6. ON THE IMPORTANCE OF USING COMPARABLE LABOUR INPUT TO MAKE INTERNATIONAL COMPARISON OF PRODUCTIVITY LEVELS
Canada-U.S., A Case Study

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Introduction

In 2005, Statistics Canada’s Canadian Productivity Accounts released two studies that, for the first time, examined the comparability of labour productivity levels between Canada and the United States. Previously, Statistics Canada limited comparisons to productivity growth rates. Using analogous sources, concepts and methods to obtain the most comparable measure possible of productivity levels, these new studies found that the Canada–U.S. productivity level difference was lower than normally described.

Neither the Canadian nor the American data used to measure work intensity for this project are the same as those used by many who have conducted Canada/U.S. comparisons of the level of labour productivity. Other studies have used data that were assumed to be comparable – such as data from the Labour Force Survey (LFS) in Canada and those from the equivalent American survey, the Current Population Survey (CPS) – but which are not.

This third study focuses in more depth on the construction of the volume of hours worked developed for this project and on the choice of estimates of jobs and population. It describes the reasons why the work intensity measures used in our Canada/U.S. project are superior to alternatives that are readily available but non-comparable and therefore inappropriate for studies of Canada/U.S. comparisons of the level of productivity.

The author would like to thank John Baldwin, Tarek Harchaoui and Mustapha Kaci for their invaluable help with the presentation and content of the various drafts that led to this final version. He also wishes to thank Don Drummond, Graham Rose and Gloria Wong for their relevant comments, as well as Mike Harper and Phyllis Otto from the Bureau of Labor Statistics for the many clarifications provided about U.S. labour statistics. This third article on the project comparing Canada–United States productivity levels initiated in fall 2003 by the Canadian Productivity Accounts would never have seen the light of day without the outstanding work of a team of analysts composed of Marc Tanguay, Jin Lee, Fanny Wong and Sean Burrows. However, despite the involvement of all these people, the author remains wholly responsible for any error or omission in this study.

Baldwin et al., 2005; Baldwin, Maynard and Wong, 2005.

This paper is a shorter version of a more detailed study The comparative level of GDP per capita in Canada and in the United States: A Decomposition into Labour Productivity and Work Intensity Differences.
This study answers the following questions:
1. What are the reasons for the choice of data to measure the volume of hours worked?
2. Why are the estimates of the volume of hours worked developed for this study the most appropriate for comparing levels of work intensity and hours worked per job between Canada and the United States?
3. What are the problems with traditional data sources that make them inappropriate for comparisons of levels?
4. What is the degree of error that is made if a study relies on alternate but easily accessible labour force sources to compare levels of productivity and work intensity between Canada and the United States?

The first section develops and illustrates the conceptual and methodological framework required to make Canada–United States estimates of labour and population comparable in terms of level.

Using the year 2000 as an example, the second section quantifies the “statistical error” that arises from using inadequate statistics or statistics not designed for this type of international comparison. This exercise reveals that the comparability of data on hours worked per job is especially crucial to identifying the origin of the differences in GDP per capita between labour productivity and hours worked per capita. The worst error involves comparing hours worked estimated from an employer survey with those obtained from a household survey. This type of comparison between Canada and the United States results in assigning an estimated 72% of the difference in GDP per capita to labour productivity when, in reality, it counted for barely 36% in 2000.

The last section of the paper presents a brief Canada-U.S. analysis of the GDP per capita differences and its components based on this comparable measure over the period 1994 to 2005.

**Estimation of labour input for comparisons of relative levels of labour productivity in Canada and the United States**

**Background**

Although Canada and the United States are located on the same continent and their culture and institutions are similar, the statistical systems in the two countries rely on concepts and methods that are not always equivalent. There are two possible approaches that can be used to draw cross-country comparisons using Canada/U.S. data:

a) A mechanical approach is to use various labour market data published by the two statistical systems without considering the initial objective for which the series were established and whether series with similar titles are really comparable;

b) A more time intensive approach is to compare sources, concepts and methods and to make modifications to the series of one or other country to reconcile differences.
It was the latter approach that was adopted by Baldwin et al., (2005) and Baldwin, Maynard and Wong (2005), who made a considerable effort to ensure that the various components of the decomposition of GDP per capita were as comparable as possible in terms of concept and coverage.

**Selection criteria**

There are a number of different sources that can be used to develop estimates of labour inputs for the purpose of comparing productivity levels in Canada and the United States. The suitability of particular sources depends on four factors: the extent to which they are consistent with the required concept, whether their coverage is appropriate, whether their methodology is comparable, and whether their accuracy is similar.

**Concept**

An estimate of labour input for the purposes of analyzing productivity must allow for the measurement of the derived work effort that most accurately reflects the production of goods and services.

Labour input can be measured by the number of persons employed or by the hours worked. Since workers do not work the same hours in every country, differences in effort are better reflected by the volume of hours worked than by the number of persons employed.

The 1993 System of National Accounts thus proposed hours worked as the preferred measure to be used with gross domestic product (GDP) for productivity estimates. Furthermore, the international definition of what constitutes work is based on time worked.

The System of National Accounts (1993) uses a definition of hours worked that is consistent with the concept defined by the International Labour Office.\(^{85}\)

According to the retained definition, hours worked means the total number of hours that a person spends working, whether paid or not. In general, this includes regular and overtime hours, breaks, travel time, training in the workplace and time lost in brief work stoppages where workers remain at their posts. On the other hand, time lost due to strikes, lockouts, annual vacation, public holidays, sick leave, maternity leave or leave for personal needs are not included in total hours worked.

**Coverage**

Estimation of labour inputs must correspond as closely as possible to the National Accounts production boundary, which serves to measure the production of goods and services. This applies to estimates of jobs, hours and population when gross domestic product per capita is calculated. Some labour input sources do not cover all sectors. For example, agriculture is usually excluded from employer surveys. Some population aggregates also exclude a

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\(^{85}\) For the official definition, see System of National Accounts 1993, Chapter XVII, Section 3
substantial number of individuals (i.e., those who live in institutions, such as long-term care facilities and penitentiaries or military personnel). Ideally, sources that provide only partial coverage need to be supplemented by data on the excluded part of the population.

**Accuracy or quality of estimates**

The accuracy of each estimate associated with a survey depends on both sampling error and non-sampling error. Sampling error will depend on the size of the sample and its design, while non-sampling error will depend on administrative practices, coverage problems and definitions.

The quality of an estimate is partially dependent on its intended use. Some estimates may be highly appropriate for some uses and less so for others. For example, a particular source of labour data may be downward biased in terms of levels, while providing a good indication of the trend. Such a data source is appropriate for developing an estimate of labour growth used to derive estimates of labour productivity growth, but it would be inappropriate for estimating the level of labour productivity.

In fact, as we note below, this issue is critical to the choice of a particular estimate of labour input for the United States and Canada if comparable estimates of the productivity levels in each country are to be produced.

**Corroboration**

Discovering information that corroborates estimates of labour input is one way of evaluating the quality of such estimates. Alternative methods, albeit imperfect, can still be indicative of the appropriateness of the chosen estimate.

**Sources of labour inputs**

There are two main sources from which estimates of labour input for Canada and the United States can be produced, namely household surveys and employer surveys. The first collects information by asking members of selected households whether they are working and how much time they spend at work, whether paid or unpaid. The second asks employers directly for information on the number of people working at their businesses and the amount of time they work (normally their hours paid).

Each of these surveys differs in terms of accuracy, although it is important to note that accuracy depends on the intended use for each source. What is appropriate for one use is not necessarily appropriate for another. We have already noted that what would be adequate for comparing the employment growth rates in each country may not be adequate for comparing levels. Different series may provide essentially similar estimates of growth rates but different estimates of levels. It should be noted that producing accurate data in terms of levels is much more demanding in terms of statistical quality than what is necessary to provide a trend indicator.

It is important to recognize that surveys are often developed to meet objectives that are different from those of a particular analyst – especially those conducting cross-country comparisons. A household survey may be developed to provide information on short-term
trends in the labour market but not necessarily to estimate the level of the employment–population ratio. Moreover, a household survey does not necessarily constitute the best instrument for obtaining full coverage of all jobs in the economy, but may yield a more than adequate estimate of hours worked per job.

In evaluating the extent to which a particular data source is appropriate for a particular use, an analyst needs to ask whether the respondent has the ability to provide the information requested. An equally important consideration is whether the statistical agency is able to deal with the estimation difficulties associated with a particular instrument used for data collection.

Both household surveys and enterprise surveys encounter problems in obtaining hours worked, which is required for measuring productivity. However, the problems and the solutions for dealing with them are different in each case.

**Enterprise surveys**

Hours worked data from enterprise surveys contain several problems. The first is that firms often do not keep data on jobs that are not paid on an hourly basis. This includes white collar workers or the self-employed. It also includes workers with non-standard working arrangements. The latter make up a substantial part of the workforce. The Upjohn Institute reports that only 70% of workers are in jobs with standard work arrangements (Houseman, 1999). And of this group, only about 70% are hourly workers. This is becoming more of a problem in the service economy as contracts are often specified in terms of annual salaries with unspecified overtime commitments.

A second problem occurs since enterprises can generally only report hours paid and not hours worked. And the size of unpaid hours worked has been increasing over the last two decades. In Canada, almost 9% of jobs report unpaid overtime, accounting for between 2% and 3% of total hours worked.86

These problems have been dealt with in the United States in different ways. For example, the Bureau of Labor Statistics (BLS) supplements the hours worked estimates derived from an enterprise survey (the Current Employment Survey, or CES) for hourly workers with data on hours worked for salaried workers and self-employed workers taken from its household survey (the Current Population Survey, or CPS). Hours paid are transformed into hours worked with other information on how many hours worked are unpaid and on how many hours paid have not been worked (e.g., paid vacations, paid sick leave, etc.).

Enterprise surveys may also have problems obtaining data on hours worked from businesses if firms just do not keep track of hours worked data. As the work week becomes less standardized, firms have less of an incentive to keep hours worked as part of their management information systems. Indeed, Statistics Canada gave up asking questions about hours worked on its enterprise manufacturing surveys in the 1990s when the response rate to these questions fell well below 50% and resort to widespread imputations became extensive.

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86 Special extractions from the 1998 Labour Force Survey.
Household surveys

Household surveys have been developed with an extensive set of questions that permit statistical agencies to delve into the labour market status of household members, the type of work that they perform, and the number of hours including usual hours, and overtime hours, hours without remuneration and the reasons for time lost – due to holidays, sickness, etc.

When these surveys are conducted across different classes of workers (paid hourly, salaried, self-employed), they generate estimates with good coverage. And since they ask for both paid and unpaid hours worked, they permit direct coverage of the definition of hours worked that meets international standards of work effort.

While household surveys have the advantage over enterprise surveys in that they directly request information on the concepts required to meet international standards, household surveys do face various problems in providing error-free estimates of hours worked.

First, in many households, the respondent will provide proxy answers for members of the household who are not present. And since respondents are asked for information on the previous week’s experience, there may be a case of recall bias – that is, respondents may not remember precisely the hours actually worked in the previous week.

Survey methodologists in statistical agencies have devised ingenious methods to minimize these problems. The solution has been to design detailed questionnaires with special prompts as to unusual events in previous weeks, and to do follow-up surveys to gauge error rates. The result is a professional product in which most statistical agencies place great confidence.

It is nevertheless the case that household surveys often need special editing because they are not continuous surveys and extrapolation of the results from the survey week to other weeks for the purposes of the Productivity Accounts requires recognition that holidays affect each week in a month differently. Household surveys may have problems with unusual events that occur during the reference week. The solution of the Canadian Productivity Accounts is to make detailed use of data on holidays and other events to provide ‘corrected’ estimates for other weeks in a month.

Enterprise surveys will not have problems with holidays that occur during the reference week if they report hours paid – but to transform this estimate to number of hours worked to other periods not covered by the pay period requires transformations that are extremely complex.

Estimating the volume of hours worked

Despite our preference for the data on hours worked that are produced by household surveys, not all components that are required to estimate total hours worked for various categories (class of worker, industry, region) are available from one source.

Part of this problem arises because of slightly imperfect coverage of the household survey in Canada. Part of it arises because of inadequate industry coverage (low sample size) in the Labour Force Survey at very fine levels of industry detail.
Therefore, the Canadian Productivity Accounts (CPA) proceeds in several stages to develop total hours worked for its industry accounts. Only the first two are relevant here. At the level of the economy as a whole, the CPA first generates estimates of jobs, and then it calculates estimates of hours worked per job. The volume of hours worked is then obtained by multiplying these two components together.

\[ \Sigma \Sigma (J_{imn} \times H_{imn}) = Vh_{imn} \]  
\( J = \) number of jobs  
\( H = \) average annual hours worked  
\( Vh = \) total hours worked

where \( i = \) industry, \( m = \) region and \( n = \) category of worker (hourly, salaried, self-employed).

**Jobs**

The CPA focus on the concept of Jobs instead of Persons Employed since it is this notion that is specified by the System of National Accounts. Jobs is chosen as the basic unit since it corresponds more closely to production than does a person employed in a world where persons can have multiple jobs.

Enterprise surveys tend to capture the number of jobs (though analysts will often incorrectly refer to the measure yielded by an enterprise survey as employment). On the other hand, household surveys focus on the person who is employed – but, with a set of additional questions, can ascertain whether that person has multiple jobs and where those jobs are located and thus estimate both employment and jobs.

In Canada, the Productivity Accounts use the Labour Force Survey to measure both employment and total number of jobs – enhanced by several other sources to cover the small number of segments not covered by this survey. The Labour Force Survey is benchmarked to the Canadian Census of Population – which is taken at five-year intervals and regular revisions are made to benchmark totals derived from Census totals and results are backcast to provide historically consistent series.

However, the U.S. employer survey is considered more reliable than the household survey for estimating number of jobs in the United States for our purposes. Aside from the fact it does not entail any breaks, the aggregated series that comes out of the Current Employment Survey (CES) is adjusted annually to a benchmark based on the administrative data collected for the purposes of managing the unemployment insurance program (Nardone et al., 2003), making the CES a complete source of information on non-agricultural employment. Information on

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87 The reader is referred to Girard, Maynard and Tanguay (2006) for more discussion of how detailed industry labour estimates are obtained for the Canadian Productivity Accounts.

88 In October 2003, a group of authors from the Bureau of Labor Statistics and the Bureau of Economic Analysis prepared an article analyzing the discrepancy between the employment figures from the Current Population Survey and the Current Employment Survey for a presentation to the Federal Economic Statistics Advisory Committee. The article contains a host of information and explanations on the differences between the two surveys. For further details, see “Examining the Discrepancy in Employment Growth between the CPS and the CES” by Nardone et al.
employment for the groups not covered by the CES, such as unincorporated self-employed workers, family workers and farm workers, is complemented by other sources, the main one being the Current Population Survey (CPS).

**An illustration of the differences between the concepts of jobs and of persons employed in the United States**

For United States data, we choose the enterprise survey rather than the labour force survey to estimate total jobs because of well-known undercoverage in the CPS (Nardone et al., 2003). The CPS, like its Canadian counterpart, is benchmarked to the population census. However, the adjustment is decennial in the United States and quinquennial in Canada. During the 1990s, the U.S. projection system used to extrapolate the 1990 Census estimates fell further and further behind. As a result, the CPS sample frame, i.e., estimates of population aged 16 years and over, has some serious weaknesses for our purposes. The results of the 2000 Census revealed an underestimation of the working-age civilian non-institutional population that was equivalent to 2.7 million people that was mainly reflecting an underestimation of immigration, particularly undocumented and temporary immigrants (Nardone et al., 2003).

The CPS survey results were therefore substantially revised when the 2000 Census results became available. However, these revisions were made only for the period after 2000, resulting in a substantial break between the period prior to 2000 and that which followed (see graph 6–1, which compares the employment estimates derived from the CES to the estimates obtained from the CPS). The fact that the CPS measure of persons employed is subject only to periodic review and incomplete revision makes this source less than ideal for historical international comparisons.
In contrast, it is felt that the CES suffers less from this problem. In light of their undocumented status, Nardone et al. (2003) suspect that this population of immigrants would be very reluctant to respond to household surveys (Nardone et al., 2003) and argue that the CES employer survey would be much more likely to capture the jobs held by undocumented immigrants. Employers must, in fact, report the number of employees they have to the Employment Insurance program once a year. It should be recalled that it is the data from this file that is used as an annual benchmark for the CES. Frequent audits of this file have revealed a significant increase in the number of employees with false Social Security numbers. It was also noted that the use of false numbers was more likely to occur in industries in which employers have a tendency to hire more immigrants.

**Jobs versus employment**

While we focus on the number of jobs in our analysis, we can reconcile it with the number of persons employed from the sources that are utilized. Table 6–1 illustrates for 2002 the change from the concept of number of persons employed as published by the household surveys of the two countries to that of number of jobs, in keeping with the framework of the System of National Accounts that we are using here.

Some of the differences in table 6–1 between estimates of jobs and employment arise from differences in coverage, some come from differences in concept – since both jobs and employment data come from the same source (the Labour Force Survey [LFS]) for Canada, but different sources for the United States (jobs from the Current Employment Survey [CES] and employment from the Current Population Survey [CPS]).

### T 6–1 Difference between the number of persons employed and the number of jobs, 2002

<table>
<thead>
<tr>
<th></th>
<th>Canada (A)</th>
<th>United States (B)</th>
<th>(A) / (B) in percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Persons employed</td>
<td>15,310</td>
<td>136,485</td>
<td>11.2</td>
</tr>
<tr>
<td>2. plus Persons holding jobs</td>
<td>756</td>
<td>7,691</td>
<td>9.8</td>
</tr>
<tr>
<td>3. minus Unpaid absences</td>
<td>674</td>
<td>2,076</td>
<td>32.5</td>
</tr>
<tr>
<td>4. plus Military personnel</td>
<td>82</td>
<td>1,464</td>
<td>5.6</td>
</tr>
<tr>
<td>5. plus Other adjustments</td>
<td>87</td>
<td>2,386</td>
<td>3.6</td>
</tr>
<tr>
<td>6. equal Number of jobs</td>
<td>15,559</td>
<td>145,950</td>
<td>10.7</td>
</tr>
<tr>
<td>7. Line ([(6) / (1)] - 1) × 100</td>
<td>2%</td>
<td>7%</td>
<td>-5</td>
</tr>
</tbody>
</table>

Note: Calculations are based on labour sources produced by both countries.
Source: Statistics Canada, Canadian Productivity Accounts.

Line 1 is total employment as derived from the household surveys in both countries. The second line adds multiple jobs to those who are employed as generated by the household surveys. The third adjusts for a difference in concept – people who are absent from work
but have a job are not included in the work concept that is required for productivity purposes but are included in the number of people who have a job by labour market analysts. They therefore are subtracted from the second line. The fourth corrects for differences in coverage since the military are often left out of household surveys but need to be added in for complete coverage of labour markets. The fifth line includes additional adjustments to bring the total employment number yielded by the household surveys into line with the number of jobs. For Canada, these include people on First Nation reserves, in the north, and government employees outside of Canada that are missed by the LFS. For the United States, this adjustment comes from taking the difference between the total number of jobs as defined by the CES and the total derived from the CPS using the same adjustments outlined in lines 2, 3 and 4. It will include the same type of adjustments made for Canada – slight geographic extensions – but the primary difference results from a substantial undercoverage of the CPS relative to the CES in terms of number of jobs, as was discussed in the previous section.

An illustration of the differences between the estimate of jobs and of persons employed in Canada

Changing from one concept to the other is associated with a 2% increase in the variable in Canada (column A), as compared to 7% for the United States (column B).

There are many reasons for the difference in the magnitude of the adjustments between the two countries. They have to do with the difference in the way the labour market is regulated and the percentage of military personnel in each country as well as purely geographical questions and their impact on the accuracy of the statistics compiled.

For example, the number of persons who responded that they held a job but who were absent from work and were not paid by their employer, as a percentage of the number of
persons employed, was three times higher in Canada than in the United States in 2002. While it was relatively stable until 2000, this percentage has grown significantly in the interim, partly because of the adoption in Canada of legislation supporting parental leave funded through the employment insurance program\(^89\) (see graph 6–2).

Furthermore, Canada differs from the United States in terms of the role and the place held by the armed forces. The number of military, as a percentage of the number of persons employed, in the United States, is approximately double that of Canada.

Lastly, it should be noted that the percentage of other adjustments that we make here, which primarily relates to those of a statistical nature, is three times higher for the United States than for Canada. In Canada, this category reflects the addition of northern Canada and of Aboriginal reserves. For the United States, this category stems from the difference between the figures for the number of persons employed obtained from the CPS and that of the number of jobs derived from the U.S. productivity program, which is obtained by adding the CPS data for jobs in farms, private households and self-employment to the number of paid jobs from the CES.

**Hours worked per job**

Hours worked in this study are calculated from the labour force surveys of the two countries for the reasons outlined above. But in both countries, adjustments are made to the series since the unadjusted estimates do not adequately take into account holidays. Each of the labour force surveys is conducted monthly but covers only one week. The results of that week need to be extrapolated to other weeks in the month. In doing so, we need to recognize that the reference week used by the household survey may not be representative of the other weeks in the month, either because it has more or less holidays than other weeks.

The Canadian Productivity Accounts (CPA) have developed a procedure to make the corrections to raw Labour Force Survey totals – to correct for what we refer to as reference-week bias. In this study, average hours from the Current Population Survey were subject to the same type of adjustment as those from the CPA so as to correct the estimation bias associated with the choice of reference week. We explain below what these adjustments entail (see Maynard, 2005 for details).

The occurrence of a public holiday or specific vacation during the reference week means that the number of hours worked as collected through the survey for this week are not representative of the 52 weeks that make up the year as a whole. For Canada, we identified 13 statutory public holidays that are recognized by either a provincial or the federal government. Of that number, there are two that appear regularly during the reference week and three others that appear sporadically. We observed a similar phenomenon in the United States, but it was of lesser magnitude. Of the 11 federal holidays granted as days of rest in the United States, only three appear during the CPS reference week, including two that occur on an irregular basis (Eldridge, Manser and Flohr, 2004).

\(^{89}\) The other reason for this large percentage relates to the economic cycle: temporary layoffs tend to increase when the economy is in a downturn. A similar phenomenon was observed during the recessions of 1980 to 1981 and 1990 to 1992. See Galarneau et al., (2005) for further details.
In Canada, the estimation bias associated with the reference week owing to such factors as the sporadic presence of statutory public holidays primarily affects the trend in average hours. However, average annual hours calculated solely from the 12 reference weeks causes a relatively lower error than in the United States in terms of levels. In the United States, average annual hours calculated solely from the 12 reference weeks are nonetheless less vulnerable to trend bias (see table 6–2).

### T6–2 Effect of adjustment of hours per job on Canadian and U.S. estimates, all jobs

<table>
<thead>
<tr>
<th>Total</th>
<th>Unadjusted hours</th>
<th>Adjusted hours</th>
<th>Percentage difference between unadjusted and adjusted hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Canada</td>
<td>United States</td>
<td>Canada</td>
</tr>
<tr>
<td>1994</td>
<td>1,811.8</td>
<td>1,944.5</td>
<td>1,762.2</td>
</tr>
<tr>
<td>1995</td>
<td>1,799.3</td>
<td>1,951.8</td>
<td>1,761.0</td>
</tr>
<tr>
<td>1996</td>
<td>1,811.9</td>
<td>1,957.4</td>
<td>1,774.1</td>
</tr>
<tr>
<td>1997</td>
<td>1,813.0</td>
<td>1,967.0</td>
<td>1,767.4</td>
</tr>
<tr>
<td>1998</td>
<td>1,796.7</td>
<td>1,954.0</td>
<td>1,766.8</td>
</tr>
<tr>
<td>1999</td>
<td>1,811.5</td>
<td>1,972.0</td>
<td>1,769.0</td>
</tr>
<tr>
<td>2000</td>
<td>1,823.8</td>
<td>1,983.0</td>
<td>1,767.7</td>
</tr>
<tr>
<td>2001</td>
<td>1,788.6</td>
<td>1,955.0</td>
<td>1,762.1</td>
</tr>
<tr>
<td>2002</td>
<td>1,775.9</td>
<td>1,954.5</td>
<td>1,744.3</td>
</tr>
<tr>
<td>2003</td>
<td>1,745.1</td>
<td>1,949.3</td>
<td>1,734.0</td>
</tr>
<tr>
<td>2004</td>
<td>1,762.6</td>
<td>1,955.3</td>
<td>1,752.5</td>
</tr>
<tr>
<td>2005</td>
<td>1,777.3</td>
<td>1,955.9</td>
<td>1,738.1</td>
</tr>
<tr>
<td>Average</td>
<td>1,791.9</td>
<td>1,958.4</td>
<td>1,757.6</td>
</tr>
</tbody>
</table>

Notes: Calculations are mainly based on Labour Force Survey microdata for Canada and on Current Population Survey microdata for the United States. Unadjusted hours are obtained by using the number of persons employed 15 years and over as denominator while the adjusted hours worked are using the number of SNA jobs as denominator.

Source: Statistics Canada, Canadian Productivity Accounts.

In the CPA’s case, adjustment of hours can be summarized in four steps. An initial adjustment entails neutralizing the effect of statutory holidays on the reference weeks by adding the number of hours of absence to actual hours. Weekly hours are then standardized. The next step is a linear interpolation of the number of standardized hours in the reference weeks for the purpose of producing estimates for all weeks of the year. At the same time, estimates of hours of absence relating to statutory holidays and certain specific vacations that arise during the weeks other than the survey’s reference weeks are estimated from the number of lost hours observed using the reference weeks for all jobs. These hours of absence as well as those observed during the reference weeks are then subtracted from the estimate of standardized hours. These adjustments give a better annual estimate of hours worked since the hours actually lost because of statutory holidays (which occur every year) are systematically deducted from the CPA database year after year.

The same type of adjustment also applies to certain vacation hours since in some provinces the reference weeks coincide sporadically with vacations on fixed dates, such as those of construction employees in Quebec and the school break for primary and secondary school
teachers. A final adjustment is also made to take into account the fact that calendar years do not necessarily start on a Sunday and do not necessarily end on a Saturday.

We applied similar adjustments to the data on hours worked from the Current Population Survey. The information on hours of absence and the reasons for them that had been captured during the reference weeks were used to estimate hours lost owing to public holidays that do not appear during the survey’s reference week. We have also made an extensive use of the U.S. time use survey to improve the estimation of hours lost due to holidays. The time use survey was used here to help derive U.S. estimates because the CPS reference weeks do not cover enough statutory holidays.

This series of adjustments eliminated the bias associated with specific events that affect both the level and the trend for hours per job. In both Canada and the United States, this series of adjustments reduced the level of average hours calculated solely on the basis of the 12 reference weeks. Table 6–2 contains series that show the impact of the adjustment of hours worked for Canada and the United States.

In Canada, this adjustment resulted in a decrease in average hours of approximately 2% per year over the period from 1994 to 2005, while in the United States the same type of adjustment represents a 5.9% decrease. The more substantial decrease observed in the United States comes from the fact that the Bureau of Labor Statistics statisticians chose the reference week so as to minimize the presence of public holidays. This means that the comparison of unadjusted hours worked from the household surveys of the two countries exaggerates the difference in hours per job (and per person) between Canada and the United States.

It is useful to ask whether there is outside information on the reliability of our estimates of the number of days lost that corrects for reference week bias. Without a weekly labour force survey, the only way to validate our estimates is through information taken from Canada’s labour legislation. Table 6–3 provides estimates of the number of days lost in relation to the primary reasons for absence for Canada and the United States. These data reflect the adjustments described above.

### T 6–3 Number of days and hours of work lost by salaried employees, by reason, in Canada and the United States, 2002

<table>
<thead>
<tr>
<th>Reason</th>
<th>Canada</th>
<th></th>
<th>United States</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours lost</td>
<td>Days lost</td>
<td>Hours lost</td>
<td>Days lost</td>
</tr>
<tr>
<td>Annual vacation</td>
<td>96</td>
<td>12.0</td>
<td>67</td>
<td>8.4</td>
</tr>
<tr>
<td>Public holidays</td>
<td>54</td>
<td>6.7</td>
<td>30</td>
<td>3.8</td>
</tr>
<tr>
<td>Temporary layoff</td>
<td>2</td>
<td>0.3</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>Illness or accident</td>
<td>34</td>
<td>4.2</td>
<td>26</td>
<td>3.3</td>
</tr>
<tr>
<td>Inclement weather</td>
<td>2</td>
<td>0.2</td>
<td>2</td>
<td>0.3</td>
</tr>
<tr>
<td>Family or personal responsibilities</td>
<td>10</td>
<td>1.2</td>
<td>10</td>
<td>1.3</td>
</tr>
<tr>
<td>Maternity</td>
<td>4</td>
<td>0.5</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>0.5</td>
<td>32</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>205</td>
<td>26</td>
<td>174</td>
<td>22</td>
</tr>
</tbody>
</table>

Notes: The number of days in this table is estimated on the assumption that a workday equals 7.5 hours per day. Labour Force Survey and Current Population Survey hours of absence are compiled after adjustment for holidays and vacations.

Source: Statistics Canada, Canadian Productivity Accounts.
Canada’s labour legislation requires a minimum of two weeks of vacation per year. An average of 12 days lost through vacation is therefore entirely reasonable. As for public holidays, the majority of full-time Canadian workers are entitled to eight major holidays. Approximately one-quarter of the full-time workforce, largely in the government sector, is entitled to a maximum of 11 statutory public holidays. Given the large percentage accounted for by part-time work, seasonal work and essential services (in health and security, for example), an average of 6.7 days lost for this reason is acceptable. When only full-time workers are taken into consideration, the average number of hours lost through annual vacations is 102.6 hours (13.7 days), while the equivalent figure for statutory holidays is 62 hours lost, or 8.3 days. This suggests that our estimates are comparable to those enforced by the legislation.

In the United States, public holidays and vacations are not mandatory. This probably explains why our adjusted estimates from the CPS show fewer hours lost than in Canada for statutory public holidays and vacations. The same holds true for most other categories, except for temporary layoffs and weather. However, it must be noted that the figure for the “Other” category is eight times higher in the United States. This result could be an indication that the data on causes of days lost for the United States are less accurate.

Measurement of population

For comparisons of gross domestic product (GDP) per capita or of hours worked per capita, estimates of population are also required.

The notion of population and its derivatives, such as working-age population, which is consistent in terms of GDP coverage, is resident population. This concept, which includes the armed forces and persons in institutions, is consistent with GDP coverage – because this indicator includes the activities of these groups when measuring the total value of economic activity. It is this concept that is used in the official measure of GDP per capita published in the National Accounts tables of both countries.

There is a different concept of the population that is used in labour force surveys – that of the civilian non-institutional population, which excludes some who are considered not to be relevant by analysts who are trying to estimate how well the economy is supplying jobs to its population. This definition leaves out the young by choosing to look at those above a certain age – 15 years and over in Canada and 16 years and over in the United States. In addition, the military is left out for the anachronistic reason that these individuals are not considered to be voluntarily participating in this labour market, which may have been true when military drafts were common but is no longer the case in either Canada or the United States. Finally, those who are in institutions (penitentiaries, long-term care hospitals) are omitted because of the belief that these individuals cannot participate in labour markets.

Table 6–4 reconciles the two population measures. The differences, calculated as a percentage of the resident population, are about the same.

While there are conceptual differences between the estimates of population that are associated with the labour force surveys, there are also differences in accuracy. Population estimates taken from different sources differ from one another – particularly in the United States. Analysts need to take these differences into account when choosing a particular source.
On the one hand are the estimates of population that are provided in both countries by the census of population from a periodic (five-year intervals in Canada and ten-year intervals in the United States) census. This is regarded as perhaps the most comprehensive and accurate method of collecting data – though it is not without error. But these errors are carefully tracked via post enumeration surveys. For the 1990 Census, the U.S. Census Bureau estimated that the undercount was 1.6%.\textsuperscript{90} For the 2000 U.S. Census, the undercount was initially estimated at about 1.2%,\textsuperscript{91} but this estimate was revised downward to -0.49%.\textsuperscript{92} In neither 1990 nor 2000 was the U.S. Census adjusted since it was felt the error in the Census was within the margin of error that the post-enumeration estimates provided.\textsuperscript{93}

But a population program also provides intercensal projections – using data on births, deaths, immigration and emigration – to predict population changes in intercensal years. And as pointed out previously, Canada and the United States have differed in the accuracy of these projections in intercensal periods because of differences in the frequency with which the census is taken (5 years in Canada but 10 years in the U.S.) and differences in the extent to which there is unmeasured immigration in each country. Nardone et al., (2003) have outlined the main reasons for the underestimation of population in the United States for the intercensal estimates. The latter pertained primarily to immigration that appears to have been greatly underestimated in the intercensal data between the 1990 and 2000 censuses. The characteristics of this population are quite different from those of the original population. Research has shown that the number of undocumented and temporary immigrants, large numbers of whom are Hispanic or black, was considerably underestimated between 1990 and

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\textsuperscript{91} U.S., Census Monitoring Board (2001).
\textsuperscript{92} Robinson and Kostanich (2003).
\textsuperscript{93} Stark (2002) argues that this is justified since the post-enumeration surveys that are used to estimate the size of the census error themselves are subject to error that is about the same as their estimate of the census error.
2000 (Nardone et al., 2003). But these intercensal estimates can be and are revised backward after benchmarks become available from census years. However, the extent to which this revision is made differs across U.S. sources.

**Accuracy of civilian non-institutional population estimates from the Current Population Survey (CPS) as compared to resident population**

The data on resident population that are published by the U.S. Census Bureau are quicker to reflect all of the revisions deemed necessary to make methodological changes to these estimates and do so in most cases without introducing any breaks in continuity. As can be seen from graph 6–3, which compares the estimate of the over 16 years resident population from the census to the population estimate for this group published by the Current Population Survey (CPS), the population estimates that are used by the CPS that are derived from the projections of the population program are not revised backward completely after benchmark adjustments.

The figure shows the breaks that affected the CPS series in 2000 and 2003. In looking at graph 6–4, which compares the same series for Canada, it can be seen that the population aged 15 and up from the Labour Force Survey (LFS) is consistent with that from the post-census estimates of population. The difference between the two arises from the fact that the census is using the resident concept while the LFS is using the civilian non-institutional concept and the fact that the ratio between the two remains constant indicates that the two measures are generally fully reconciled in Canada.
Accuracy of Canadian estimates of civilian non-institutional population from the Labour Force Survey (LFS) compared to resident population

![Graph showing comparison between resident population and population from LFS]

Notes: Resident population is derived from CANSIM series 051-0005; civilian population, 15 years and over comes from the Labour Force Survey (special aggregate calculated by the Canadian Productivity Accounts). Source: Statistics Canada, Canadian Productivity Accounts.

Framework for reconciliation between alternative measures

The framework

This section quantifies the errors committed when alternate, easily accessible but non-comparable data sources are used in order to compare the sources of differences in GDP per capita between Canada and the United States.

To analyse the impact of these alternate measures, we use a standard identity that decomposes real GDP per capita into its constituent parts, namely labour productivity and work intensity.

\[
\frac{GDP}{POP} = \frac{GDP}{HRS} \cdot \frac{HRS}{EMP} \cdot \frac{EMP}{WAP} \cdot \frac{WAP}{POP}
\]

(2)

where \( GDP \), \( POP \), \( HRS \), \( EMP \) and \( WAP \) represent, respectively, GDP expressed in comparable currencies using purchasing power parities, population, number of hours, number of jobs, and working-age population (the appropriate measures for these variables are discussed below). The ratios \( \frac{HRS}{EMP} \) and \( \frac{EMP}{WAP} \) are referred to, respectively, as average number of hours and the employment rate.
To analyse more precisely some key factors of the standard of living, the work intensity variable is divided into three components – the number of hours per job, the number of jobs per member of the potential labour force and the potential labour force relative to the overall population.

**Results based on three different alternatives**

Table 6–5 presents the results of the decomposition of the Canada–U.S. difference in GDP per capita for the year 2000 using two inappropriate measures that have been occasionally used for Canada/U.S. comparisons. The first inappropriate measure (line 1) uses estimates of labour input developed by the productivity program of each country to measure the *growth* in labour productivity. Note that the primary objective of these programs is to estimate productivity *growth* and not the *level* of productivity relative to other countries. The second measure (line 2) uses data coming from the monthly household surveys of the two countries – the Labour Force Survey (LFS) in Canada and the Current Population Survey (CPS) in the United States. The third measure (line 3) makes use of the data on labour inputs generated in the Statistics Canada project that developed comparable data to be used to estimate the relative level of Canada – U.S. productivity.

<table>
<thead>
<tr>
<th>Source data</th>
<th>GDP per capita</th>
<th>Labour productivity</th>
<th>Work intensity</th>
<th>Work intensity components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hours worked per capita</td>
<td>Hours worked per job</td>
</tr>
<tr>
<td>1. CPA / BLS-PA</td>
<td>-20</td>
<td>-14</td>
<td>-6</td>
<td>+1</td>
</tr>
<tr>
<td>2. LFS / CPS</td>
<td>-20</td>
<td>-11</td>
<td>-9</td>
<td>-8</td>
</tr>
<tr>
<td>3. CPA project</td>
<td>-20</td>
<td>-7</td>
<td>-13</td>
<td>-6</td>
</tr>
</tbody>
</table>

Notes: Differences are expressed in this study in logarithms to preserve their additivity. The three rows make use of different source data. Measure #1 compares official data for the economy as a whole that are used to measure labour productivity growth in the two countries. “CPA” is the acronym for the Canadian Productivity Accounts, while “BLS-PA” stands for Bureau of Labor Statistics - Productivity Accounts. In measure #2, “LFS” refers to Canada’s Labour Force Survey and “CPS” stands for Current Population Survey, the American equivalent. Measure #3 presents results derived from the project to compare productivity levels conducted by the Canadian Productivity Accounts (CPA).

Using the year 2000 as an example and the same GDP per capita measure for the three sources of components, this study shows the crucial importance of using comparable measures to make international comparison of levels. They were developed by harmonizing concepts and coverage and by adjusting data to consider differences in collection methods and in data accuracy. The appropriate comparison (line 3) that uses comparable data shows that labour productivity contributes much less to GDP per capita differences than the two inappropriate techniques.
Measure #1: Problem with hours per job

The first inappropriate measure uses the levels of hours worked and the number of jobs derived from the official measures used to estimate labour productivity growth in both countries. Using this comparison, 70% of the 20% gap in gross domestic product (GDP) per capita in favour of the United States in 2000 can be attributed to Canada’s weaker level of labour productivity. The correct measure (line 3) indicates that only 35% of the gap is due to lower labour productivity.

In general, both countries produce detailed estimates of the volume of hours worked by estimating the number of jobs and the annual number of hours worked per job. The volume of hours worked is obtained by multiplying these two elements.

The Canadian Productivity Accounts rely mainly on a household survey, the Labour Force Survey (LFS), to estimate employment; in the United States, the starting point for constructing these same estimates is an employer survey, the Current Employment Statistics (CES). Given that this survey has only partial coverage (does not cover, for example, farms and self-employed workers), the Current Population Survey (CPS) estimates are used to complete the coverage. Our assessment is, that based on conceptual, coverage and accuracy criteria, these two measures of employment are appropriate for comparing employment levels between the two countries.

The problem with measure #1 arises because the estimates of hours per job are derived from different types of surveys that in each country yield quite different estimates of hours worked per job. The Canadian Productivity Accounts rely on hours actually worked collected from a household survey – the LFS; on the other hand, the Bureau of Labor Statistics (BLS) instead uses the hours paid collected from its survey of employers. Although the estimates of hours paid are then converted by the BLS into hours worked by excluding hours of paid leave (vacation, holidays, sick, etc.), these two approaches produce results that are not comparable because household and employer surveys produce estimates that differ in a systematic way.

As part of this project, the Canadian Productivity Accounts conducted a comparison of the estimate of hours worked per job using household and employer surveys in each country. The results from similar surveys were compared across countries (household survey in Canada to household survey in the United States; employer survey in Canada to employer survey in the United States).

In table 6–6, we compare hours worked per job obtained from household surveys with those derived from employer surveys.

The comparison for household surveys made use of a similar methodology to adjust these data for the bias associated with household surveys that do not take into account statutory holidays when extrapolating data from a survey reference week to other weeks in the month.
**T6–6 Comparison of estimated aggregations of hours by job according to adjusted data from household surveys with those derived from employer surveys, annualized data, 2003**

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>United States</th>
<th>Difference (U.S.–Canada)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Adjusted household surveys</td>
<td>1,734.0</td>
<td>1,844.4</td>
<td>111</td>
</tr>
<tr>
<td>B – Employer surveys</td>
<td>1,601.3</td>
<td>1,714.8</td>
<td>114</td>
</tr>
<tr>
<td>Difference (A – B)</td>
<td>133</td>
<td>130</td>
<td>...</td>
</tr>
</tbody>
</table>

… not applicable

Notes: Estimates for Canada are based on data from the Labour Force Survey and the Survey of Employment, Payrolls and Hours; for the United States, adjusted hours were compiled by the Canadian Productivity Accounts based on data from the Current Population Survey while the estimates from the employer survey correspond to hours per job estimated by the Bureau of Labor Statistics productivity program.

Source: Statistics Canada, Canadian Productivity Accounts.

For the United States, the employer survey data correspond to the estimate of hours worked taken from the Bureau of Labor Statistics’ productivity growth program. The starting point for the Canadian estimates is data on hours paid for employees paid by the hour, including overtime, combined with the number of hours that reflect the regular work week of workers receiving a fixed annual salary as collected under the SEPH. To transform this data into hours worked, we deducted paid hours of absence as determined by the LFS. Hours worked by workers not covered by the SEPH, such as those in agriculture, religious organizations and private households as well as all self-employed workers, also come from the LFS (see table 6-A1 in attachment).

Table 6–6 shows that, for both countries, the data on hours worked derived from employer surveys are lower than those calculated using the data from household surveys. This underestimation is approximately 133 hours in Canada and 130 in the United States. Hours worked derived from employer surveys are therefore not comparable to those obtained from household surveys, at least for these two countries. This table also suggests the average American works at least 100 hours more than the average Canadian (differences expressed in the last column of the table), regardless of whether the comparisons are derived using the household or the employer surveys. This demonstrates the direction and size of the error that occurs when a household survey in Canada is compared to an employer survey in the United States, as is done for measure #1.

There still remains the issue of whether hours worked for comparisons of levels should be estimated from household or employer surveys. Various studies conducted in several countries, including Canada and the United States, have compared the estimates of hours worked collected from households using a daily survey of time use – in theory the best approach for collecting this information – to the estimates derived both from employer and

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94 These estimates are obtained by combining hours paid collected from the employer survey (Current Employment Survey) with Current Population Survey hours worked data to fill the employees categories and industries not covered by the CES. An annual compensation survey is also used to estimate the hours paid not worked due to holidays, vacation, etc.
labour force surveys. The estimates derived from the time-use surveys suggest that labour force surveys provide the most accurate estimates of hours per job. Therefore, these are the estimates that have been adopted in our Canada/U.S. comparison.

This first example demonstrates that the source of the data on hours worked per job is especially important in order to attribute the origin of GDP per capita differences to labour productivity or to hours worked per capita. Comparing hours worked estimated from a survey of employers to those obtained from a household survey has the potential to overestimate the impact of productivity gap on GDP per capita differences between Canada and the United States by about 8%.

**Measure #2: Sources of labour intensity**

The second inappropriate measure (line 2) compares the levels of the volume of hours worked, the number of persons employed and the civilian population of working age outside institutions obtained directly from household surveys in both countries. For this comparison, the 20% difference in gross domestic product per capita in favour of the United States in 2000 is divided almost equally between labour productivity (-11%) and work intensity (-9%). As was the case with measure #1, this one also attributes more importance to differences in labour productivity than the estimate that our Canada/U.S. project yields (line 3).

The differences with our reference measure originate mainly, in this case, with the absolute measures: the number of jobs and the working age population for the United States.

Although, at first glance, Canada’s Labour Force Survey (LFS) and the U.S. Current Population Survey appear to provide fully comparable estimates, a more detailed analysis of these two surveys reveals unsuspected and quite substantial differences due to data coverage. These differences are enough to compromise use of these surveys for direct comparisons of levels of jobs – though not for hours worked per job when comparable methodology is applied to each survey.

While both countries use similar questionnaires, the statistical agencies on opposite sides of the border do not have access to a similar method to calculate the survey frame. In Canada, the demographic weights of the Labour Force Survey are recalibrated every five years using a five-year census, while in the United States, this recalibration occurs only once every ten years. In addition, Canada’s recalibration results in an historical revision of the LFS estimates to eliminate any break in the series. In contrast, in the United States, this exercise leads to significant breaks in the Current Population Survey (CPS) series, the most recent having occurred in 2000 and 2003. (As discussed in Section 2.5).

Added to this statistical problem is the much higher proportion of undocumented immigrants in the United States, whom Bureau of Labor Statistics analysts suspect are somewhat reluctant to respond to the CPS survey. On the other hand, legislation requires employers to report all of their employees annually to unemployment insurance officials and this approach appears to provide a better estimate of undocumented immigrants.

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In the United States, it is mandatory to have a social security number in order to obtain a job. It is the data from this file that are used as an annual benchmark for the employer survey (Current Employment Survey [CES]), which would explain why exercises to reconcile the two surveys indicate a substantial under-counting of jobs in the CPS compared to the CES. This problem was particularly evident between 1996 and 2003. Corrections made to the population estimate projection model by the U.S. Census Bureau have made it possible to narrow considerably the differences in job estimates between the two surveys since 2003.

As a result, data from the U.S. household survey (CPS) frequently suffer from a problem of underestimating the levels of jobs and the working age population. Since it only partially revises its series when benchmarking to the Census, this survey also experience breaks in its historical series. These two problems make using job estimates from this survey inappropriate for Canada–U.S. comparisons.

Measure #3: Reference measures from the Canada/U.S. project for comparing levels

Since the last historical revision of the National Accounts, the Canadian Productivity Accounts (CPA) have developed a measure of the volume of hours worked that can be used to measure both the growth and level of labour productivity. This is why Canadian estimates of the volume of hours worked and the number of jobs in measure #3 correspond to the estimates published by the CPA.

In their project to compare Canada–United States productivity levels, analysts with the Canadian Productivity Accounts selected their U.S. data sources to be comparable with the Canadian CPA data.

For several years, the Bureau of Labor Statistics’ productivity program has also produced a level of employment that corresponds to the National Accounts concept, which covers the entire American economy and represents the most reliable level of employment that can be developed for that country. These are the estimates derived from their employer survey.

However, there is a problem of comparability with respect to hours per job as described above. As part of the Canada/U.S. comparison project, analysts in the Canadian Productivity Accounts produced estimates of hours worked per job using the Current Population Survey and a similar methodology used for Canadian data to account for holiday bias. It is these estimates that were used to compare the sources of differences in the level of gross domestic product (GDP) per capita.

Lastly, the population estimates used in this article are based on the concept of resident population. This concept is the one used in international GDP per capita comparisons. It is also important to note that it is the U.S. Census Bureau that produces these estimates using a revision procedure that avoids historical breaks.

Although there are differences in the methodologies used by the two countries to produce hours worked estimates that enter into measures of the growth in productivity, as long as these differences remain constant, the accuracy of comparisons of growth rates in the two countries will not be greatly affected. However, these differences in methodology make comparisons of productivity levels more difficult and some care should be used in interpreting and using the
data that have been used for comparisons of growth rates. In order to obtain more accurate estimates of productivity levels in Canada relative to the United States, effort is needed to harmonize data sources and methods.

**Canada/U.S. differences**

This section examines differences in labour productivity and work intensity between Canada and the United States based on the Canada-US database developed by the Canadian Productivity Accounts.

Using the GDP per capita identity exposed in the previous section which shows that GDP per capita (CAP) is equal to the product of labour productivity (GDP/HRS), effort (the hours worked per job), and the per capita employment rate, (the ratio of the number of jobs to the total population). Or rewriting

\[
GDPCAP = PROD \times EFFORT \times EMPRATE
\]

The amount available for consumption per person in a country (GDPCAP) will be higher when productivity (PROD) is higher, when employees work longer hours (EFFORT), and when a larger proportion of the population is employed (EMPRATE). The variables EFFORT and EMPRATE can also be grouped together in a variable called work intensity which corresponds to the volume of hours worked per capita.

This comparison is accomplished for the total economy of both countries. Therefore, it combines both the business and the government and non-profit sectors to obtain measures of GDP.

Estimates of GDP for the total economy are taken from official estimates (Statistics Canada’s System of National Accounts [SNA] and the National Income and Product Accounts [NIPA] Tables of the United States Bureau of Economic Analysis). Both countries generally adhere to the international standards embodied in the SNA (1993) manual (Baldwin et al., 2005). While there are some minor differences, they are not regarded as a major problem for Canada/U.S. comparisons at the level of the total economy.

For comparisons of GDP in Canada and the United States, a deflator must be chosen to allow us to compare estimates of GDP that are produced in different currencies. For the purpose of this paper, we use the bilateral purchasing power parity indices that are produced by Statistics Canada to compare expenditures across these two countries (Temple, 2007).

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96 This means that the productivity estimates in this study also refer to the total economy. Statistics Canada normally only produces productivity growth estimates for the business sector because the estimation procedure followed by the National Accounts for the non-business sector (the non-market sector) essentially assumes that productivity in that sector is zero. Cross-country comparisons of labour productivity for the total economy therefore will be affected by the size of the non-market sector. If all countries follow the same assumption of zero productivity in the non-market sector, those countries with larger non-market sectors will have lower labour productivity because of statistical assumptions not because they are necessarily any less productive.

97 There are differences in specific industries that need to be considered when detailed comparisons are made at the industry level.
this paper, we make use of recently revised estimates. In our accompanying study (Baldwin et al., 2005), we examine the appropriateness of these data for cross-country comparisons and conclude that this measure is somewhat imperfect and suggest several variants which tend to increase the value of Canada’s labour productivity relative to that of the United States. For simplicity, we make use of the traditional estimate here.

The ratios needed for Equation (3) are estimated for the period 1994 to 2005 and presented in table 6–7. These include GDP per capita, labour productivity and work intensity for Canada relative to the United States (U.S.=100). To analyse more precisely some key factors of the standard of living, the work intensity variable is divided into three components – the number of hours per job, the number of jobs per member of the potential labour force and the potential labour force relative to the overall population.

The potential labour force is defined as those who are aged 15 years and over. While it might be argued that the elderly should be excluded from this definition, it is difficult to choose a particular age (i.e., 65 years old) when we arbitrarily designate individuals as unemployable. Choosing a lower bound is facilitated by mandated education requirements.

Over the period, GDP per capita in Canada averaged only 83.2% of GDP per capita in the United States (table 6–7). The output gap between the two countries was 16.8% of the U.S. GDP per capita. But the gap between Canada and the United States in labour productivity was much less – at only 7.8% of the U.S. productivity level. The difference in labour productivity accounted for 45% of the total percentage point difference in the GDP per capita between the two countries. That is, if work intensity was the same in the two countries, more than half of the difference in GDP per capita would disappear.

When work intensity is decomposed into the three components mentioned above, substantial differences between Canada and the United States exist in each of the two former areas. Hours worked per job in Canada are only 95.1% of those in the United States and jobs per potential member of the labour force are 92.4% of the United States.

The course of relative Canada/U.S. GDP per capita, labour productivity and hours worked per capita over the period 1994 to 2005 is plotted in graph 6–5. Gross domestic product per capita remained stable over the period around 83.2%. However, the period before 2000 differs substantially from the period after 2000 in terms of the movement in the two components – labour productivity and hours worked per capita.

Prior to 2000, both components – labour productivity and work intensity – are relatively constant. Relative Canadian labour productivity is 93% of U.S. labour productivity and relative Canadian hours worked per capita is 88%. During this time, lower hours worked in Canada account for over two-thirds of the gap in GDP per capita.

In contrast, after 2000, productivity falls while work intensity rises dramatically. Relative Canadian labour productivity decreased from 94.1% in 2000 to 89.0% in 2005. The Canada/U.S. ratio of the number of hours worked per capita increased from 88.4% in 2000 to 94.7% in

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98 These purchasing power parity indices (PPPs) have been revised to take into account new data for the government sector that the United States recently released.

99 And as the accompanying paper (Baldwin et al., 2005) indicates, the actual difference in productivity levels is probably less than the estimate used here.
6. ON THE IMPORTANCE OF USING COMPARABLE LABOUR INPUT TO MAKE INTERNATIONAL COMPARISON OF PRODUCTIVITY LEVELS

T 6–7  Decomposition of GDP per capita: Canada relative to the United States
(U.S.=100)

<table>
<thead>
<tr>
<th>Years</th>
<th>GDP per capita</th>
<th>Labour productivity</th>
<th>Work intensity</th>
<th>Work intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hours worked per job</td>
<td>Ratio of jobs to population aged 15 years and over</td>
</tr>
<tr>
<td>1994</td>
<td>82.3</td>
<td>92.6</td>
<td>88.8</td>
<td>96.0</td>
</tr>
<tr>
<td>1995</td>
<td>83.1</td>
<td>93.9</td>
<td>88.6</td>
<td>96.3</td>
</tr>
<tr>
<td>1996</td>
<td>82.0</td>
<td>93.2</td>
<td>88.0</td>
<td>96.2</td>
</tr>
<tr>
<td>1997</td>
<td>81.4</td>
<td>93.2</td>
<td>87.3</td>
<td>95.6</td>
</tr>
<tr>
<td>1998</td>
<td>81.0</td>
<td>92.6</td>
<td>87.5</td>
<td>95.3</td>
</tr>
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<td>92.2</td>
<td>88.5</td>
<td>95.2</td>
</tr>
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<td>83.3</td>
<td>94.1</td>
<td>88.4</td>
<td>94.5</td>
</tr>
<tr>
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<td>84.3</td>
<td>94.0</td>
<td>89.7</td>
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<tr>
<td>2002</td>
<td>85.6</td>
<td>92.6</td>
<td>92.5</td>
<td>94.3</td>
</tr>
<tr>
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<td>90.3</td>
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<td>84.6</td>
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<td>84.3</td>
<td>89.0</td>
<td>94.7</td>
<td>93.9</td>
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Average sub-period

<table>
<thead>
<tr>
<th>Years</th>
<th>GDP per capita</th>
<th>Labour productivity</th>
<th>Work intensity</th>
<th>Work intensity</th>
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<tr>
<td>1994–1999</td>
<td>81.9</td>
<td>93.0</td>
<td>88.1</td>
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<td>2000–2005</td>
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<td>92.5</td>
<td>94.3</td>
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<tr>
<td>1994–2005</td>
<td>83.2</td>
<td>92.2</td>
<td>90.3</td>
<td>95.1</td>
</tr>
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1. Canada as percentage of United States. United States = 100.
Source: Statistics Canada, Canadian Productivity Accounts.

Canadian gross domestic product per capita relative to the United States, 1994 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Relative Canadian GDP per capita</th>
<th>Relative Canadian labour productivity</th>
<th>Relative Canadian hours worked per capita</th>
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<tbody>
<tr>
<td>1994</td>
<td>75</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>1995</td>
<td>80</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>1996</td>
<td>85</td>
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<td>1997</td>
<td>90</td>
<td>95</td>
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<td>1998</td>
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<tr>
<td>2004</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Calculated from Appendix 1, Tables A2 and A3.
Source: Statistics Canada, Canadian Productivity Accounts.
2005. This was due mainly to an increase in the extent to which the Canadian economy was providing jobs for its population. The Canada/U.S. ratio of the number of jobs worked by the population aged 15 years and over increased from 91.0% to 97.0% over the same period. By 2005, most of the gap in GDP per capita now comes from the gap in labour productivity, not the gap in work intensity.

Conclusion

What are the sources of the difference of real gross domestic product (GDP) per capita between Canada and the United States? To what extent do labour productivity and work intensity (the number of hours worked per person) contribute to the gap in the level of real GDP per capita between the two economies?

Answering these questions involves an empirical exercise that seems simple since it depends only on a small number of variables – GDP, population, employment, hours, etc. – that have been published on a regular basis since World War II by most statistical agencies.

In reality, the answer to these questions is more complex than it appears. Statistical agencies produce different variants of these primary indicators of economic activity for different purposes. An analyst who focuses on international comparisons needs to ask which statistic is best suited for this purpose and whether adjustments are necessary to improve their comparability.

There are several criteria that need to be used when choosing among alternatives when measures of work effort are being used for cross-country comparisons of labour productivity or work intensity.

First, the variable should have the correct coverage – that is, it should correspond as closely as possible to the production boundaries used in the System of National Accounts to calculate gross national product since the latter is the numerator used both to calculate GDP per capita or GDP per hour worked. Some measures of employment do not capture all sectors of the economy. Some measures of population exclude members of the military whose wages are included in GDP. Measures of employment need to be made comprehensive with respect to sectors and groups covered.

Second, the variable should be able to measure the correct concept. A measure of hours worked must be able to capture all hours devoted to production. Sometimes hours paid but not worked are included in data sources and this should be excluded from this measure. Sometimes hours worked but not paid (i.e., unpaid overtime) are excluded in data sources and these need to be included.

Third, measures should be as accurate as possible in terms of levels. For the purposes of estimating growth rates of labour input, the accuracy of levels is less important – as long as
the error rate remains relatively constant over time. But for comparing employment levels across countries for purposes of estimating productivity levels, the analyst needs to consider whether the available estimates differ in terms of levels. In both Canada and the United States, household surveys provide higher estimates of hours worked per person than do firm-based surveys. International comparisons that choose different sources can therefore be biased.

Fourth, estimates of levels need to ask whether there is corroborative evidence that helps substantiate or triangulate the results. Are there other sources that help us substantiate the differences?

This paper describe how estimates of Canadian and U.S. hours worked, employment and population were developed for purposes of estimating relative levels of GDP per capita, GDP per hour worked and hours worked per capita that meet these four criteria. At the same time, it also examines shortcomings in some measures that are commonly used for Canada/U.S. comparisons – shortcomings with respect to coverage, concept or accuracy.

The paper demonstrates that these imperfect measures can lead to incorrect conclusions about the causes of the gap in GDP per capita between Canada and the United States. The appropriate measures developed here indicate that, as of 2000, only about one-third of the gap is attributed to lower productivity in Canada (lower GDP per hour worked) and about two-thirds to lower work intensity (lower hours worked per capita). This is quite different from some commonly used alternate measures – those labour measures that are used in the productivity growth programs of Statistics Canada and the Bureau of Labor Statistics. Other alternative measures are available – such as the data on hours worked from the labour force surveys. These contain problems that cancel out in some situations but not in others. While the proportion that should be attributed to labour productivity as opposed to work intensity changes over time (by 2005, a larger proportion is due to labour productivity), the lesson to be learned from our explorations is that it is important to make use of comparable data if the correct assessments are to be made over long periods.

International comparisons of labour productivity tend to emphasize data problems. But they have traditionally focused on comparability of GDP or capital – where problems are well known. The size of the problems that are involved in developing comparable estimates of labour inputs often receive less attention.

This paper focuses on two countries whose statistical systems are relatively similar – but where nevertheless there are sufficient differences to create problems if estimates of labour inputs are not carefully chosen to provide comparability in terms of coverage, concept and accuracy. The size of the error that would be made if comparability is ignored emphasizes the need to give careful attention to measurement issues on the labour side for cross-country comparisons of labour inputs, labour intensity and estimates of labour productivity differences.
References


Also available at www.un.ece/org/stats/eece/ces/ge.20/2004/mtg2/14e.pdf.


Appendix

T6–A1 Estimate of hours worked based on hours paid from the Survey of Employment, Payrolls and Hours (SEPH), 2003

<table>
<thead>
<tr>
<th>Employees paid by the hour</th>
<th>Hours by job</th>
<th>Jobs</th>
<th>Hours worked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaried workers with regular schedules</td>
<td>SEPH</td>
<td>1,461.3</td>
<td>7,318,397</td>
</tr>
<tr>
<td>Other categories of salaried workers</td>
<td>SEPH and LFS1</td>
<td>1,710.1</td>
<td>4,297,410</td>
</tr>
<tr>
<td>Agriculture</td>
<td>SEPH</td>
<td>1,739.2</td>
<td>1,613,307</td>
</tr>
<tr>
<td>Hunting and fishing</td>
<td>LFS</td>
<td>2,244.8</td>
<td>142,821</td>
</tr>
<tr>
<td>Religious organizations</td>
<td>LFS</td>
<td>1,744.4</td>
<td>8,338</td>
</tr>
<tr>
<td>Private households</td>
<td>LFS</td>
<td>1,547.4</td>
<td>100,020</td>
</tr>
<tr>
<td>Self-employed workers</td>
<td>LFS</td>
<td>1,799.9</td>
<td>1,540,903</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,601.3</td>
<td>15,214,431</td>
</tr>
</tbody>
</table>

1. The volume of hours worked for the other categories of salaried workers are not collected by SEPH. They were estimated by multiplying these jobs by industry from SEPH by the respective hours worked per job from LFS.

Source: authors’ calculation.

Source: Statistics Canada, special tabulations by the Canadian Productivity Accounts based on estimates from the Survey of Employment, Payrolls and Hours, and the Labour Force Survey.

T6–A2 Canadian data for productivity level estimates

<table>
<thead>
<tr>
<th>Years</th>
<th>GDP, millions of dollars</th>
<th>GDP adjusted to PPPs, millions of dollars</th>
<th>Hours worked (thousands)</th>
<th>Jobs (thousands)</th>
<th>Population aged 15 years and over (thousands)</th>
<th>Population (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>770,873</td>
<td>640,595</td>
<td>23,626,206</td>
<td>13,407</td>
<td>23,041</td>
<td>28,999</td>
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<tr>
<td>1995</td>
<td>810,426</td>
<td>675,895</td>
<td>23,985,703</td>
<td>13,620</td>
<td>23,329</td>
<td>29,302</td>
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<td>1996</td>
<td>836,864</td>
<td>703,803</td>
<td>24,419,755</td>
<td>13,764</td>
<td>23,625</td>
<td>29,611</td>
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<td>1997</td>
<td>882,733</td>
<td>740,613</td>
<td>24,787,390</td>
<td>14,025</td>
<td>23,930</td>
<td>29,907</td>
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<td>1998</td>
<td>914,973</td>
<td>774,067</td>
<td>25,336,204</td>
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<td>30,157</td>
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<td>1999</td>
<td>982,441</td>
<td>823,286</td>
<td>26,037,717</td>
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<td>2000</td>
<td>1,076,577</td>
<td>888,176</td>
<td>26,606,886</td>
<td>15,052</td>
<td>24,805</td>
<td>30,689</td>
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<td>2001</td>
<td>1,108,048</td>
<td>928,544</td>
<td>26,791,467</td>
<td>15,204</td>
<td>25,167</td>
<td>31,021</td>
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<td>2002</td>
<td>1,152,905</td>
<td>975,358</td>
<td>27,181,228</td>
<td>15,583</td>
<td>25,547</td>
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<tr>
<td>2003</td>
<td>1,213,408</td>
<td>1,014,409</td>
<td>27,593,613</td>
<td>15,913</td>
<td>25,884</td>
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<td>2004</td>
<td>1,290,788</td>
<td>1,077,808</td>
<td>28,377,150</td>
<td>16,193</td>
<td>26,233</td>
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<td>2005</td>
<td>1,371,425</td>
<td>1,142,397</td>
<td>28,607,286</td>
<td>16,459</td>
<td>26,585</td>
<td>32,271</td>
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Source: Statistics Canada, Canadian Productivity Accounts.
### T6–A3 United States data for productivity level estimates

<table>
<thead>
<tr>
<th>Years</th>
<th>GDP, millions of dollars</th>
<th>PPPs (US$ per CAN$)</th>
<th>Hours worked (thousands)</th>
<th>Jobs (thousands)</th>
<th>Population aged 15 years and over (thousands)</th>
<th>Population (thousands)</th>
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<tr>
<td>1994</td>
<td>7,072,200</td>
<td>0.831</td>
<td>241,616,008</td>
<td>131,675</td>
<td>205,323</td>
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<td>1995</td>
<td>7,397,700</td>
<td>0.834</td>
<td>246,406,214</td>
<td>134,738</td>
<td>208,007</td>
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<td>1996</td>
<td>7,816,900</td>
<td>0.841</td>
<td>252,829,892</td>
<td>137,101</td>
<td>210,690</td>
<td>269,714</td>
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<td>1997</td>
<td>8,304,300</td>
<td>0.839</td>
<td>259,150,256</td>
<td>140,165</td>
<td>213,560</td>
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<td>1998</td>
<td>8,747,000</td>
<td>0.846</td>
<td>265,032,245</td>
<td>143,001</td>
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<td>1999</td>
<td>9,268,400</td>
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<td>270,372,149</td>
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<td>2000</td>
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<td>274,748,578</td>
<td>147,652</td>
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<td>2002</td>
<td>10,469,600</td>
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<td>0.833</td>
<td>277,647,909</td>
<td>150,034</td>
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