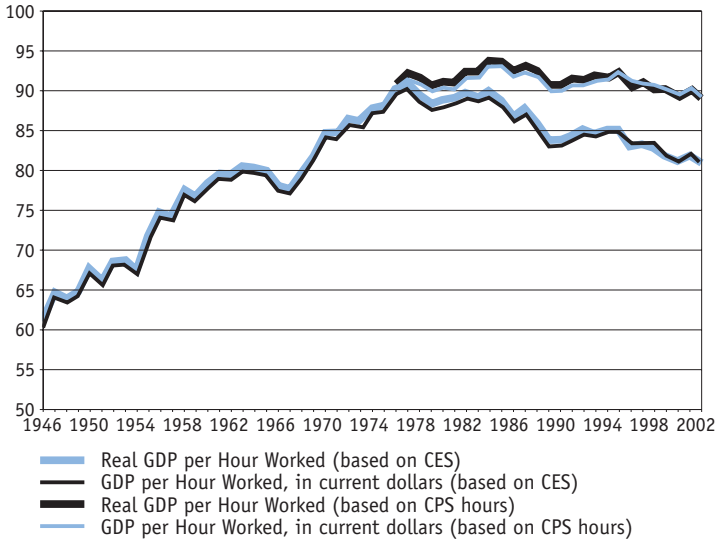
Canada's level of output per person employed, $63,002 in U.S. current dollars in 2002, was 81.0 per cent of the U.S. level of $77,800.[9] This was the lowest relative level since the late 1960s (Chart 5). The highest relative level was 90.5 per cent in 1958. There appears to have been no convergence of Canadian levels of

Chart 5
GDP per Worker Levels, Canada as a Per cent of the United States, 1946-2002



Source: Table 7 in the unabridged version of the paper.

Chart 6
GDP per Hour Worked Levels, Canada as a Per cent of the United States, 1946-2002



Source: Table 7 in the unabridged version of the paper.

output per worker toward U.S. levels in the post-war period in Canada as even in 1946 the relative level was 79.8 per cent (Appendix Table 1).

As noted in the previous section, Canada's level of GDP per hour worked relative to the U.S. level is sensitive to the choice of hours data for the United States. When establishment-based hours estimates are used, there is little difference between output per worker and output per hour relative estimates because average weekly hours worked are almost identical in the two countries. On the other hand, using household-based estimates, the Canada-U.S. labour productivity gap is reduced because these estimates show greater hours worked in the United States than in Canada.

In 2002, Canada's level of output per hour worked was $35.54 in current U.S. dollars. When CES hours estimates are used for the United States, a productivity relative of 81.0 per cent is obtained, the lowest level since the late 1960s (Chart 6 and Appendix Table 1). On the other hand, when CPS hours estimates are used for the United States, a much higher productivity relative of 89.2 per cent in obtained. This too is the lowest level in the history of the household-survey hours series, which only goes back to 1976.

The 8.2 percentage point difference in the Canada-U.S. output per hour level gap in 2002 between the productivity relative based on the U.S. CES hours estimates (19.0 points) and the productivity relative based on CPS hours estimates (10.8 points) is, of course, explained by the difference in CES and CPS hours (34.2 hours per week versus 37.6 respectively).

Other estimates of Canada's relative productivity level are fairly consistent with the above estimates.[10] They all show that output per hour in Canada has always been below that of the United States, that the productivity gap has increased in the 1990s, particularly since 1994, and that the current gap is between 11 and 19 percentage points depending on the source of hours data used.

Capital productivity

The productivity of the capital stock is defined as the amount of value added produced per unit ($1,000) of capital stock. In 2001 (capital stock for 2002 is not yet available for the United States) Canada's capital productivity level, calculated with constant price data, was 97.1 per cent that of the

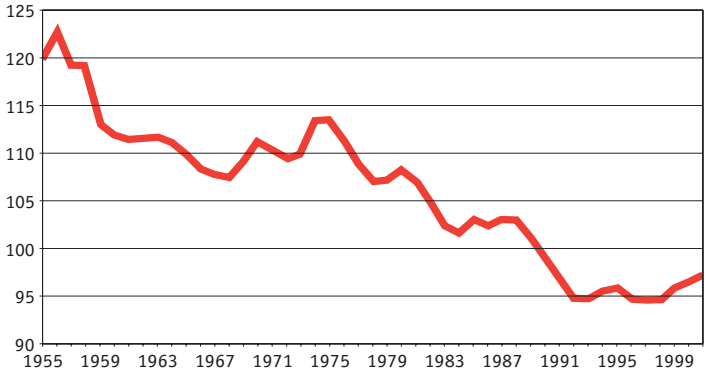
United States. Canada's capital productivity gap with the United States is thus much less than the labour productivity gap. There has been a strong secular decline in Canada's relative capital productivity since the 1950s (Chart 7).[11]

Total factor productivity

Total factor productivity growth is the difference between an index of output and an index of input where the growth rate of the input index is the weighted average of factors of production with the weights the factor income shares. Canada's level of total factor productivity relative to that in the United States can be calculated by combining its relative labour and capital productivity using as weights the income share of labour and capital. The results are of course sensitive to which hours measure in used for the United States.

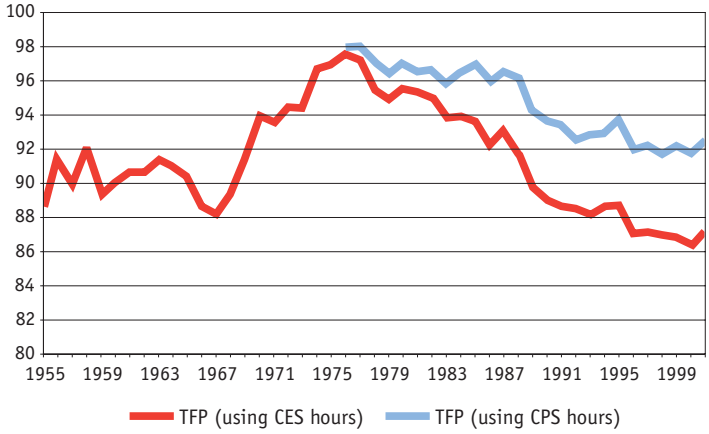
In 2001, Canada's relative level of total factor productivity for the total economy was 87.2 per cent that of the United States using relative labour productivity based on the US CES hours estimate and 92.5 per cent using relative labour productivity based on the US CPS hours estimate.[12] Both estimates were down considerably from those experienced in the mid-1970s, when the level of TFP in Canada approached that in the United States (Chart 8).

Chart 7
Relative Capital Productivity Levels, Canada as a Percentage of the United States, 1955-2001



Source: Table 8.

Chart 8
Relative Total Factor Productivity Levels, Canada as a Percentage of the United States, 1955-2001



Source: Table 9 and 10.

Explanations for the Canada-U.S. Labour Productivity Gap

This section of the paper examines possible explanations for the current gap in total economy labour productivity levels between Canada and the United States. Three types or levels of explanations are included. First, sectoral contributions to productivity growth and the impact of industry structure on aggregate productivity are analyzed. Second, the main drivers of productivity growth, capital intensity, technological innovation, and human capital, are discussed. Finally, the framework environment or infrastructure influencing the productivity drivers, which includes economies of scale and scope, taxes, social policies, unionization, and regulation, is examined.

Sectoral Contributions to the Gap and Industrial Composition

As a first step in the analysis of the total economy labour productivity gap between Canada and the United States, it is useful to calculate the sectoral contributions to the gap.[13] Unfortunately,

this exercise runs up against two serious problems. First, industry-specific purchasing power parities, which are needed to calculate industry relative productivity levels, are not available. Statistics Canada currently calculates PPPs on an expenditure basis, not an industry basis. Second, Statistics Canada now produces industry statistics on the basis of the North American Industrial Classification System (NAICS), while some U.S. statistical agencies continue to use the Standard Industrial Classification (SIC). This makes the industry classification systems not directly comparable between the two countries.

Despite these serious problems, both current dollar and constant dollar productivity relatives have been calculated for 10 Canadian industries for 1999 (the most recent year for current dollar industry estimates) on the basis of the GDP PPP and the two different industry classification systems.[14] These data should be regarded as highly provisional and may be subject to major changes when industry PPPs are developed and NAICS is fully adopted by U.S. statistical agencies.

The current and constant dollar estimates of productivity relatives by industry are quite close. Output per worker in mining in Canada appears to be twice as high as in the United States, while output per worker in construction is somewhat higher. Labour productivity in agriculture, forestry, and fisheries appear roughly comparable in the two countries. In manufacturing, transportation and public utilities, finance, insurance and real estate, and services, Canada appears to have between 80 and 90 per cent of the U.S. level. In retail and wholesale trade, Canada appears to have only around two-thirds the U.S. level.

The industry or sectoral contribution to the overall Canada-U.S. productivity gap (23 percentage points in 1999 for output per worker according to these figures) can be approximated as the product of a particular industry productivity gap and the industry's employment share. Thus all industries except for mining and construction contributed to the gap, with the contributions of retail trade and services reflecting both the large gaps in these sectors and their large employment shares.

At the 10 industry level there are not major differences in the industry structure of employment in Canada and the United States. At a more disaggregated level, more differences would appear, as a greater share of manufacturing employment is in natural resource-related industries in Canada and a greater share in high-tech industries in the United States. Thus difference in the industry composition of employment between Canada and the United States accounts for very little of the gap. If Canada had the U.S. employment structure at the 10 industry level, with actual Canadian labor productivity levels, aggregate labour productivity in Canada in 1999 would be only 1.0 per cent higher.

Main Drivers of Productivity Growth

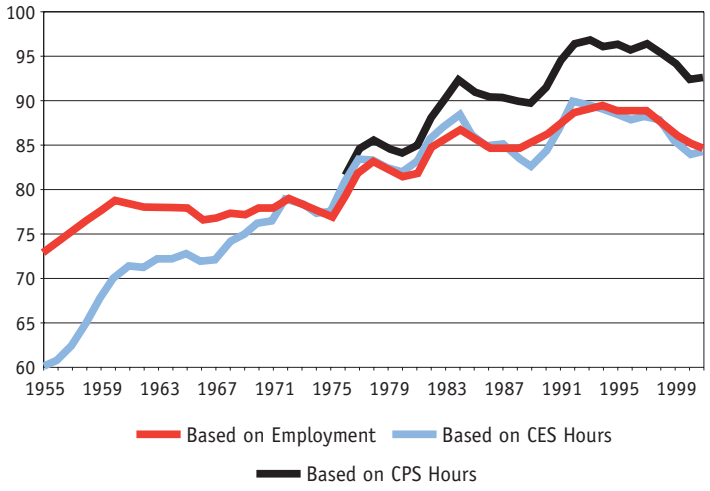
Capital Intensity

A possible explanation for a lower aggregate labour productivity level in Canada than in the United States is a lower level of capital intensity, that is capital per worker or per hour worked. This is indeed the case. The Canada-U.S. relative capital-labour ratio at the total economy level in 2001 was 84.7 per cent based on employment, 84.3 per cent based on US CES hours, and 92.6 per cent based on U.S. LFS hours. The lower level of capital intensity means that Canada's gap in TFP with the United States is less than that for labour productivity.[15] Capital intensity has been rising faster in Canada than in the United States from 60.0 per cent in 1955 to 84.3 per cent based on U.S. CES hours (Chart 9).

The actual contribution of Canada's lower capital-labour ratio to the labour productivity

gap can be calculated by multiplying the share of capital income in GDP by the capital-labour gap. The output per hour gap based on U.S. CES hours was 17.9 points in 2001 and the capital-labour ratio gap was 15.7 points, and capital's share of GDP was 0.3. Thus 4.7 points (15.7*0.3) of the labour productivity gap or 26.3 per cent of the gap was due to lower capital intensity in Canada. The comparable calculation for the labour productivity gap based on CPS hours (9.2 points) and the capital-labour ratio gap based on CPS hours gap of 7.4 points is 2.2 points or 30.0 per cent. If capital intensity were equal in both countries, then this factor would make no contribution to the labour productivity gap.[16]

Chart 9
Relative Capital Labour Ratio Levels, Canada as a Percentage of the United States, 1955-2001

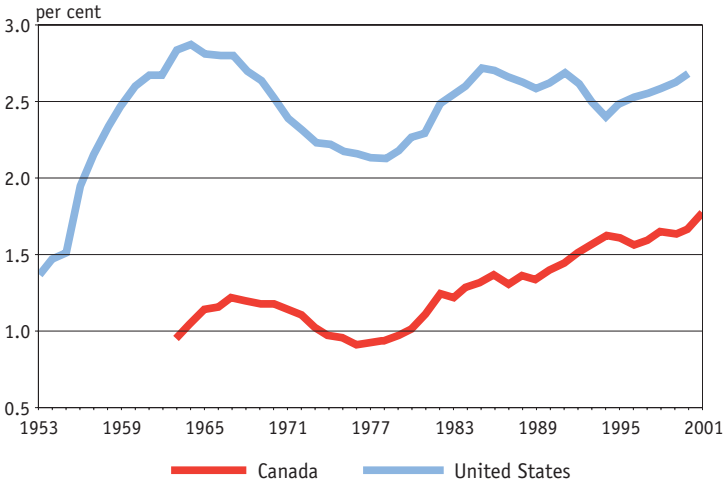


Source: Table 13 and 14.

Technological Innovation

In addition to the productivity gap between Canada and the United States, there is also an innovation gap,[17] the latter contributing to the former. The most widely recognized manifestation of the innovation gap is the large discrepancy between the two countries in terms of R&D expenditures.[18] In 2000 (the most recent year for which data are available for the United States), Canada devoted 1.67 per cent of GDP to R&D, a full percentage point below the US effort of 2.69 per cent (Chart 10). This situation reflects both differences in industrial structure between the two countries, with Canada's relatively larger natural resource-related industries less R&D intensive, and the high level of foreign ownership in Canadian industry, with R&D concentrated in the home country.

Chart 10
Research and Development Expenditure as a Share of GDP in Canada and the United States



Source: United States: R&D data: National Science Foundation. National Patterns of Research and Development Resources, 2000 Data update (NSF 01-309), Table D. Available online at www.nsf.gov/sbe/srs/nprdr/start.htm, January 23, 2003. Nominal GDP data: NIPA Tables, www.bea.gov, January 17, 2003. Canada: CANSIM II Table 358-0001 for R&D data and 379-0024 for Nominal GDP, January 21, 2003.

Canada's low level of R&D spending has negative implications for Canada's patenting record, another key indicator of our ability to innovate.[19] According to Trajtenberg (2002:273-4), Canada stands mid-way vis-a-vis other G-7 countries in terms of patents per capita and patent/R&D ratios and has been overtaken in recent years by a group of countries geared toward the high-tech sector (Finland, Israel, Taiwan, with South Korea closing in). Trajtenberg also finds that the "rate of success" of Canadian patent applications in the United States has been relatively low and the technological composition of Canadian patents is out of step with the rest of the world, with weak-

nesses in the crucial computer and electrical and electronic products areas.

Due to Canada's small size, it will always account for a very small proportion of the world supply of innovations. From this perspective, what matters for productivity growth is the importation of best-practice technologies from other countries and the wide diffusion and adoption of these technologies by Canadian business. Some argue (e.g. Helliwell, 1998:104) that domestic R&D is a key measure (better, for example, than educational attainment) of a nation's capacity to obtain and make use of foreign technologies. Thus Canada's low level of R&D may have negative effects on the pace at which best-practice technologies are imported into Canada, diffused throughout the country and hence adopted by industry.

It is very difficult to estimate the contribution of the innovation gap, defined as both the production of new technologies through domestic R&D and the adoption of best-practice technologies from abroad, to the labour productivity gap, but it is likely the key factor.[20] Certainly, the widening of the gap in the second half of the 1990s has reflected the larger and more dynamic nature of the information technology (IT) industries in the United States. Indeed, Bernstein, Harris and Sharpe (2002) found that the much more rapid growth in high-tech industries in the second half of the 1990s in the United States largely accounted for faster U.S. manufacturing productivity growth and hence the growing Canada-U.S. manufacturing, and total economy, productivity gap.

Human Capital

The average educational attainment of the population is very similar in Canada and the United States. According to OECD figures, the average Canadian aged 25 to 64 in 1999 had 99.4 per cent of the years of educational attainment of a worker in the United States — 13.21 years versus 13.29 years.

The profiles of educational attainment however differ somewhat between the two countries. In 1998, 40 per cent of Canadian women and 36 per cent of men aged 25-64 had attained tertiary education (all forms of post-secondary education, including universities and community colleges), compared to 34 per cent and 35 per cent respectively in the United States (OECD, 2001b:55, Chart A10.3). Canada has increased its lead over the United States in this crucial area in the 1990s. Between 1989 and 1996, the percentage point change in the proportion of the employed population aged 25 to 64 with tertiary qualifications increased 6.8 points in Canada, nearly double the 3.9 point rise in the United States. (OECD, 2001b: Table C4.2).

However, the proportion of the population that had attained at least upper secondary education was lower in Canada than in the United States, particularly for older Canadians: 67 per cent versus 80 per cent for persons aged 55-64, and 88 per cent versus 90 per cent for those 25-34 (OECD, 2001b:55, Chart A10.2).

The higher incidence of tertiary education in Canada is explained by the high level of development of the community college system (including CEGEPs in Quebec). The proportion of the adult population with a university degree is actually lower in Canada than in the United States.

In addition, the United States outperforms Canada in the graduation rate for advanced research programs. The proportion of the population at typical age of graduation who received a PhD in 1999 was 1.3 per cent in the United States and 0.8 per cent in Canada (OECD, 2002:169, Table C4.1). To the extent that a university education, particularly an advanced university education, is more important than a non-university post-secondary education for productivity, the relative weakness of the Canadian uni-

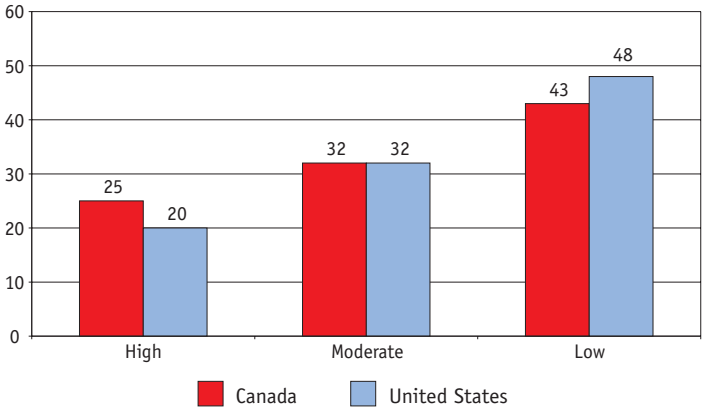
versity system may contribute to the labour productivity gap.[21]

The average literacy and numeracy skills of the workforce appear somewhat higher in Canada than in the United States. According to the International Adult Literacy Survey, in 1998 25 per cent of adult Canadians scored in the high level in document literacy, compared to 20 per cent of Americans (Chart 11). At the other end of the literacy spectrum, 48 per cent of Americans scored in the low level, compared to 43 per cent of Canadians.

Canada also fares better that the United States in standardized test results for grade 8 students. The Program for International Student Assessment (PISA) results for science and mathematics show that Canadian students outperformed their U.S. counterparts in both 1995 and 1999 in both areas (OECD, 2002:312, Table F 1.1).

A major strength of the United States is the high quality of its research universities. The United States has proportionately more world-class university researchers than Canada, as evidenced by Nobel prizes, and has 35 per cent proportionately more scientists and engineers in R&D.[22] This situation has undoubtedly contributed to the high level of productivity in the United States, as research universities create a very favourable environment for the development of applied, productivity-enhancing research outside the university, as seen for example in Silicon Valley. This strength in highly qualified labour, which is closely related to the innovation gap discussed earlier, undoubtedly contributes to the Canada-U.S. labour productivity gap, but the importance is extremely difficult to quantify.[23] One study attempt is Hall and Jones (1996:Table 1), who estimated that in 1988 lower human capital per worker in Canada accounted for 5 percentage points of the Canada-U.S. aggregate labour productivity gap, that is virtually all of the gap.

Chart 11
Adult Population by Level of Document Literacy, Canada and United States, 1998



Source: OECD. Society at a Glance, OECD Social Indicators 2001. OECD, 2001, pp 57. Data is based on Industrial Adult Literacy Survey.

Environment Influencing Productivity Drivers

Economies of scale and scope

Large establishments tend to have higher labour productivity levels than smaller establishments as they enjoy longer production runs and greater economies of scale and scope. Establishment size tends to be lower in Canada than in the United States. There is evidence that the combination of these two factors contributes to the Canada-U.S. labour productivity gap.

Baldwin, Jarmin, and Tang (2002) found that small and medium-sized plants accounted for 67.1 per cent of value added and 76.6 per cent of employment in Canadian manufacturing in 1994 compared to 54.2 per cent and 65.4 per cent respectively in the United States. They also found that relative value-added per employee in Canadian manufacturing for small plants (less than 100 employees) was 67 per cent of the overall average, 104 per cent for medium plants (100-500 employees) and 147 per cent for large plants (over 500 employees). If Canada had had the same employment size distribution as the United States, but the same relative productivity by

plant size, the value added per employee in Canadian manufacturing would have been 8 per cent higher. It is likely that the same situation prevails in other sectors, although comparable data on establishment size are more difficulty to obtain outside manufacturing.

A key issue is why average establishment size continues to be smaller in Canada than in the United States when the Canada-U.S. Free Trade Agreement reduced trade barriers between the countries. In theory, Canadian firms have open access to the U.S. market, but in reality, because of past history or path dependency, there is still much more East-West trade within Canada relative to North-South trade than predicted by gravity models based on population. This inertia in the adjustment of trade flows to potential market opportunities has been labeled border effects (Helliwell, 1998).[24] Over time it is expected that these border effects will continue to fall, with positive implications for Canadian productivity growth and the reduction in the productivity gap. It is unlikely however that border effects will completely disappear.

Taxes

The government plays a larger role in economic life in Canada than in the United States. In 2002, government revenues, which include both tax and non-tax receipts, represented 41.4 per cent of nominal GDP in Canada, compared to 30.5 per cent in the United States. Tax revenues in Canada were 29.2 per cent of GDP compared to 18.6 per cent in the United States.

Canada's higher tax share has been advanced by some as an explanation of Canada's lower labour productivity level. However, the evidence of this negative impact is weak for three reasons. First, the main potential linkage between taxes and productivity is through investment, with high corporate taxes potentially stifling business investment (Chen and Mintz, 2003). Yet the share of current dollar investment in non-residential fixed assets in GDP has actually been higher over the 1955-2002 period in Canada (16.2 per cent of GDP) than in the United States (14.6 per cent), and comparable in the 1980s and 1990s.

Second, high personal taxes can have negative effects on labour supply, both in terms of the decision to participate in the labour force and the decision on how many hours of work to supply. Taxes do affect economic growth through this channel, but reduced labour supply or input affects output proportionately and has no negative effect on productivity. It is unlikely that any negative supply effects on labour supply has had any significant effect on personal saving and national investment.

It can also be noted that the OECD reports that the total tax wedge, including employer's social security contributions, are very similar in Canada and the United States, and much lower than in most European countries. In 1999, the tax wedge for a single person was 31.8 per cent in Canada, almost identical to the 31.1 per cent in the United States (OECD, 2001b:61. Table A13.1). For married persons, the rates were 23.0 percent and 24.5 per cent respectively.

Equally Chen and Mintz (2003:8, Table 5) report that the differences between Canada and the United States in the combined effective corporate and personal tax rate on entrepreneurial capital are small.[25]

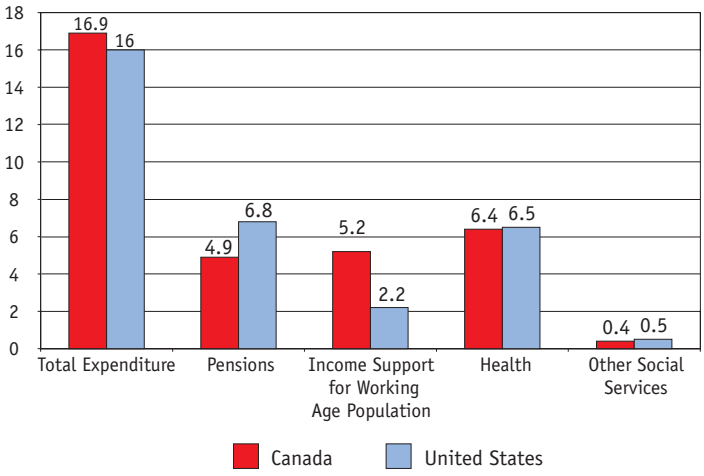
Third, many European countries have much higher taxes shares in GDP than experienced in the United States, yet have high labour productivity levels. Indeed, all of the six countries with higher levels of output per hour than the United States in 2002 (Belgium, Norway, Ireland, Germany, France, and the Netherlands in Table 2 in the unabridged version of the paper) had much higher tax shares than the United States.

Social policies

It has been suggested that social policies may account for the lower level of Canadian labour productivity as such policies may dampen the pace of reallocation of resources from declining to expanding regions and industries. But the evidence, as in the case of tax policy, is weak. Again social programs largely affect labour supply behaviour, not output per hour. The even more generous social programs in Europe have not prevented many European countries from achieving high productivity levels, in certain cases even superior to US levels.

Total public social spending is actually only slightly larger in Canada than in the United States (Chart 12). Public social spending (cash benefits and services) was 16.9 per cent of GDP in Canada in 1997 compared to 16.0 per cent in the United States (OECD, 2001b:73, Chart B6.2).[26] However, income support to the working age population was greater in Canada (5.2 per cent versus 2.2 per cent of GDP).[27]

Chart 12
Public Social Expenditure by Broad Social Policy Area, Canada and United States, 1997



Source: OECD. Society at a Glance, OECD Social Indicators 2001. OECD, 2001, pp 57. Data is based on Industrial Adult Literacy Survey.

Unionization

The unionization rate is significantly higher in Canada than in the United States. Indeed, in 2002, 32.2 per cent of employees were unionized in Canada, compared to 14.6 per cent in the United States. Unions can have negative effects on productivity through restrictive work practices, so the higher unionization rate in Canada has been advanced as an explanation of the labour productivity gap.

But unions can also have positive effects on productivity through their voice function which reduces costly labour turnover and through their wage effects, which spurs employers to substitute capital for labour thereby increasing labour productivity. It is unclear which effect dominates. Consequently, it is likely that unions have little net effect on labour productivity levels and that the difference in unionization rates does not account for lower productivity levels in Canada.

Regulation

It is often asserted that the degree of labour market and product market regulation is greater in Canada than the United States. Since regulations can have a negative effect on productivity, it is sometimes argued that this situation contributes to the Canada-U.S. labour productivity gap.

But it is very difficult to quantify the wide range of regulations that affect economic activity in the two countries and to conclude that Canada is more regulated than the United States. Indeed, environmental regulation is considered by many to be more stringent in the United States. In addition, certain regulations can have a positive effect on labour productivity (though possibly a negative effect on total factor productivity) by forcing firms to invest in capital-intensive machinery and equipment that is both pollution-reducing and labour-saving. Consequently, it is

unlikely that differences in the regulatory environment can account for much of the gap between U.S. and Canadian aggregate labour productivity levels.

Other factors

In addition to the factors discussed above, there are many other factors which influence productivity growth rates and levels, including capacity utilization, minimum wages and payroll taxes, and competition.

Capacity utilization tends to be positively correlated with productivity growth. Much weaker capacity utilization in Canada than in the United States could account for part of the labour productivity gap. But in 2002, the Bank of Canada estimated that the economy-wide output gap was higher in Canada than in the United States. This suggests that no part of the current Canada-U.S. labour productivity gap can be accounted for by cyclical factors. Indeed, the strong cyclical position of the Canadian economy may even be dampening the gap.

One explanation that has been advanced for relatively high output per hour productivity levels in Europe is that low wage jobs have largely been eliminated through high minimum wages, high wage floors negotiated through collective bargaining, and payroll taxes borne by employers. The lack of low productivity jobs increases average labour productivity through a composition effect.

In mid-2000, the ratio of adult minimum wages to median full-time earnings was 0.42 in Canada (OECD, 2001b:71, Chart 5B5.1). This ratio was lower than in many European countries such as France (0.61), but higher than in the United States (0.37). In the mid to late 1990s, the incidence of low pay in Canada was 21 per cent, compared to less than 15 per cent in most European countries and 25 per cent in the United States (OECD, 2001b:67, Chart B3.1). In principle, this situation would not account for the labour productivity gap, but rather would tend to reduce the gap.

On the other hand, payroll taxes are actually lower in Canada than in the United States due to lower social security contribution rates, reducing labour costs. This gives less incentive for employers to increase labour productivity by substituting capital for labour. Given the offsetting influences of Canada's high relative minimum wage and low payroll costs, and the relatively small differences with the United States, it is unlikely that the net effect of these two factors on the Canada-U.S. labour productivity gap is significant.

Competition is the driving force behind productivity advance. A possible explanation for lower productivity levels in Canada than in United States may be that Canadian firms are under less intense competitive pressures than U.S. firms. Such a situation could reflect either regulatory barriers in Canada (e.g. restrictions on foreign ownership in certain sectors such as banking, transportation, and cultural industries), the smaller size of the Canadian market, or behavioural differences between Canadian and U.S. entrepreneurs and managers. Unfortunately, little evidence is available on differences in competitive pressures between the two countries.

Conclusion

This paper has documented a labour productivity gap currently in the 10 to 20 per cent range in the total economy between Canada and the United States in 2002.[28] Unfortunately, the uncertainly surrounding the reliability of the two estimates of average weekly hours produced by the U.S. Bureau of Labor Statistics does not allow one to narrow the range of the estimates of the gap.

This paper reviews possible explanations for this gap and concludes that it reflects five factors:

- The lower capital intensity of economic activity in Canada, estimated to account for around one fifth of the gap;
- Canada's innovation gap as manifested by lower R&D expenditures and patenting as well as lags in the diffusion of best-practice techniques into Canada from other countries, particularly the United States;
- Canada's relatively underdeveloped high-tech sector which has had much lower productivity growth than its U.S. counterpart;
- Canada's less developed human capital at the top end of the labour market, as manifested by proportionately fewer university graduates and scientists and engineers in R&D; and
- More limited economies of scale and scope in Canada reflecting smaller plant size due to the continuation of border effects.

The paper finds no conclusive evidence that the other factors examined, including industry structure, taxes, social policies, unionization, and regulation accounted for a significant portion of the gap. However, further research is needed before definitive conclusion can be drawn on the importance of these factors in explaining the productivity gap.

The future evolution of the Canada-U.S. productivity gap depends on the relative productivity growth rate in the two countries. To the degree that Canada can reduce its innovation gap, foster investment to increase capital intensity, develop the high-tech sector, improve the quality of workers at the high end of the labour market, and increase plant size, it can increase its productivity growth rate and reduce the productivity gap (assuming that the United States experiences a slower rate).

The key data recommendation of the paper is that further research be undertaken on the hours issues, in particular to ascertain the comparability of the household survey hours estimates between the two countries in order to narrow the range of estimates of the size of the gap.

Notes

* This is an abridged version of a paper presented at a public lecture at the Centre for International Business, College of Business and Economics, Western Washington University (WWU), Bellingham, Washington on January 23, 2003 and at the Conference on Relative Canadian-U.S. Productivity and Living Standard Trends, Canadian Consulate General, New York, New York, April 16, 2003. I would like to thank Steven Globerman for the invitation to present the lecture at WWU and thank James Dean, Steven Globerman and others attending the lecture for useful comments. I would like to thank Olivier Guilbaud for excellent research assistance in the preparation of this paper and Someshwar Rao, Jack Triplett, and Ed Wolff for comments on the version of the paper presented in New York. The unabridged version of the paper is posted at www.csls.ca under the *International Productivity Monitor.* Email: csls@csls.ca.

1 There is no necessary relationship between physical and value concepts of productivity. For example, the agricultural sector has enjoyed very rapid long-term productivity growth, but the value productivity of the sector (current dollar value of output per worker) is well below the economy-wide average due to the fall in the relative price of agricultural goods. The productivity gains have been passed on to consumers through lower prices. Conversely, certain services sectors which have experienced no growth in physical productivity may have a high value productivity level. This may be because of strong demand for the output of the sectors, high costs of factor inputs in the sectors, or monopoly power in the sector allowing firms to raise prices.

2 On the two-way relationship between productivity and social progress, see Sharpe, St-Hilaire and Banting (2002)

3 McGuckin and Van Ark (2003) shows that in 2002 Canada's GDP per capita was 82.6 per cent that of the United States. This estimate was slightly less than Canada's aggregate labour productivity relative (83.7 per cent of the U.S. level) because of fewer hours worked in Canada (4.0 percentage points less than in the United States) offset by a higher share of employment in the total population (2.8 per cent).

4 One minor difference between the LFS and the CPS is that the working age population is defined as 15 and over in Canada, and as 16 and over in the United States.

5 Also see Van Ark (1998), OECD (1998) and OECD (2001a) for discussion of the measurement of hours.

6 Jack Triplett, a former senior BLS official, in his discussion of this paper, remarked that he considers the U.S. establishment survey "dreadful." He feels it is very out-of-date as it was designed in the 1920s. He also noted that at that time, the concept of production worker, used by the establishment

survey, may have had meaning, but it has little relevance in the 21st century.

7 Three multilateral PPP estimates are also available for Canada (Appendix Table 5 in the unabridged version of the paper). Two of the three are quite similar to the bilateral estimates. For example, the OECD GDP PPP historical series gives an estimate of $0.825 U.S. for 2000 and the Statistics Canada multilateral PPP for OECD countries gives an estimate of $0.83 U.S. compared to the Statistics Canada bilateral estimate of $0.84. The Penn World table estimate is a bit of an outlier at $0.793. Productivity relatives would be slightly different if these PPPs were used.

8 As the focus of this paper is on explaining productivity level differences, not productivity growth rates, it can be argued that current dollar levels are more relevant than constant dollar levels as they capture shifts in expenditure patterns (although the movement to chain GDP indexes may have reduced this advantage of current dollar estimates and may also explain the near identical time paths of the two series, as Chart 6 shows).

9 This estimates of the Canada-U.S. aggregate labour productivity gap in this paper are much larger than that 6.1 point gap in the level of output per worker between the two countries reported by Hall and Jones (1996) for 1988. This paper finds that the gap in 1988 was 13-14 per cent (Appendix Table 1).

10 See the unabridged version of the paper for comparison of CSLS estimates of Canada-U.S. relative labour productivity with estimates calculated by other researchers, including Angus Maddison (2001), the Groningen Growth and Development Centre and the OECD.

11 The composition of the capital stock varies significantly between Canada and the United States. In 2001, machinery and equipment represented only 25.2 per cent of the real ($1997) capital stock in Canada compared to 34.8 per cent in the United States. Conversely, structures accounted for 74.8 per cent of the capital stock in Canada and 65.2 per cent in the United States. This different structure has implications for the capital productivity of the two components. Because of the smaller share of machinery and equipment in Canada, the relative productivity of this component of the capital stock was 158.5 per cent that of the United States. Equally, because of the higher share of structures, the relative productivity of this component of the capital stock was only 78.5 per cent of the U.S. level.

12 The positive Canada-U.S. aggregate total factor productivity gap in this paper differs from the finding of gap in the TFP level between the two countries reported by Hall and Jones (1996) for 1988. This paper finds that the gap in 1988 was 3.8 points using CPS hours (Table 10 in the unabridged version of the paper).

13 For an excellent discussion of factors at the firm level that can explain productivity level differences across countries at the industry level, see Baily and Solow (2001).

14 See Table 11 in the unabridged version of the paper.

15 This finding of lower capital intensity in Canada differs from that of nearly identical capital intensity between the two countries reported by Hall and Jones (1996) for 1988. This paper finds that capital/labour ratio in 1988 was 10 per cent lower in Canada than in the United States (Table 14 in the unabridged version of the paper).

16 Because of the greater importance of structures in the capital stock in Canada relative to the United States, the capital-labour ratio for this component of the capital stock is actually greater in Canada than in the United States. Conversely, the capital-labour ratio for machinery and equipment is much lower in Canada than in the United States. Indeed, Canada's capital-labour ratio for machinery and equipment in 2001 was only 52-57 per cent of the U.S. level depending on the measure. To the degree that machinery and equipment has a greater impact on productivity than structures, the use of the all components total capital-labour in the calculation of this factor's contribution to the Canada-U.S. labour productivity gap may be understated.

17 One measure of the innovation gap is provided by the technology achievement index, a measure developed by the United Nations Development Program (2001: Table A2.1). This index is based on indicators of technology creation, diffusion of recent innovations, diffusion of old innovations, and human skills. The index for Canada is 24 per cent less than for the United States.

18 See Rao et al. (2001) for a discussion of the innovation gap and the impact of this gap on productivity.

19 The UNDP (2001: Table A2.1) reports that the patent rate in Canada in 1998 was 31 per million persons, compared to 289 in the United States.

20 The federal government has identified the innovation gap as a key, if not the key, factor in Canada's productivity gap with the United States. See Government of Canada (2002a) for a discussion of proposed government measures to reduce the innovation gap.

21 For evidence of this in the context of the manufacturing sector, see Rao, Tang and Wang (2002).

22 In 1987-97, Canada averaged 2,719 scientists and engineers in R&D per 100,000 persons, compared to 3,676 in the United States (UNDP, 2001:Table A2.2).

23 The federal government has identified skills as a key determinant of Canada's productivity growth. See Government of Canada (2002b) for a discussion of proposed government measures to strengthen skills and learning in Canada.

24 Anderson and Wincoop (2003) have recently shown that national borders reduce trade flows between industrialized countries by 20-50 per cent, much less than earlier estimates.

25 In manufacturing, the combined tax rate for large firms in Canada in 2001 was 72.4 per cent, compared to 69.7 per cent in the United States. The comparable tax rate for small firms was 72.5 per cent and 69.2 per cent respectively. In services, the combined tax rate for large firms in Canada in 2001 was 66.4, compared to 64.6 per cent in the United States. The comparable rate for small firms was 65.4 per cent and 63.5 per cent respectively.

26 Private spending on social spending was larger in the United States than in Canada (8.6 per cent of GDP compared to 4.5 per cent) in 1995 because of much higher private spending on health in the United States (OECD, 2001:75, Table B 7.1). This meant that total social spending was actually less in Canada than in the United States in 1997 (21.4 per cent versus 24.6 per cent).

27 For example, the average net replacement rate for four household types (single, married couple, couple with two children and lone parent with two children) in the first month of benefit receipt in Canada in 1999 was 66 per cent compared to 55 per cent for the United States (OECD, 2001b:59, Table A12.1). The difference between Canada and the United States for the average net replacement rate for long-term benefit recipients was even greater: 62 per cent versus 35 per cent.

28 The unabridged version of the paper also addresses the much broader, and even more crucial, question of how important Canada-U.S. productivity relatives are for the well-being of Canadians. See Sharpe (2002a) on the contribution of productivity to economic well-being.

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Appendix Table 1:
Relative Aggregate Labour Productivity Levels, Canada-United States, 1946-2001
(Canada as % of United States)

	Employment		Establishment-based hours		Household-based hours	
	GDP per Worker (in thousands of 1997 dollars)	GDP per Worker (in current dollars)	GDP per Hour Worked (in 1997 dollars)	GDP per Hour Worked (in current dollars)	GDP per Hour Worked (in 1997 dollars)	GDP per Hour Worked (in current dollars)
1946	80.42	79.77	60.94	60.45	n/a	n/a
1950	86.52	85.83	67.69	67.15	n/a	n/a
1955	87.23	86.53	71.90	71.32	n/a	n/a
1960	88.17	87.47	78.40	77.77	n/a	n/a
1961	87.45	86.75	79.56	78.93	n/a	n/a
1962	87.07	86.38	79.47	78.83	n/a	n/a
1963	87.19	86.49	80.56	79.91	n/a	n/a
1964	86.57	85.87	80.33	79.69	n/a	n/a
1965	85.50	84.81	80.05	79.41	n/a	n/a
1966	83.13	82.46	78.06	77.44	n/a	n/a
1967	82.77	82.10	77.74	77.12	n/a	n/a
1968	83.00	82.33	79.69	79.05	n/a	n/a
1969	84.16	83.49	81.87	81.22	n/a	n/a
1970	86.45	85.76	84.73	84.05	n/a	n/a
1971	85.86	85.17	84.59	83.91	n/a	n/a
1972	86.33	85.64	86.39	85.70	n/a	n/a
1973	86.09	85.40	86.15	85.46	n/a	n/a
1974	87.97	87.27	87.75	87.05	n/a	n/a
1975	87.39	86.69	88.05	87.34	n/a	n/a
1976	88.21	87.50	90.15	89.43	90.80	90.07
1977	89.15	88.44	90.90	90.17	92.09	91.35
1978	89.01	88.30	89.38	88.66	91.72	90.98
1979	88.29	87.58	88.37	87.66	90.69	89.96
1980	88.25	87.54	88.73	88.02	91.04	90.31
1981	87.54	86.84	89.11	88.40	90.89	90.16
1982	88.79	88.08	89.73	89.01	92.36	91.62
1983	87.93	87.22	89.26	88.55	92.29	91.55
1984	88.14	87.43	89.84	89.12	93.78	93.02
1985	88.27	87.56	88.65	87.94	93.71	92.96
1986	86.72	86.02	86.89	86.20	92.52	91.78
1987	87.21	86.51	87.67	86.97	93.09	92.34
1988	87.11	86.41	85.87	85.18	92.56	91.81
1989	86.27	85.58	83.70	83.02	90.75	90.02
1990	85.35	84.66	83.74	83.07	90.68	89.95
1991	84.71	84.03	84.28	83.60	91.48	90.75
1992	84.06	83.38	85.22	84.54	91.42	90.68
1993	84.40	83.97	84.66	84.22	91.83	91.35
1994	85.32	85.13	85.01	84.81	91.64	91.44
1995	85.12	84.99	84.92	84.79	92.41	92.27
1996	84.06	84.68	83.05	83.67	90.57	91.23
1997	83.84	83.84	83.23	83.23	90.95	90.95
1998	82.72	83.31	82.89	83.48	90.15	90.79
1999	82.74	82.55	81.98	81.79	90.29	90.08
2000	82.29	82.57	80.95	81.22	89.28	89.58
2001	82.31	82.50	81.87	82.05	89.98	90.18
2002	80.80	80.98	80.82	81.00	89.00	89.20
Average annual rate of change						
46-02	0.01	0.03	0.51	0.52	n/a	n/a
46-73	0.25	0.25	1.29	1.29	n/a	n/a
73-02	-0.22	-0.18	-0.22	-0.18	n/a	n/a
73-81	0.21	0.21	0.42	0.42	n/a	n/a
81-89	-0.18	-0.18	-0.78	-0.78	-0.02	-0.02
89-02	-0.50	-0.42	-0.27	-0.19	-0.15	-0.07
89-95	-0.22	-0.11	0.24	0.35	0.30	0.41
95-02	-0.74	-0.69	-0.70	-0.65	-0.54	-0.48

Source: Tables 3 and 4 in the unabridged version of the paper.