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Why Are Americans More Productive Than Canadians?

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Why Are Americans More Productive Than Canadians?[1]

I Introduction

The issue of Canada's productivity performance has received much attention in Canada in recent years. The focus of the concern has been that Canada's productivity growth rate in the second half of the 1990s has 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 five major 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. Factors discussed include the industry structure, the capital intensity of production, human capital, and technological innovation. The fourth section briefly examines the relationship between productivity levels and economic well-being. The fifth 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. It is defined as output growth minus the weighted average of the growth of inputs (usually labour and capital) where the weights are the input income shares. 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.[2]

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[1] This paper was originally presented at a public lecture at the Centre for International Business, College of Business and Economics, Western Washington University, Bellingham, Washington on January 23, 2003. I would like to thank Steven Globerman for the invitation to present the lecture and James Dean, Steven Globerman and others attending the lecture for useful comments. A revised version was presented at the Conference organized by the Centre for the Study of Living Standards on Relative Canada-U.S. Productivity and Living Standard Trends that took place at the Canadian Consulate General in New York, New York, April 16, 2003. An abridged version of this paper is published in the Spring 2003 issue of the *International Productivity Monitor* posted at www.csls.ca. 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 prersnted in New York.

[2] For a more detailed examination of productivity concepts, see Sharpe (2002b).

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

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.

Before beginning the discussion of productivity gaps, it is useful to review why productivity is important.[3] 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. In the golden age of postwar capitalism from 1946 to 1973 when productivity growth was particularly strong (3.81 per cent per year), productivity growth accounted for nearly four-fifths of output growth (Table 1 and Chart 1). After 1973, when output per hour growth slowed down (1.34 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 (Table 1 and Charts 2 and 3). In the 1946-73 period, the contribution of output per hour growth was 147.7 per cent, declining to 76 per cent in 1973-2002.

[3] On the two-way relationship between productivity and social progress, see Sharpe, St-Hilaire and Banting (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. Table 2, based on Van Ark (2002), 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 (82.6 per cent of the U.S. level) because of fewer hours worked in Canada (3.5 percentage points less than in the United States), offset by a higher share of employment in the total population (1.8 per cent) due to a greater share of the working population in the total population (1.2 per cent). This reflects the lower fertility rate in Canada and hence a relatively smaller proportion of the population in the under 15 age group.

II Estimates of the Canada-US Aggregate Productivity Gap

This section presents estimates of the Canada-US 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 can be 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. This section first provides a detailed discussion of the variables needed for estimates of relative labour, capital, and total factor productivity levels and the methodological and statistical problems associated with the estimation of these variables. It then presents estimates of Canada's relative aggregate labour, capital, and total factor productivity level from several 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.

<u>Output estimates</u>

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.

One minor issue is that the base year for the constant price estimates is generally not the same in Canada and the United States. For example, Statistics Canada currently uses a 1997 base year while the U.S. Bureau of Economic Analysis uses 1996. Either GDP series can be rebased by multiplying the series by the ratio of GDP deflators for old and new base years. The convention in this paper is to use the Canadian base year of 1997, which requires rebasing the U.S. series from 1996 to 1997.

Current price GDP estimates must be deflated by the GDP deflator to obtain constant price GDP estimates. A major issue is the international comparability of the expenditure price series used to derive the GDP deflator because of possible differences in methodologies used to construct prices indexes. Methodological differences in the treatment of quality change in existing goods and the treatment of new goods pose the most challenging problems and have been approached differently by national statistical agencies. The Bureau of Labor Statistics (BLS) has been relatively aggressive in the quality adjustments it has introduced into price series, particularly when compared to national statistical agencies in Europe. Some observers argue that this has introduced an upward bias to real growth estimates for the United States compared to European countries such as Germany. This argument is particularly relevant for the output of the high-tech sector, but has less relevence at the total economy level because of the relatively small size of the high-tech sector in the overall economy.

Statistics Canada has tended to follow the lead of the BLS for the development and the adoption of new methodologies for prices. Indeed, Statistics Canada has at times even adopted US deflators, as was the case for the deflator series for computers in the 1980s. Consequently, it is unlikely that differences in price indexes due to different methodologies greatly bias real GDP estimates in Canada relative to those in the United States.

Table 3 provides current price and constant (chained) price (1997 dollars) estimates of GDP for Canada for the 1946 to 2002 period. Table 4 provides similar estimates for the same period for the United States.

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 it is called the Current Employment

Survey (CES). The household-based survey in Canada is called the Labour Force Survey (LFS) and in the United States it is the Current Population Survey (CPS).[4]

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 includes 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.

Table 3 provides aggregate employment estimates for Canada for the 1946 to 2002 period. Table 4 provides similar estimates for the same period for the United States.

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.

Table 5 provides estimates of average weekly hours from household and establishment surveys for Canada and the United States for the 1976-2002 period. It should be noted that these annual estimates are based on the average of monthly estimates and should, in principle, capture the impact of vacations, holidays, strikes, sickness, maternity and paternity leave, unpaid hours, and off-the-job training on total annual hours worked.

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). This estimate reflects an average 37.9 hours per week for salaried workers and 31.9 hours for hourly paid employees, including overtime. 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, 3.4 hours per week (176 per year) or 9.9 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,

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[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.

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, and that 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. Table 6 provides estimates of constant price net capital stock based on the geometric depreciation assumption[7] for the total economy for Canada and the United States for the 1955-2001 period.

Intermediate goods

Data on constant price intermediate goods and raw materials are needed for calculation of multifactor productivity based on gross output. A key problem in this regard is the importance of imported intermediate goods and the manner in which the

[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, has 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] See Diewert (2003) for calculations of Canadian reproducible capital services aggregates under alternative assumptions of depreciation, opportunity cost of capital, and treatment of capital gains.

prices of imported intermediate goods are incorporated into the price indexes used to deflate current price intermediate goods. It has been suggested that in the United States, the prices of intermediate inputs reflect the prices of domestically produced intermediate goods only, biasing this index upward because of the exclusion of cheaper imported intermediate goods. As this paper examines only value added productivity measures, this issue will not be explored, but it is a very important consideration for future work on Canada-US total factor productivity comparisons based on gross output.

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).[8] 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 (Table 3, column F). 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.

A strength of the first methodology is that current dollar series capture shifts in the shares of expenditure components. A disadvantage is that the converted series is in current price common currency units, making it impossible to calculate growth rates in real terms. There are two solutions to this problem. The first is to not use the current common currency units for growth comparisons, relying instead on constant price national currency series for this purpose. The second is to convert the series in current price common currency series to a real series using the appropriate deflator from the common currency country. For example, PPPs would be used to convert Canadian GDP in current Canadian dollars to current US dollars, and the US GDP deflator would then be applied to convert the series to constant US dollars. It should be noted that growth rates calculated from the converted constant price common currency series will likely not correspond to growth rates of the official constant price national currency series.

The second methodology is conversion of a constant price national currency series to a real common currency series by applying the PPP in the base year of the

[8] Three multilateral PPP estimates are also available for Canada (Appendix Table 5). 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.

constant price series to the value in all years. The converted series retains the same growth rates as the series in national currency units, with the added benefit that only one PPP estimate is necessary. A disadvantage of this methodology it that base year expenditure shares are applied to all years in the series, ignoring shifts over time in expenditure patterns. This can be particularly problematic for very long periods. Given the advantages and disadvantages of each method, there is no professional consensus on which should be preferred.[9]

This paper presents both current price and constant price common currency (U.S. dollar) estimates for Canadian GDP based on the two methodologies outlined above.

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) and the United States (Table 4) for the 1946-2002 period in both nominal and real terms. Table 7 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. 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).

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.[10] 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 output per worker toward U.S. levels in the postwar period in Canada as even in 1946 the relative level was 79.8 per cent (Table 7)

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 in the output per hour relative estimates because average weekly hours worked are almost identical in the two countries. On the other hand, when household-based estimates are used, the Canada-

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[9] It should also be mentioned that the development of industry PPPs for industry level productivity comparisons is a much more complex issue than the development and use of expenditure PPPs and is not discussed in this paper.

[10] This estimates of the Canada-US 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 Smith (1996) for 1988. This paper finds that the gap in 1988 was 14 per cent (Table 7).

US 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). 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 CPS series, which only goes back to 1976.

The 8.2 percentage point difference in the Canada-US 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).

It is useful to compare the CSLS estimates of Canada's relative labour productivity presented above with estimates calculated by other researchers, including Angus Maddison, the Groningen Growth and Development Centre (GGDC) and the OECD.

Angus Maddison (2001) has compiled estimates of Canada's GDP per hour relative to that in the United States back to 1870. In 1870, Maddison calculates that GDP per hour worked in Canada was 76.0 per cent of that in the United States (Appendix Table 3 and Chart 7). By 1913, it had attained 86.9 per cent, the highest relative achieved in the history of the series. It fell to 81.7 per cent by 1950, then rose to 83.2 per cent in 1973. It has declined in the post-1973 period, falling to 78.2 per cent in 1990 and 75.4 per cent in 1998. For the postwar period, Maddison's labour productivity relatives are somewhat below those calculated by the CSLS (Chart 5). The 1998 estimate in particular is around 5 percentage points below the lowest CSLS estimates of 83 per cent.

The Groningen Growth and Development Centre at the University of Groningen in the Netherlands has compiled estimates on GDP per hour worked for Canada and the United States for 1950, 1960, 1973, and the 1979-2002 period inclusive (Appendix Table 5).[11] According to this source, in 2002 Canada's level of GDP per hour was 83.75 per cent of the U.S. level. This is somewhat higher than the CSLS productivity relative (constant dollar) based on CES U.S. hours (80.8 per cent), but below the CSLS relative based on CPS U.S. hours (89.0 per cent). The GGDC and CSLS series track relatively closely in the 1970s and 1980s, but the GGDC productivity relative is much higher in the 1950s and 1960s.

The GGDC data base also provides total economy productivity relatives for all OECD countries (Table 2). In 2001, four countries had higher levels of output per hour than the United States: Belgium (112.4 per cent of the U.S. level), Norway (109.7 per cent, France (101.8 per cent), and the Netherlands (100.9 per cent). Canada at 82.6 per

[11] These estimates are posted at www.eco.rug.nl/ggdc for free download.

cent ranked 13th out of 27 OECD countries, behind the four countries already mentioned, the United States (100.0 per cent), Ireland (98.4 per cent), Austria (95.9 per cent), Denmark (93.5 per cent), Germany (92.5 per cent), Italy (88.0 per cent), Finland (86.3 per cent), and Switzerland (85.8 per cent).

The OECD also produces a series on Canada's relative GDP per hour for selected years from 1960 to 2001 (Appendix Table 4). In 2001, this series shows that GDP per hour in Canada was 80.5 per cent of U. S. level. This is close to the lower CSLS estimate of 81.9 per cent and is likely explained by use of the multilateral OECD PPP rather than the bilateral Statistics Canada PPP. The OECD estimates for earlier years are also similar to CSLS estimates.

The estimates of Canada's relative productivity level from the sources discussed above are fairly consistent. 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. Table 8 shows that 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 8).

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 of that of the United States (Appendix Table 7). 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 (Appendix Table 6).

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 (Table 9) and 92.5 per cent using relative labour productivity based on the US CPS hours estimate (Table 10).[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 9).[13]

III Explanations for the Canada-US 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 is 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.[14]

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.[15] 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

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[12] The positive Canada-US 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 Smith (1996) for 1988. This paper finds that the gap in 1988 was 3.8 points using CPS hours (Table 10).

[13] This result is consistent with a recent study by Dachraoui and Harchaoui (2003) who found that mutlifactor productivity growth was slower in Canada than in the United States over the 1981-2000 period: 0.60 per cent versus 0.88 per cent per year. Using an experimental frontier approach to productivity measurement, the authors found that the technical change component of multifactor productivity advanced 0.76 per cent per year in Canada, but less efficiency in production relative to that in the United States reduced multifactor productivity growth 0.16 per cent.

[14] Within the context all countries of the world, Hall and Jones (1996) show that differences in governmental, cultural, and natural infrastructure are important sources of productivity variation. They find that a high-productivity country: 1) has institutions that favours production over diversion; 2) is open to international trade; 3) has at least some private ownership; 4) speaks an international language; and 5) is located in a temperate latitude far from the equator. A favourable infrastructure fosters productivity both by stimulating the accumulation of human and physical capital and by raising its total factor productivity. These five factors are not particularly relevant in explaining the Canada-U.S. labour productivity gap because the two countries do not exhibit significant differences in these areas.

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

industry statistics on the basis of the North American Industrial Classification System (NAICS), while 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, Table 11 presents, for exploratory purposes, both current dollar and constant dollar productivity relatives 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. 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 US level. The productivity relative for public administration of around 30 per cent likely reflects differences in the definition of the sector and should be ignored.

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. Table 11 thus shows that 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.

Although labour productivity relatives based on industry PPPs and a common industry classification system are not available, estimates of total factor productivity (TFP) Canada-U.S. relatives for 33 industries are available for 1995 from an Industry Canada study (Lee and Tang, 2002). This study based on a translog production function framework found that in 1995 Canada was less productive in terms of total factor productivity than the United States in 23 of 33 industries, up from 22 in 1988, 20 in 1973 and 25 in 1961 (Table 12).

Canada was found to be much less productive in: agriculture; forestry; crude petroleum and gas; paper; printing; rubber and plastics; stone, clay and glass; fabricated metals; industrial machinery; and transportation and warehousing. On the other hand, Canada was significantly more productive than the United States in: coal mining; construction; tobacco; petroleum refining; electrical utilities; and gas utilities. The authors concluded that the deterioration of Canada's TFP levels relative to those in the United States has become more widespread across industries since 1973.

As the Industry Canada study adjusted for labour and capital quality and used total factor productivity instead of labour productivity, its TFP relatives are not comparable to the labour productivity relatives in Table 11. There appear to be few common patterns, but one such pattern is in construction where both Canada's labour and TFP levels exceed those of the United States.

As Table 11 shows, at the ten 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, differences 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 ten 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-US relative capital-labour ratio at the total economy level in 2001 was 84.7 per cent based on employment (Table 13), 84.3 per cent based on US CES hours, and 92.6 per cent based on U.S. LFS hours (Table 14). The lower level of capital intensity means that Canada's gap in TFP with the United States is less than that for labour productivity, as seen in Tables 9 and 10.[16] 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 10).

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 productivity gap.

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

[16] This finding of lower capital intensity in Canada differs from that of nearly identical capital intensity between the two countries reported by Hall and Smith (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).

stock (Appendix Table 8 and 10) is actually greater in Canada than in the United States. Conversely, the capital-labour ratio for machinery and equipment (Appendix Tables 9 and 11) 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.

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 (Table 15 and Chart 11). 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.

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

Due to Canada's small size, the country 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

[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 the 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.

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 reflects 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 the 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 (Chart 12).

However, the profiles of educational attainment 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, 2001:55, Chart A10.3). Canada 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, 2002: 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, 2001:55, 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

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[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.

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 university 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 13). 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 university research institutions 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 its importance is extremely difficult to quantify.[23] One study attempt is by 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.

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.

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[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.

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 plant size are more difficult 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). 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. 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 (Appendix Table 12). 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, if non-existent, for three reasons. First, the main potential linkage between taxes and productivity is largely 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 (Table 16).

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 of how many hours of work to supply. Taxes do affect economic growth through their effects on labour supply, 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 a 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, 2001:61. 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. 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.

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 four countries with higher levels of output per hour than the United States in 2001 (Belgium, Norway, France, and the Netherlands in Table 2) 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 they 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 14). 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, 2001:73, Chart B6.2).[24] However, income support to the working age population was greater in Canada (5.2 per cent versus 2.2 per cent of GDP). 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

[24] 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).

in 1999 was 66 per cent compared to 55 per cent for the United States (OECD, 2001:59, 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.

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 (Appendix Table 13). 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 spur 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-US 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-US 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 and payroll taxes borne by employers. The lack of low productivity jobs increases average labour productivity through a composition effect. Canada's relative minimum wage is somewhat higher that that in the United States as is the incidence of low-wage employment, defined as the proportion of full-time workers earning less than two-thirds median earnings.

In mid-2000, the ratio of adult minimum wages to median full-time earnings was 0.42 in Canada (OECD, 2001:71, 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, 2001:67, 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.

IV Productivity Levels and Economic Well-being

This paper has addressed in detail the important issue of why aggregate productivity levels are higher in the United States than in Canada. This section briefly addresses the much broader, and even more crucial question of how important Canada-US productivity relatives are for the well-being of Canadians? One's definition of what constitutes economic well-being is key to answering this question. Productivity is the key determinant of living standards, defined as income per capita, and income is certainly an important component of any definition of economic well-being. But economic well-being also consists of equality and economic security. While higher productivity can indirectly provide the basis for improvements in these components of well-being, public policy plays a key role though policies and programs such as social assistance and Old Age Security which reduce income inequality, and policies and programs such as Employment Insurance and universal health coverage which provide economic security.

The Centre for the Study of Living Standards has developed an Index of Economic Well-being based on four components: consumption flows, stocks of wealth, income equality, and economic security and has produced estimates of the Index for Canada and the United States (Osberg and Sharpe (2002a) and OECD countries (Osberg and Sharpe, 2002b). The weighting scheme applied to these four components to calculate the overall index is crucial for the outcome.

In 1999, consumption flows per capita in Canada were 69.2 per cent of the U.S. level and per capita stocks of wealth were 92.1 per cent (Table 17 and Chart 15). But both equality and security were much higher in Canada than in the United States, 143.8 per cent and 150.2 per cent respectively of the U.S. level.

Consumption is the component of the Index most closely linked to productivity.[25] When a high weight is given to consumption, the United States emerges as having a higher level of economic well-being than Canada, as seen in the alternative weighting scheme (0.7 to consumption) in Chart 16. But when the four components of well-being are equally weighted, Canada obtains a higher level of economic well-being (113.8 per cent of the U.S. level) because of the greater income equality and economic security its citizens enjoy. While productivity can certainly have positive effects on equality and security, public policy can play an even greater role. For Canadians who give high weights to equality and security in their definition of economic well-being, public policy may trump productivity as a potential means to increase well-being.

V 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. 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.

The paper reviews possible explanations for this gap and concludes that it reflects four factors:

- The lower capital intensity of economic activity in Canada, estimated to account for around one fifth of the gap;

[25] See Sharpe (2002a) for discussion of the relationship between productivity and the four components of the Index of Economic Well-being.

- Canada's innovation gap as manifested by lower R&D expenditures and patenting as well as lags in the diffusion of best practice techniques in Canada;

- Canada's relatively underdeveloped high-tech sector which has had much lower productivity growth rates 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 found no conclusive evidence that the other factors examined, including industry structure, human capital, 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-US 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, 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.

References

Anderson, James and Eric Van Wincoop (2003) "Gravity with Gravitas: a Solution to the Border Puzzle," *American Economic Review*, Volume 93, Number 1, March, pp. 170-192.

Baily, Martin N, and Robert Solow (2001) "International Productivity Comparisons Built from the Firm Level," *Journal of Economic Perspectives*, Volume 15, Number 3, Summer, pp. 151-172.

Baldwin, John R., Ron S. Jarmin and Jianmin Tang (2002) "The Trend to Smaller Producers in Manufacturing: a Canada/US Comparison," Economic Analysis Research Paper Series, Number 003, Statistics Canada, May.

Bernstein, Jeffrey I., Richard G. Harris and Andrew Sharpe (2002) "The Widening Canada-US Productivity Gap in Manufacturing" *International Productivity Monitor* Number 5, Fall, pp. 3-22. Posted at www.csls.ca.

Chen, Duanjie and Jack Mintz (2003) "How Canada's Tax System Discourages Investment," *C.D. Howe Institute Backgrounder*, Number 68, January.

Coulombe, Serge (2002) "The Canada-US Productivity Growth Paradox," in Rao, Someshwar and Andrew Sharpe, editors (2002) *Productivity Issues in Canada* pp. 117-136 (Calgary: University of Calgary Press).

Dachraoui, Kais and Tarek Harchaoui (2003) "A Frontier Approach to Canada-U.S. Multifactor Productivity Performance," Micro-Economic Analysis Division, Statistics Canada, March.

Diewert, Erwin (2003) "Measuring Capital," NBER Working Paper No. 9526, February.

Eldridge, Lucy, Marilyn Manser, Phyllis Otto, and Brooks Robinson (2001) "Hours Data in Productivity Measures," paper prepared for the FESAC meeting, June 7-8.

Government of Canada (2002a) *Achieving Excellence: Investing in People, Knowledge and Opportunity*, February.

Government of Canada (2002b) *Knowledge Matters: Skills and Learning for Canadians*, February.

Hall, Robert E. and Charles I. Jones (1996) "The Productivity of Nations," Working Paper 5812, November, National Bureau of Economic Research.

Helliwell, John (1998) *How Much Do National Borders Matter?* (Washington, D.C.: Brookings Institution).

Kemp, Katherine (2002) "Purchasing Power Parities and Real Expenditures, United States and Canada, 1992-2001," Statistics Canada Cat. 13-604-MIB, No. 36, June.

Lee, Frank and Jianmin Tang (2002) "Productivity Levels and International Competitiveness Between Canada and the United States," in Someshwar Rao and Andrew Sharpe, editors *Productivity Issues in Canada* (Calgary: University of Calgary Press). Pp. 93-115.

Maddison, Angus (2001) *The World Economy: A Millennial Perspective* Paris: OECD Development Centre).

OECD (1998) "Annual Hours of Work: Definitional and Comparability Issues," paper prepared for the 16th Meeting of the Working Party on Employment and Unemployment

Statistics, March 23-24, Paris.

OECD (2001) *Society at a Glance: OECD Social Indicators* (Paris: OECD).

OECD (2001a) “Activities of the Working Party on Employment and Unemployment Statistics – Estimates of Annual Hours Actually Worked in OECD Countries,” DSTI/EAS/IND/SWP(2001)16.

OECD (2002) *Education at a Glance: OECD Indicators* (Paris: OECD).

Osberg, Lars and Andrew Sharpe (2002a) “The Index of Economic Well-being,” *Indicators: The Journal of Social Health*, Spring Vol. 1, No. 2, pp.24-62.

Osberg, Lars and Andrew Sharpe (2002b) An Index of Economic Well-being for Selected OECD Countries, *Review of Income and Wealth*, Series 48, Number 3, September, pp. 291-316. Posted at www.csls.ca.

Rao, Someshwar, Ashfaq Ahmad, William Horsman, and Phaedra Kaptein-Russell (2001) ‘The Importance of Innovation for Productivity,” *International Productivity Monitor*, Number Two, Spring, pp. 111-18. Posted at www.csls.ca.

Rao, Someshwar, Jianmin Tang and Weimin Wang (2002) “The Importance of Skills for Innovation and Productivity,” *International Productivity Monitor,* Number Four, Spring, pp. 15-26. Posted at www.csls.ca.

Sharpe, Andrew, France St-Hilaire and Keith Banting (2002) *Review of Economic Performance and Social Progress: Toward a Social Understanding of Productivity,* (Ottawa: Centre for the Study of Living Standards and Montreal: Institute for Research on Public Policy). Posted at www.csls.ca.

Sharpe, Andrew (2002a) “The Contribution of Productivity to Economic Well-being in Canada,” in Someshwar Rao and Andrew Sharpe (eds.) *Productivity Issues in Canada* (Calgary: University of Calgary Press), pp. 843-875.

Sharpe, Andrew (2002b) “Productivity Concepts, Trends and Prospects: An Overview,” in Andrew Sharpe, France St-Hilaire and Keith Banting *Review of Economic Performance and Social Progess: Linkages between Productivity and Social Progress* (Ottawa: Centre for the Study of Living Standards and Montreal: Institute for Research on Public Policy). Posted at www.csls.ca.

Smith, Jeremy (2003) “International Productivity Comparisons: An Examination of Data Sources,” *International Productivity Monitor,* Spring. posted at www.csls.ca.

Trajtenberg, Manual (2002) “Is Canada Missing the Technology Boat? Evidence from Patent Data,” in Someshwar Rao and Andrew Sharpe, eds. *Productivity Issues in Canada* (Calgary: University of Calgary Press).

United Nations Development Program (2001) *Human Development Report 2001: Making new technologies work for human development* (New York: Oxford University Press).

Van Ark, Bart (1998) "Annual Working Hours in the United States: Which Measure Should be Used for International Comparisons?" Groningen Growth and Development Centre, unpublished paper, July.

Van Ark, Bart (2002) "Understanding Productivity and Income Differentials in the OECD Area: A Survey," in Andrew Sharpe, France St-Hilaire and Keith Banting *Review of Economic Performance and Social Progess: Linkages between Productivity and Social Progress* (Ottawa: Centre for the Study of Living Standards and Montreal: Institute for Research on Public Policy). Posted at www.csls.ca.