Statistics Canada

The Comparative Level of GDP per Capita in Canada and the United States: A Decomposition into Labour Productivity and Work Intensity Differences

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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

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1. Introduction

The Canadian Productivity Accounts (CPA) is one of the oldest productivity programs in the world. Since its creation in the early 1960s, this program has refined the concepts associated with the measurement of productivity growth and its related measures, has been integrated fully into the Canadian System of National Accounts, given an important place to international comparison, and explored many productivity measurement issues.

The program regularly provides comparisons of productivity growth in Canada and the United States. Although there are differences in the methodologies used by the two countries to measure productivity growth, as long as these differences remain constant, this type of comparison remains meaningful. However, these differences make comparisons of productivity levels more difficult. For accurate estimates of productivity levels for Canada as opposed to the United States to be produced, greater effort must be put into harmonizing data sources and methods.

Our previous study (Baldwin et al., 2005) constitutes the first attempt by the CPA to examine, in an exploratory way, the question of comparability of labour productivity in Canada and in the United States. Using analogous sources, concepts and methods to arrive at the most comparable measure of productivity levels possible, Baldwin et al. (2005) conclude that Canada-U.S. productivity level difference in 1999 was lower than normally described.

The study by Baldwin, Maynard and Wong (2005, hereafter BMW) also uses the same methodology to compare gross domestic product (GDP) per capita in Canada and the United States and to deconstruct it into its constituent parts, namely labour productivity and work intensity.

$$\frac{GDP}{POP} = \underbrace{\frac{GDP}{Hours}}_{\text{Labour productivity}} \cdot \underbrace{\frac{Hours}{Emp} \cdot \frac{Emp}{PAT} \cdot \frac{PAT}{POP}}_{\text{Work intensity}} = \frac{GDP}{Hours} \cdot \frac{Hours}{POP} \tag{1}$$

where *GDP*, *POP*, *Hours*, Emp and *PAT* represent, respectively, GDP expressed in 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 $\frac{Hours}{Emp}$ and $\frac{Emp}{PAT}$ are referred to respectively as average number of hours and the employment rate.

Relying on the same sources, concepts and methods, Baldwin, Maynard and Wong (2005, hereafter BMW) concluded that, during the period from 1994 to 2002, Canada's GDP per capita was approximately 80% that of the United States, largely because of the gap in the level of work intensity (hours worked per capita). The productivity level was approximately 90.0%.

While BMW (2005) quantified the sources of the differences in the standard of living in Canada and the United States, they did not extensively explore the relative labour market performance in

the two countries or the extent to which the latter could be reconciled with other labour market data published by the statistics bureaus of the two countries. The purpose of this study is to address those two concerns, while keeping in mind the need to illustrate the errors that could result from the use of series that are incompatible with one another.

2. Comparison framework

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 BMW (2005), who made a considerable effort to ensure that the various components of the decomposition in equation #1 were as comparable as possible in terms of concept and coverage.

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

There are a number of different sources that can be used to develop estimates of labour inputs for the purposes 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, their comparability, and their accuracy. We will take another look at each of these criteria in the next section when we address specific sources in detail.

3.1 Criteria

3.1.1 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 hours worked. Since workers do not work the same hours in every country, differences in effort are better reflected by the number 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 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.

The definition specifies that hours worked should include:

- hours actually worked during normal periods of work;
- time worked in addition to hours worked during normal periods of work, and generally paid at higher rates than the normal rate (overtime);
- time spent at the place of work on work such as the preparation of the workplace, repairs and maintenance, preparation and cleaning of tools, and the preparation of receipts, time sheets and reports;
- time spent at the place of work waiting or standing-by for such reasons as lack of supply of work, breakdown of machinery, or accidents, or time spent at the place of work during which no work is done but for which payment is made under a guaranteed employment contract; and
- time corresponding to short periods of rest at the workplace, including tea and coffee breaks.

and that hours actually worked should exclude:

- hours paid for but not actually worked, such as paid annual leave, paid public holidays, paid sick leave;
- meal breaks; and
- time spent on travel to and from home and work.

Any source of data on hours worked must include both hours worked during regular time and hours spent on work outside the regular schedule, whether paid or unpaid.

3.1.2 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 GDP per capita is calculated. Some sources for estimates of labour inputs do not cover all sectors. For example, agriculture is usually excluded from establishment surveys. Some population aggregates also exclude a 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.

3.1.3 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 how it corresponds to 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 could be entirely appropriate for developing an estimate of labour growth that would be used to derive the growth of labour productivity but it would be inappropriate for estimating the level of such 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.

3.1.4 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.

In developing estimates of labour input for the purposes of comparing relative productivity levels in Canada and the United States, the Canadian Productivity Accounts focus on issues relating to coverage, concepts and accuracy. Harmonizing the definitions of labour to appropriate concepts and coverage is a priority for the Canadian Productivity Accounts because they are included in the Canadian System of National Accounts (SNA), which meets the 1993 SNA international standards with regards to GDP estimates. The method used to construct the appropriate measure of hours worked using different sources available also takes into account the accuracy and availability of each source. In addition, the Canadian Productivity Accounts examines other information to corroborate the results obtained. The chosen method is described in the pages that follow. We will begin with a description of the sources available.

3.2 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 for comparing levels. Different series may provide essentially similar growth rates but very different levels. What may be appropriate for one use may be inappropriate for another. In fact, 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. Compromises in terms of concept, coverage and accuracy are quite acceptable when a survey is designed for trend comparisons but these compromises might be inappropriate for level comparisons.

In fact, 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 still 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 data collection instrument.

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

3.2.1 Enterprise surveys

Hours worked data from enterprise surveys contains 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[1].

These problems have been dealt with in the U.S. in different ways. For example, the 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

1. Special extractions from the Labour Force Survey, 1998.

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. Related to the problems that firms have in responding to surveys on hours worked is the extent to which outsourcing of payrolls has occurred. Many firms use third-party payroll firms and when hours worked data are supplied to the payroll firm, they are not kept permanently on computer files by these third-party payroll firms or by the originating firm since computer storage space is costly. If the enterprise survey is not done immediately after the payroll period, data are no longer available for hours worked even for hourly-paid workers.

3.2.2 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 that can be compared to measures of output.

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 reference week if they report hours paid—but to transform the estimate of number to hours worked from a survey done for a period that covers anything other than the pay period used by the firms to other periods not covered by the survey requires transformations that are extremely complex.

3.2.3 Example: Differences between household surveys and enterprise surveys

In Canada, the Survey of Employment, Payrolls and Hours, or SEPH (an employer survey in which data are collected from a sample of employers) collects monthly data on *hours paid* for workers paid by the hour and *hours usually worked* for workers with a fixed salary. Since the early 1990s, the percentage of employees paid by the hour has remained more or less constant, accounting for 52% of salaried employees in the SEPH universe in 2004. However, the percentage of workers with a fixed annual salary[2] decreased from 42% to 36% during the same period, while the category covering 'Other' employees increased from 6 to 12% of jobs covered by the SEPH. The SEPH does not collect data on hours for these employees.

The concept of *hours paid* and that of *normal hours* does not correspond to that of number of hours people work that is collected in the Canadian household survey (Labour Force Survey, or LFS) and that is required for the purpose of productivity measurement.[3] By definition, hours paid or normal hours worked includes paid hours absent from work for vacation, holidays, illness and other leave provided for in employment contracts. To calculate the hours people work, these components must therefore be estimated and then subtracted from hours paid. The concept of hours paid has a second problem: it includes paid overtime but not unpaid overtime. Transforming these concepts of hours paid into hours spent at work required by the SNA definition therefore requires adjustments using additional data.[4]

Since 1997, the LFS has collected data on the two types of overtime separately. These data show that unpaid overtime is extremely significant, especially in the service industries. As a percentage of hours worked, the LFS indicated in 2002 that unpaid overtime accounted for approximately 2.4% of total hours worked, slightly more than the 1.8% represented by paid overtime. Not taking unpaid overtime into account thus results in significant underestimation of hours worked (see Maynard and Sunter, 2004).

In Table 1 below, we compare hours worked per job obtained from household surveys with those derived from employer surveys. For the United States, the estimates correspond to the hours

2. *Hours usually worked* represent the regular work schedule of salaried employees. This variable would be 37.5 hours per week for federal employees, for example.
3. For a comparison, see Table A1 in Appendix 2.
4. See Table A3 for an attempt to reconcile the paid worker concept from the Canadian employer survey (SEPH) with the hours worked concept from the Canadian household survey (LFS).

worked taken from the BLS's productivity growth program.[5] The starting point for the Canadian estimates is hours paid worked by 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 absent 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 A2 in attachment.)

Table 1 Comparison of estimated aggregations of hours by job according to adjusted data from household surveys with those derived from establishment surveys– annualized data –2003

	Canada	United States	Difference (U.S. – Can)
A – Adjusted household surveys	1,733.1	1,844.4	111
B – Establishment surveys	1,607.8	1,714.8	107
Difference (A – B)	125	130	

Source: Canada : Labour Force Survey, Employment, Earnings and Hours Survey and Canadian Productivity Accounts ; US : Current Population Survey and BLS Productivity Growth Program

Table 1 shows that, for both countries, the data on hours worked derived from establishment surveys are lower than those calculated using the data from household surveys. This underestimation has been determined to be approximately 125 hours in Canada[6] 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 establishment surveys.

3.2.4 Overall reliability of average hours worked derived from household surveys

As argued above, household surveys are more likely to be able to provide the coverage of hours worked that corresponds to hours actually devoted to the production process than can enterprise surveys. The sign of the differences between the estimates produced by these types of surveys bear out our expectations.

While a household survey can potentially provide more accurate data in areas than an employer survey, the issue of overall accuracy nonetheless remains. When it comes to estimating hours worked, labour force surveys are sometimes criticized for problems that may arise from proxy reporting and from recall bias. The data that come from labour force surveys can often entail recall bias on the respondents' part, since respondents must report their weekly hours of work from the previous week as well as those of other household members.[7] Added to this is the fact that labour force surveys in North America collect data only for one reference week each month.

5. These estimates are obtained by combining hours paid collected from the employer survey (CES) with CPS 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.
6. For more detail on industry differences, see Appendix 2 Table A2.
7. Time use surveys require respondents to give a comprehensive breakdown of how they spend each hour of the day for all purposes.

Studies conducted in a number of countries, including Canada and the United States, have therefore compared the results of time use surveys to the findings from labour force surveys. Surveys of time use provide an alternate source of accurate data on hours worked, since this information is generally collected using a detailed day planner. Furthermore, the sampling for time use surveys in Canada and the United States allows data to be collected for every day of the year, which gives more comprehensive data on holidays and working arrangements than a labour force survey that only covers one week out of every month.[8]

Studies by Keinänen (2004) for Finland, Williams (2004) for great Britain, and Frazis and Stewart (2004) for the United States confirm that hours actually worked as collected through surveys such as the Labour Force Survey produce results that are very close to those of time use surveys.

The same can be seen for Canada. Table 2 contains estimates of average hours per person obtained from time use surveys in Canada and the United States with hours actually worked per person from the LFS and the CPS. When the data from the labour force surveys in the two countries are annualized to take into account public holidays and vacation time that occur during the course of the year, it can be seen that estimates of the hours worked per person from the household surveys are very close to the findings from the labour force surveys.[9]

According to the 1988 Canadian time use survey, Canadian workers worked an average of 1,783.6 hours, as compared to 1,774.3 hours for the adjusted LFS data. In the United States, we observe about the same gap, this time in favour of the CPS data. The 8-10 hours difference between the time use survey estimate and our adjusted LFS or CPS estimate of hours worked per person per year falls well below the margin of error expected from the sample surveys. These estimates show that both the Canadian and U.S. time-use surveys substantiate the estimates of hours worked per person derived from household surveys.

Table 2 Comparison of different estimates of average annual hours according to different surveys – annualized data

	United States	Canada
	1998	
Time use – reference weeks	NA	1783.6
CPS/LFS adjusted to reflect Canadian approach	1873.4	1774.3
	2003	
Time use – annualized	1887.6	NA
CPS/LFS adjusted to reflect Canadian approach	1895.5	1779.1

Source:

All of this means that Statistics Canada has chosen to focus its attention on household survey estimates for its productivity program. They provide a concept that is superior in terms of coverage and accuracy to that derived from an enterprise survey. And when we came to preparing estimates for our Canada/U.S. comparison of hours worked per person, we generated

8. The 1998 Canadian survey collected data for every day of the year, while its U.S. counterpart left out about ten days in 2003.
9. It is important to note that the 2003 U.S. survey on time use did not cover about ten days of the year, half of which were working days, or about 2% of working days. An imputation was made to allow for this undercoverage.

U.S. data using our methodology and comparable data sources—the U.S. household survey (the CPS). The U.S. household survey is very similar to the Canadian—in terms of types of questionnaire (see Appendix 3) and questions, in terms of prompts that have been built into the system to handle unusual events, and in terms of sample size (critical for quality of response). We believe these two surveys provide data on hours worked per person that are suited to the cross-country comparison that is being made here that requires comparable levels of labour inputs.

3.3 Estimating total 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 proceed in several stages to develop total hours worked for its industry accounts. Only the first two are relevant here.[10] 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.

$$\Sigma \Sigma \Sigma (J_{imn} \times H_{imn}) = Vh_{imn}$$

J = number of jobs
Hm = average annual hours worked
Vh = total hours worked

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

3.3.1 Jobs

The CPA focuses 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 the basic unit of the accounts since it corresponds more closely to production than does a person employed in a world where persons can have multiple jobs. Work effort is defined as the amount of hours devoted by an individual to a particular task. When an individual is employed in only one job, there is no reason to distinguish the two. But when individuals can work at multiple jobs, then the work effort of each job needs to be determined—and assigned to the appropriate industry.

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,

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

household surveys focus on the person who is employed—but with a set of questions can ascertain whether that person has multiple jobs and where those jobs are located and thus estimate both employment and jobs.

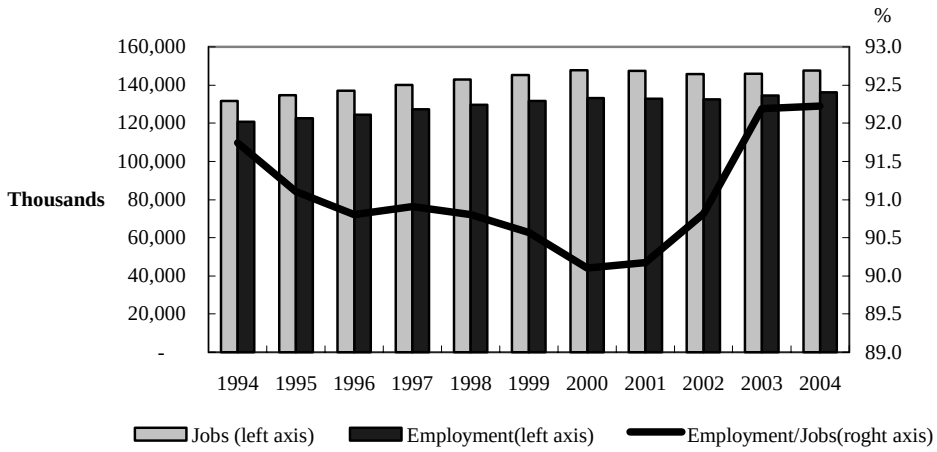
In Canada, the Productivity Accounts use the Labour Force Survey to measure both employment and total number of jobs—enhanced by several other sources to cover the small number of segments not covered by this survey. The Labour Force Survey is benchmarked to the Canadian Census of Population—which is 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. establishment 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 CES is adjusted annually to a benchmark based on the administrative data collected for the purposes of managing the unemployment insurance program[11] (Nardone et al., 2003), making the CES a complete source of information on non-agricultural employment. Information on 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 CPS.

For the United States, 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, 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 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 (Nardone et al., 2003). The survey results were therefore substantially revised when the Census results from the year 2000 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 Figure 1, which compares the employment estimates derived from the CES to the estimates coming 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.

11. In October 2003, a group of authors from the BLS and the BEA prepared an article analyzing the discrepancy between the employment figures from the CPS and the CES for a presentation to the Federal Economic Statistics Advisory Committee (FESAC). The article contains a host of information and explanations on the differences between the two surveys. For further details, see Nardone T, M. Bowler, Kirkland, K, J. Kropf and S. Wetrogan. "Examining the Discrepancy in Employment Growth between the CPS and the CES."

Figure 1 An illustration of the differences between the concepts of jobs and of persons in the United States



Sources: Jobs (CPA); persons (LFS)

The first reason then for not using the CPS is that it is based on a frame that underestimates the population in the 1990s. In contrast, it is felt that the CES suffers less from this problem. In light of their illegal 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 establishment survey would be much more likely to capture the jobs held by illegal immigrants. Employers must in fact report the number of employees they have to the unemployment 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. Spot checks of this file have revealed a substantial 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.

3.3.2 Jobs versus employment

While we focus on number of jobs in our analysis, we can calculate the number of persons employed from the sources that are utilized. Table 3 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 3 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 LFS) for Canada, but different sources for the U.S. (jobs from the CES and employment from the CPS).

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.[12] 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 primarily difference results from a substantial undercoverage of the CPS relative to the CES in terms of number of jobs discussed in the previous section.

Changing from one concept to the other is associated with a 2% increase in the variable in Canada (column 1), as compared to 7% for the United States (column 2).

Table 3 Change from concept of number of persons employed in relation to that of number of jobs, 2002 (thousands)

		Canada (1)	United States (2)	(1)/(2) in percentages
	Persons employed (3)	15,310	136,485	11.2
more	Persons holding jobs	756	7,691	9.8
less	Unpaid absences	674	2,076	32.5
more	Military personnel	82	1,464	5.6
more	Other adjustments	87	2,386	3.6
equal	Number of jobs (4)	15,559	145,950	10.7
	[((4) / (3))-1]× 100	2%	7%	-5

Source: Canadian data from the Labour Force Survey and the Canadian Productivity Accounts; US data are fro m the Current Population Survey and from the BLS Productivity Growth Program

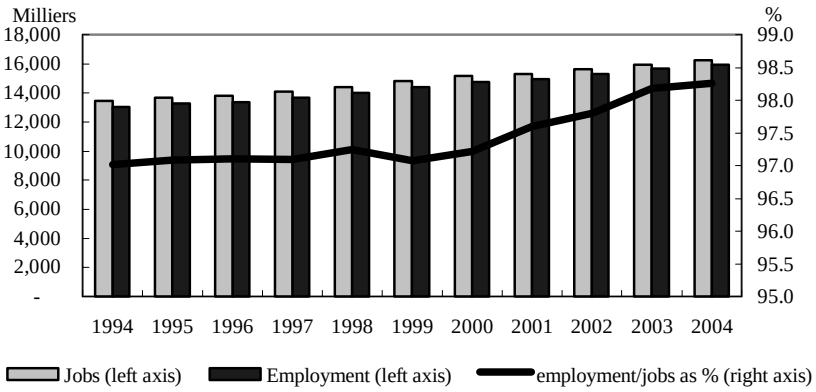
There are many reasons for the difference in the magnitude of the adjustments between the two countries. They have to do with the difference in the way the labour market is regulated and the percentage of military personnel in each country as well as purely geographical questions and their impact on 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[13] (see Figure 2).

12. They are in fact added into our coverage of number of jobs for the calculation of total number of jobs.

13. 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 1980-1981 and 1990-1992. See Galarneau et al. (2005) for further details.

Figure 2 An illustration of the differences between the concepts of jobs and of persons, Canada



Sources: CPA (jobs); LFS (persons)

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 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.

3.3.3 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 CPA has developed a procedure to make the corrections to raw LFS totals—to correct for what we refer to as reference-week bias. In this study, average hours from the CPS 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 number of hours absent owing to a public holiday or specific vacation that arise during the reference weeks mean that the number of hours worked as collected through the survey 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 et al., 2005).

Table 4 Effect of adjustment of hours per job on Canadian and U.S. estimates – All jobs

Years	Unadjusted hours		Adjusted hours		Difference between unadjusted and adjusted hours (%)	
	Canada	United States	Canada	United States	Canada	United States
1994	1,814.8	1,945.1	1,768.4	1,856.4	2.6	4.6
1995	1,799.2	1,952.3	1,766.5	1,850.9	1.8	5.2
1996	1,814.8	1,950.6	1,778.9	1,865.8	2.0	4.3
1997	1,814.8	1,965.9	1,774.8	1,870.0	2.2	4.9
1998	1,799.2	1,956.8	1,774.0	1,873.4	1.4	4.3
1999	1,814.8	1,975.8	1,777.1	1,878.0	2.1	4.9
2000	1,825.2	1,954.3	1,773.5	1,889.2	2.8	3.3
2001	1,788.8	1,928.0	1,762.1	1,876.3	1.5	2.7
2002	1,778.4	1,957.8	1,745.0	1,867.3	1.9	4.6
Average	1,805.6	1,954.1	1,768.9	1,869.7	2.0	4.3

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 4).

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 CPS. 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 4 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 2002, while in the United States the same type of adjustment represents a 4.3% decrease. The more substantial decrease observed in the United States comes from the fact that the BLS 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.

Table 5 Number of days and hours of work lost by salaried employees by reason in Canada and the United States, 2002

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

Note: The number of days in this table is estimated on the assumption that a workday equals 7½ hours per day.

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 5 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.

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 close to those recommended 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.

3.4 Measurement of population

For comparisons of 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—generally 15+ in Canada and 16+ 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 that are in institutions (penitentiaries, long-term care hospitals) are omitted because of the belief that these individuals cannot participate in labour markets.

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

Table 6 Reconciliation between the two concepts of working-age population, 2002 – Data in thousands

	Canada	United States	Canada as a % of United States
Resident, total (P)	31,373	288,253	10.9 %
Resident 15 years and +	25,547	227,344	11.2 %
Civilian non-institutional 16 years and + (LFS / CPS)	24,797	217,570	11.4 %
Difference	750	9,927	7.7 %
Difference as a %	3,%	4,%	

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%.[14] For the 2000 U.S. Census, the undercount was initially estimated at about 1.2%,[15] but this estimate was revised downward to -0.49%.[16] 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.[17]

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 (five years in Canada but ten 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 illegal and temporary immigrants, large numbers of whom are Hispanic or black, was considerably underestimated (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.

The data on resident population that are published by the U.S. Bureau of the Census are quicker to reflect all of the revisions deemed necessary to make methodological changes to these

14. See Http://www.census.gove/main/www/cen1990.html.
15. U.S., Census Monitoring Board (2001).
16. Robinson and Kostanich (2003).
17. 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.

estimates and do so in most cases without introducing any breaks in continuity. As can be seen from Figure 3, which compares the estimate of the over 16 resident population from the census to the population estimate for this group published by the 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 Figure 4, which compares the same series for Canada, it can be seen that the population aged 15 and up from the Labour Force Survey is consistent with that from the post-census estimates of population. The difference between the two arises from the fact that 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.

Figure 3 Accuracy of civilian non-institutional population estimates from CPS as compared to resident population

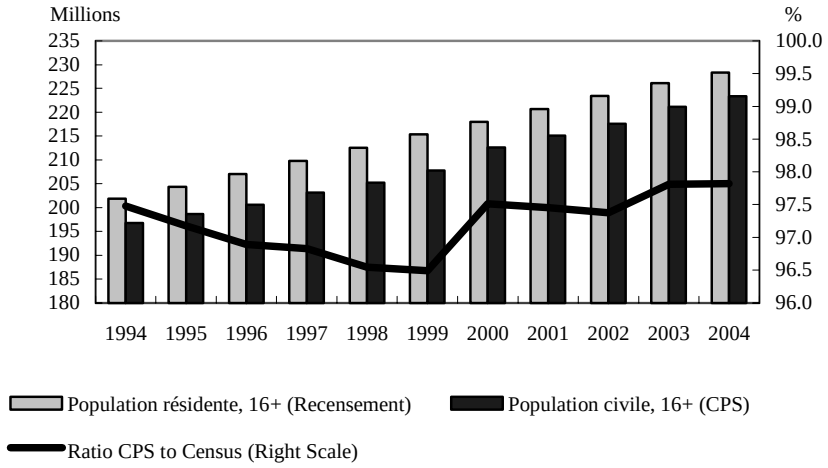
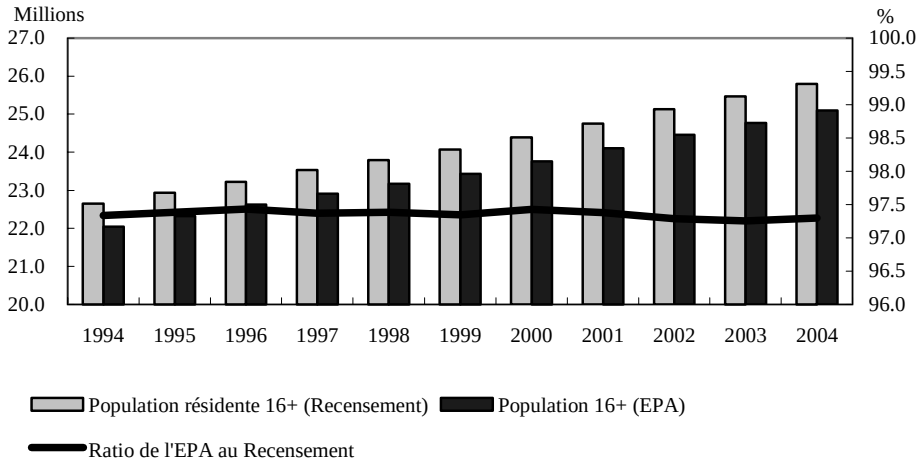


Figure 4 Accuracy of Canadian estimates of civilian non-institutional population from the LFS compared to resident population



4. Framework for reconciliation between alternative measures

4.1 Canada/U.S. differences

In this section, we examine differences in the level of GDP per capita between Canada and the United States and its subcomponents. We also estimate the percentage of the difference in GDP per capita between Canada and the United States that arises from differences in productivity.

We employ the following identity:

$$GDP / Pop = (GDP / Hours) * (Hours / Emp) * (Emp / Pop) \quad (2)$$

where GDP is gross domestic product
Pop is population
Hours is hours worked
Emp is jobs or employment.

This identity shows that GDP per capita is equal to the product of labour productivity (GDP/Hours), effort (the hours worked per job (or per employee)), and the per capita employment rate (the ratio of the number of employees (or jobs) to the total population). Or rewriting

$$GDPCAP = PROD * EFFORT * EMP \quad (3)$$

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 (EMP).

For this exercise, we examine the total economy of both countries.[18] We therefore combine both the business and the government and non-profit sectors to obtain measures of GDP.

For our comparison, we divide our effort variable into hours worked per job and the number of jobs per potential member of the labour force. The potential labour force is defined as those who are aged 15 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) when we arbitrarily designate individuals as unemployable. Choosing a lower bound is facilitated by mandated education requirements.

Estimates of GDP for the total economy are taken from official estimates (Statistics Canada's System of National Accounts (SNA) and the NIPA tables of the United States Bureau of Economic Analysis). Both countries generally adhere to the international standards embodied in the SNA (93) manual (Baldwin, Maynard, Tanguay, Wong, and Yan, 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.[19]

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 (Statistics Canada, 2002). For this paper, we make use of recently revised estimates.[20] In our accompanying study (Baldwin, Maynard, Tanguay, Wong, and Yan, 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.

18. 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 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.
19. There are differences in specific industries that need to be considered when detailed comparisons are made at the industry level.
20. These PPPs have been revised to take into account new data for the government sector that the Americans recently released.

Table 7 Relative GDP per capita levels in Canada and the United States (Canada as % of U.S.)

Years	GDP per capita	Labour productivity	Hours worked per job	Jobs to population aged 15+ ratio	Population aged 15+ to population ratio	Hours worked per capita
1994	81.9	92.3	95.4	91.2	101.9	88.7
1995	83.2	94.2	95.5	90.7	102.0	88.4
1996	82.6	94.2	95.4	90.0	102.1	87.7
1997	81.5	93.9	95.4	89.0	102.3	86.8
1998	80.7	92.7	95.2	89.3	102.4	87.1
1999	80.8	91.6	95.1	90.3	102.7	88.2
2000	82.1	93.0	94.4	90.8	102.9	88.2
2001	82.8	92.5	94.6	91.8	103.1	89.5
2002	83.8	90.8	94.2	94.9	103.2	92.3
2003	83.2	88.6	94.0	96.7	103.4	94.0
2004	82.8	86.9	94.6	97.3	103.6	95.3
2005	82.6	87.3	93.8	97.0	104.0	94.7
Mean	82.3	91.5	94.8	92.4	102.8	90.1

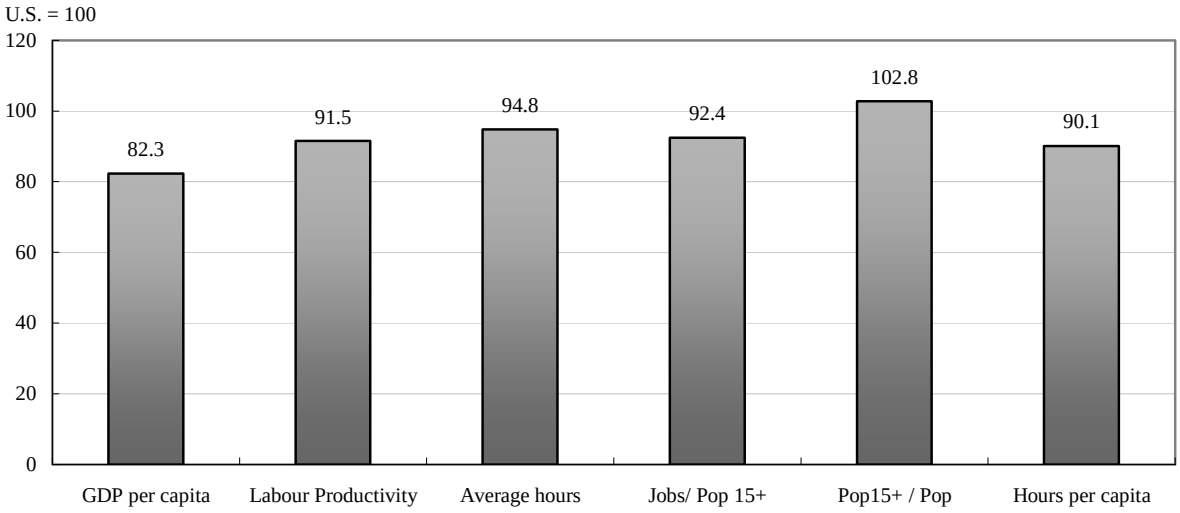
Source: Appendix 2 Tables A4, A5

The ratios needed for equation (3) are estimated for the period 1994 to 2005 and presented in Table 7. These include GDP per capita, labour productivity, effort and employment rates for Canada relative to the United States. We divide the effort variable into two components—the number of hours per job, the number of jobs per member of the potential labour force (Population aged 15 and over).

Over the period, GDP per capita in Canada averaged only 82.3% of GDP per capita in the United States (Figure 5). The output gap between the two countries was 17.7% of the U.S. GDP per capita. But the gap between Canadian and U.S. in labour productivity was much less—at only 8.5% of the U.S productivity level. The difference in labour productivity accounted for only about half of the total percentage point difference in the GDP per capita of the two countries.[21] That is, if effort was the same in the two countries, half of the difference in GDP per capita would disappear.

21. And as the accompanying paper (Baldwin et al., 2005) indicates, the actual difference in productivity levels is probably less than the estimate used here.

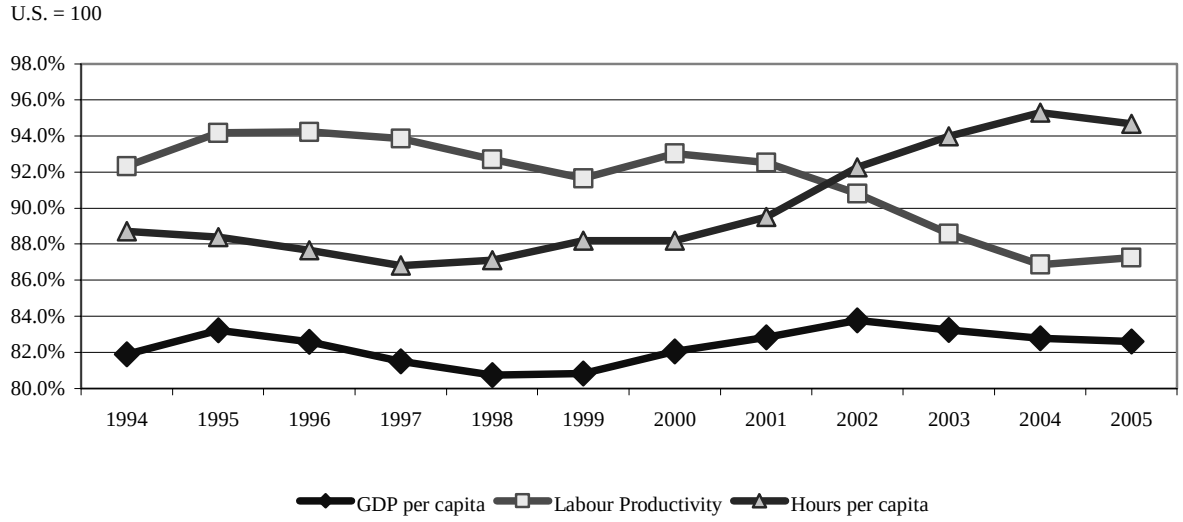
Figure 5 Decomposition of GDP per capita, Canada as % of U.S. (average ratio – 1994 to 2005)



The other half of the Canada/U.S difference in GDP per capita comes from differences in the labour input (hours worked per capita in the two countries). Hours worked per capita in Canada were only 90.1% of the hours worked per capita in the United States. This variable can be decomposed into three components—the differences in hours worked per job, the difference in jobs per potential member of the labour force (Population aged 15 and over) and the ratio of the potential labour force (Population aged 15 and over) to total population.

Substantial differences between Canada and the United States exist in each of the former two areas. Hours worked per job in Canada are only 94.8% of those in the United States. Jobs per potential member of the labour force are 92.4% of the United States.

Figure 6 Canadian GDP per capita relative to the U.S. 1994 to 2005



The course of relative Canada/U.S. GDP per capita, labour productivity and hours worked per capita over the period 1994-2005 is plotted in Figure 6. GDP per capita remained stable over the period around 82.3%. 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 ranges in the low 90s and relative Canadian hours worked per capita is in the high 80s. 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 93.0% in 2000 to 87.3% in 2005. The Canada/U.S. ratio of the number of hours worked per capita increased from 88.2% in 2000 to 94.7% in 2005. This was due mainly to an increase in the extent to which the economy was providing jobs. The Canada/U.S. ratio of the number of jobs worked by the population aged 15 and over increased from 90.8% 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.

4.2 Background

The previous sections reviewed the conditions necessary to produce comparable and consistent measures of population variables and of the labour force in order to estimate the gap in the standard of living in Canada and the United States and its various components. This measurement framework and the results associated with it were used in the BMW study, which constitutes the reference here. For reasons of coverage, consistency and accuracy, we make use of U.S. data from the CES to estimate number of jobs, data from the CPS (appropriately modified) to calculate hours worked per job and data from the Census of Population to produce comparable estimates to those used in the Canadian Productivity Accounts.

Several other less comparable measures of GDP per capita, labour productivity and work intensity can be derived from readily available data—series that are produced elsewhere in

Statistics Canada or in the various U.S. statistical agencies. These series are perfectly suited for the purposes for which they were designed. But these sources were not developed for cross-country comparisons of productivity levels. Nevertheless, since they provide such attractive alternatives for the unwary analyst, we outline what the results are using these alternatives and the shortcomings of each—at the same time showing how the estimates of BMW relate to these alternatives. In the rest of this document, all results will thus be compared and reconciled with those outlined in the previous section—hereafter referred to as the BMW estimates.

The issue here is the extent of the error that might arise if several different series on population and the labour market in Canada and the United States were used mechanically for cross-country comparisons and what the primary source of the error would be. In the preceding sections, we have noted that there are alternative series that could be used in the United States, whose inadequacy for the purposes at hand have already been detailed. There are also other Canadian series that can be used, series that are not perfectly compatible with the National Accounts. The LFS publishes data on employment, hours worked and population, which form part of the inputs for the Productivity Accounts, but which are adjusted by the Productivity Accounts to reflect the boundaries of the National Accounts.

For our comparisons, we chose two alternatives. In the first case, we adopt the household labour force surveys in the two countries to answer the following question. Is it possible to quantify the margin of error that would occur if we were to use alternative data such as those published through Canada's Labour Force Survey (LFS) and its U.S. counterpart known as the Current Population Survey (CPS) or the official data produced through the U.S. Bureau of Labor Statistics' productivity program? Each of these surveys provides estimates of hours worked—for the purpose of tracking short-run conditions in labour markets. And in each case, they are accompanied by estimates of a 'population' that they use for developing a sampling frame—thus providing estimates of hours-worked and population that can be used to generate both components needed to estimate GDP per hour worked and hours worked per population. But as we shall argue, used by themselves, they do not meet the criteria that we have set out in the preceding sections for an accurate cross-country comparison of productivity levels between Canada and the United States.

In the second case, we chose the inputs used by the official estimates of productivity *growth* in Canada and the United States. Once again, the data used in both cases are meant for a particular purpose—that of estimating productivity *growth*. And they are not meant to be comparable across countries for estimating relative *levels*. Nevertheless, they are a ready source for analysts who attempt to compare levels and thus provide an alternative that is sometimes used and that therefore needs to be examined.

Thus, for the rest of this study, the decomposition formula for the level of GDP per capita in equation (1) will be examined in relation to three alternative measures:

a) the measure used by BMW (2005), which compares the results for Canada with those obtained for the United States, with U.S. data constructed using the Canadian method (hereafter M1 measure);

b) the measure based on the official series originating from the LFS and CPS household surveys of the two countries respectively (M2), and
c) the measure obtained from the official series produced by the productivity programs of the two countries (M3).

The first comparison makes use of the series that we believe provide the greatest comparability in terms of meeting our objectives regarding fiability of concept, coverage and accuracy.

The second set is derived from readily available data coming from the labour forces of each country. In doing so, we follow the normal procedure used by those who employ these sources to derive productivity estimates and GDP decompositions: that is, we calculate the hours worked from the raw data without making corrections for holidays and other special events, estimate employment as persons employed rather than jobs in existence and calculate population as the civilian non-institutional population on which each survey is based.

While the data from the household labour force series in each country meet the needs of analysts who are trying to track changes in labour market conditions, they are less than ideal either for estimating GDP per hour worked or hours worked per capita, as we have argued previously. Table 8 recapitulates the shortcomings of each. In both countries, the household labour force survey does not cover the entire economy, and in the United States, the survey also underestimates jobs because of the benchmarking problem to the Census of Population and because of undercoverage of immigrants. In neither case are hours worked adjusted on an annual basis to take into account holidays. And both use the concept of the civilian non-institutional population rather than the concept of the resident population.

Table 8 Recapitulation of alternate methods and their shortcomings

M2	
Canada	**uses the LFS**
Jobs	undercoverage of the entire economy
Hours Worked	hours worked is not adjusted for holidays, thus overstating hours
Population	uses the civilian non-institutional concept, which is less than the resident concept
United States	**uses the CPS**
Jobs	undercoverage of the entire economy because it was benchmarked in the 1990s on a population estimate that was too small, and because it missed substantial numbers of people that the employer survey was capturing
Hours Worked	hours worked is not adjusted for holidays, thus overstating hours
Population	uses the civilian non-institutional concept ; uses an estimate that is not always benchmarked to the census total
M3	
Canada	**Canada Productivity Accounts—meets the concept, coverage and accuracy standards described previously**
Jobs	
Hours Worked	
Population	
United States	**uses data from the U.S. Productivity Accounts—CES for jobs and hours worked for production workers but the CPS for hours for non-production workers and self-employed and population estimate that is compatible with the Census**
Jobs	undercoverage of the entire economy, because it was benchmarked in the 1990s on a population estimate that was too small, and because it missed substantial numbers of people that the employer survey was capturing
Hours Worked	Hours worked is an amalgam of hours taken from the CES for hourly workers, the CPS for salaried workers and the self employed and generally understates some components of hours worked
Population	Uses the resident population estimate found in the BEA accounts

Note that, for the purposes of our M3 comparison, the Canadian series are identical to those used in M1. The only difference stems from the fact that the U.S. data on hours correspond here to those used by the official U.S. productivity program as produced by the Bureau of Labor Statistics (BLS). Here the problem basically is that the estimate of hours worked used by the BLS in its productivity *growth* program is taken from a number of different sources and it results in a much lower level than that yielded by the appropriately adjusted concept taken from the household survey. And it is the latter source that is used in Canada. The U.S. data on hours and employment use the results of the enterprise survey known as the Current Employment Survey to estimate labour productivity growth. Previously, we discussed why the estimates of hours worked from an employee survey should not be compared to a household survey (Shown in Table 1) . Since productivity measures in the two countries do not entail demographic data, the population data used here for M3 are the same as for M1.

4.3 Findings and Implications

In the preceding sections, we reviewed the conditions necessary to produce comparable and consistent measures of production, population and labour market variables for Canada and the United States in order to quantify their respective standards of living and their various

components. It will be recalled that we arrived at three alternative measures: a) those based on the Canadian approach, identified in Table 9, through indicator (1) for Canada and (3) for the United States; b) those based on the LFS series for Canada (identified by indicator (2)) and the CPS for the United States (identified by (4)); and c) the official measure of the BLS productivity program, for the U.S. data only, as identified by (5). The last part of the table provides the percentage differences between the different measures.

In Table 9, we present comparisons of productivity (output per hour worked) and work intensity (hours worked per capita) using the year 2000 as an example. Work intensity is decomposed into three components—hours worked per employee, employees per working-age population, and the percentage of the population that is of working age. It should be noted that in addition to the use of different sources, we also make use of different concepts of employees in the various comparisons. For M1 and M3, we define employment as jobs—in accord with the requirements of the System of National Accounts (1993). However, for M2, which uses the household surveys, we define employees as the number of persons employed—since this is the practice of most analysts who use these surveys.

In Table 9, we present the measures of output per worker and work intensity both in terms of levels (expressed in U.S. dollars and as ratios to one another). For example, the estimate of output per hour for Canada used in M1 (column 2, line a) as opposed to method M2 (column 2, line b) differs by 1.5% (column 2, line c). The same measure for the United States in M1 (column 2, line d) differs from that used in M2 (column 2, line e) by -2.2% (column 2, line g). Finally, the labour productivity gap between M1 (column 2, line d) and M3 (column 2, line f) for the U.S. measures corresponds to 7.1% (column 2, line h).

The last panel in the table outlines the contribution that each category makes to the overall difference in GDP per capita between Canada and the U.S. Each of the methods provides the same estimate of the difference in GDP per capita in 2000—since GDP and total population estimates are the same in each formulation. As the panel shows, there is a difference of some 19.8 percentage points in each case. But the amount of this difference that is accounted for by productivity differs considerably. Method M1 (which uses #1 and #3) indicates that productivity accounts for 7.2 percentage points of this (column 3, line i); for 10.9 in the case of M2 (using #2 and #4)—but method M3 (using #1 and #5) shows that productivity accounts for 14.3 percentage points (column 3, line k).

For all of the reasons developed in the previous sections, M1 (which uses measures (1) and (3)) is the most reliable for the Canada/United States comparison in terms of level. These two measures used in M1 thus constitute the reference to which a series of alternative measures, namely (2), (4) and (5), sometimes used by the Canadian literature on the subject, are to be compared.

4.3 Alternative 1 (using unadjusted data from the Household Labour Force Surveys)

As illustrated by Table 8, there are considerable differences in the methods used to produce the data coming from method M2 compared to M1. Hours worked per person (H/E)—(column 6)—tend to be higher because of the use of uncorrected data on hours worked from the labour force surveys (see Table 4)—though this is offset slightly because the concept employed persons is used instead of the slightly larger number derived from the concept of jobs. As a result, the number of hours worked per person using our preferred method (1766) is lower by 3.2% than the alternative that comes from the Canadian labour force survey (1824). However, the differences are larger (-5.6%) in the United States (1871 versus 1979). Part of the difference occurs because the uncorrected hours worked estimate from the labour force (CPS) is much larger in the United States (Table 4).

The second component that influences the work effort is the rate of employment—the ratio of the number employed to the working age population (E/PAT). Once again, different concepts are used in Method2 as opposed to Method1. The former uses employment in its numerator and the civilian non-resident population in its denominator. Method1 uses jobs in its denominator and total resident population in its denominator. Both are slightly larger but the differences essentially cancel out so that the employment to population ratio is slightly smaller for M1 (column 7, line c). In contrast, just the reverse occurs for the United States (column 7, line g). This is caused by the fact that, because of undercoverage, the U.S. labour force employment level is substantially below the estimate that our preferred method M1 uses (Table 3).

The final component of the intensity of work effort is the ratio of working age population to total population (PAT/POP). In Canada, the ratios differ because the M2 estimate uses the civilian population estimate while the preferred M1 estimate uses the resident population estimate and therefore the M2 estimate is lower than the estimate derived from M1 (column 8, line c) . It is also lower for the U.S. estimate, but more so (column 8, line g), because of the difference in population concepts but also because the labour force survey population estimate is below the Census population estimate as was described previously (Figure 2).

The differences in hours per person (H/E), persons employed relative to the working age population (E/PAT)and the demographic ratio (PAT/POP) interact to provide the net impact on overall work intensity (H/POP)—column 4. And interestingly, here the net impact of using the wrong estimates has different signs in the two countries. In Canada, work intensity is overestimated by about 1.5% using M2 (column 4, line c) while it is underestimated by 2.2% (column 4, line g) using M2 in the United States (column 4, line g). And these two errors decrease the contribution of work intensity from 12.9 (column 4, line i) to 8.9 percentage points (column 4, line j) and consequently increase the importance of labour productivity differences (column 3, line i) from 7.2 percentage points to 10.9 percentage points. In other words, it increases the importance of productivity differences in explaining GDP per capita differences and decreases the importance of work intensity differences.

Table 9 GDP per capita and its decomposition: comparison between alternative measures - 2000

	GDP per capita	Labour productivity	Work intensity	Sources of work intensity		
				Average hours	Employment rate	Ratio between working-age population (PAT) and total population
	GDP/POP	GDP/H	H/POP	H/E	E/PAT	PAT/POP
Canada						
a) CPA method (1)	28,520	33.0	864.6	1,766	60.6	80.8
b) Demographic and labour force data based on the LFS (2)	2,8520	32.5	877.4	1,824	61.3.1	78.5
c) ln[(1)/(2)]*100	0.0	1.5	-1.5	-3.2	-1.2	2.9
United States						
d) CPA method (3)	34,759	35.5	980.3	1,871	66.7	78.6
e) Demographic and labour force data based on the CPS (4)	34,759	36.2	959.1	1,979	64.4	75.3
f) BLS method (5)	34,759	38.1	913.1	1,743	66.7	78.6
g) ln[(3)/(4)]*100	0.0	-2.2	2.2	-5.6	3.5	4.3
h) ln[(3)/(5)]*100	0.0	-7.1	7.1	7.1	0.0	0.0
Canada/U.S.						
i) M1: BMW (2005) ln[(1)/(3)]*100	-19.8	-7.2	-12,6	-5.8	-9.6	2.8
j) M2: Official series from household surveys (LFS-CPS)ln[(2)/(4)]*100	-19.8	-10.9	-8.9	-8.2	-5.0	4.2
k) M3: Official series from productivity programs (Statistics Canada - BLS)	-19.8	-14.3	-5.5	1.3	-9.6	2.8

The individual components of work intensity (average hours, employment rate, working age population proportion) also differ and analysts should be aware of these differences if they are concentrating on these variables.

Our measure of hours worked per person—hours per job is 3.2% below the measure taken from the labour force survey—hours worked per person employed. And the comparable U.S. figure is 5.6% below the U.S. household survey estimate. One reason is that our measure is using jobs and not persons employed—though the difference caused by the use of different concepts of jobs as opposed to employment is relatively minor since the difference corresponds to the number of multiple jobs per person employed and to the unpaid absentees. In these cases, Canada and the United States do not differ much in terms of multiple job holders; the difference is slightly larger for unpaid absentees (see Table 3). But the main difference in each case is that the household survey estimates do not reflect the hours worked per job on an annual basis since they do not take into account holidays and other issues.

There is also a difference between the rate of employment concepts—number of persons employed relative to the number of persons in the working age population. Our preferred

measure is 1.2% below the measure generated by the labour force survey—for reasons described above. But our preferred U.S. estimate is 3.5% above the estimate produced from the U.S. labour force survey (the CPS). Part of this difference stems from slightly different definitions of persons employed (jobs versus persons) and population (resident versus civilian non-institutional). But the differences that arise from these conceptual differences are not significant. The main reason for the difference is that our jobs estimate from the CES is higher than the jobs estimate from the CPS because of undercoverage in the CPS that has been previously discussed (Section 3.3.1).

Figures 7 and 8 compare the time trend in the employment rate in Canada and the United States using these two different sets of measure over the period 1994 to 2004. Figure 7 makes use of the rates coming from the household surveys. Two rates are shown for Canada—one using the working age population as 15+, which is the standard generally used in Canada and the other using the working age population as 16+, which is the U.S. standard definition. Using the household surveys, Canada's employment rate has increased over most of the period and surpassed that of the U.S. by 2003. If we use the more comparable data coming from our especially constructed Canada/U.S. comparison (Figure 8), we see that the upward trend for Canada remains—but Canada does not surpass the U.S. by the end of the period.

Figure 7 Employment based on LFS and CPS data (percentage)

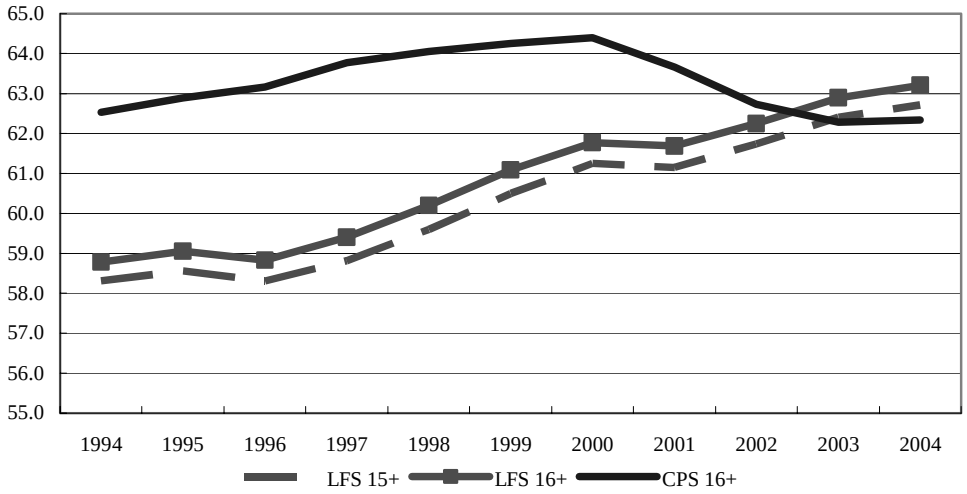
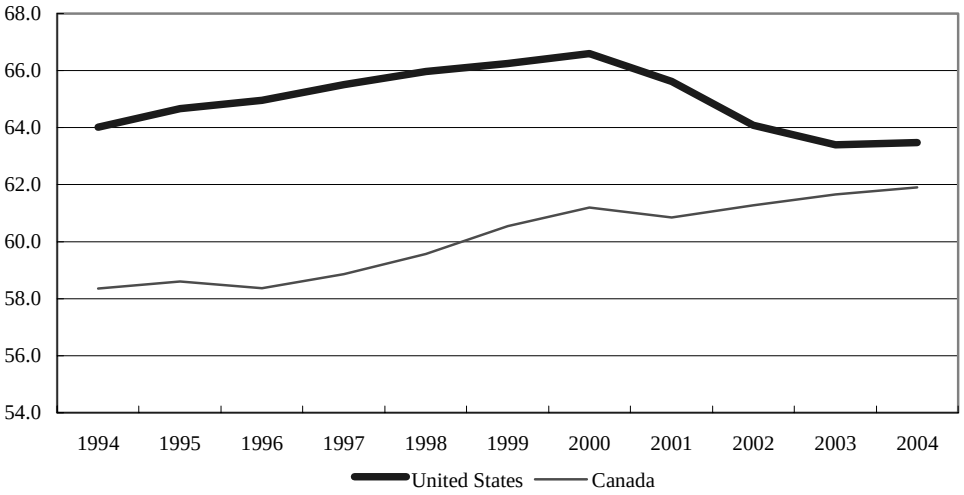


Figure 8 Employment rate based on BMW employment ratios for resident population aged 15 and over (percentage)



4.4 Alternative 2 (using U.S. data from the BLS productivity growth programs)

The second alternative (M3), which uses the data from the U.S. productivity growth program, provides an even more dramatically different interpretation of the reasons for the gap between GDP per capita in Canada and the United States than did the use of the estimates derived from the household surveys (M2). Of the 19.8 percentage points gap in 2000, 14.3 percentage points comes from a difference in productivity levels (Table 9, column 2, line k) and only 5.5 comes from differences in work intensity. This is because the U.S. data used in M3 produce a level of labour productivity that is 7.1% (Table 9, column 2, line h) higher than the estimate used in our preferred comparison. And the estimate of work intensity is 7.1 percent lower. (Table 9, column 4, line h)

The gap in terms of the difference between M1 and M3 is completely due to the different estimates of average hours. The number of hours worked per capita in Canada is 1766, while it is 1871 in the United States using the set of comparable data (Table 9, column 5, line a, and Table 9, column 5, line d). On the other hand, the resulting estimate of hours worked per person in the U.S. alternative measure that is used in M3 is 1743 hours (Table 9, column 5, line f) or 7.1% lower than the 1871 hours used in M1 (Table 9, column 5, line d) The latter is too low due to the downward bias occasioned by the use of the enterprise survey data to estimate hours worked (see Table 2). Our adjustments to estimate of U.S. hours worked increase the value of hours per person by about 7%. Since we use the same estimate of the employment rate (E/PAT) and the demographic effect (PAT/POP), there are no differences in this domain.

As a result, 12.6 percentage points of the 19.8 percentage points of the difference in the GDP per capita of the two countries are due to difference in work intensity using M1. However, most of GDP per capita gap would be attributed to productivity by those who inadvertently use the hours worked estimates used in the U.S. productivity growth program.

5. Conclusion

What is the value of real GDP per capita in Canada? How does it compare to that of the United States? To what extent do labour productivity and work intensity (the number of hours worked per person) contribute to the level of real GDP per capita of the two economies?

Answering this question 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 international 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 effort.

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. 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 US, 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 Statistics Canada's and the Bureau of Labor Statistics productivity *growth* programs. 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.

Appendix 2 Comparison of hours between LFS and SEPH

Table A1 Comparison of hours paid from the Survey of Employment, Payrolls and Hours with hours usually worked, hours actually worked, and paid or unpaid overtime from the Labour Force Survey, certain industries — 2003

	On a weekly basis	**Total**
SEPH - Paid by the hour	Regular hours paid	32.2
SEPH - Paid by the hour	Paid overtime	1.1
SEPH - Salaried workers	Regular schedule	38.1
SEPH - Total	Total hours from SEPH	34.4
LFS - Employees	Hours usually worked	36..8
LFS - Employees	Paid overtime	0.7
LFS - Employees	Unpaid overtime	0.9
LFS - Employees	Hours worked	33.1
	On an annualized basis	**Total**
SEPH - Paid by the hour	Regular hours paid	1,677.0
SEPH - Paid by the hour	Paid overtime	54.9
SEPH - Salaried workers	Regular schedule	1,980.7
SEPH - Total	Total hours from SEPH	1,789.3
LFS - Employees	Usual hours	1,912.8
LFS - Employees	Paid overtime	37.1
LFS - Employees	Unpaid overtime	44.4
LFS - Employees	Hours worked	1,723.6

Table A2 Estimate of hours worked based on hours paid from the Survey of Employment, Payrolls and Hours

		Hours by job	**Jobs**	**Hours worked**
Employees paid by the hour	EERH	1,461.3	7,318,397	10,694,090
Salaried workers with regular schedules	EERH	1,710.1	4,297,410	7,348,860
Other categories of salaried workers	EERH & EPA	1,755.3	1,613,307	2,831,838
Agriculture	EPA	2,244.8	142,821	320,611
Hunting and fishing	EPA	1,744.4	8,338	14,545
Religious organizations	EPA	1,547.4	100,020	154,769
Private households	EPA	1,295.2	193,236	250,273
Self-employed workers	EPA	1,799.9	1,540,903	2,773,468
Total		1,603.0	15,214,431	24,388,454

Table A3 Estimate of hours worked based on hours paid from the SEPH, certain industries

On an annual basis	Hours absent - LFS	Estimated hours worked from SEPH	Hours worked from LFS	Diff (LFS - SEPH)	Gap (LFS - SEPH)
Manufacturing	290.4	1,771.5	1,934.6	163	8%
Trade	171.2	1,508.3	1,599.5	91	6%
Finance, insurance, …	261.9	1,588.5	1,735.2	147	8%
Public administration	358.9	1,579.4	1,675.9	96	6%
Total comparable to the SEPH	270.6	1,563.1	1,723.6	160	9%

Table A4 Canadian data for productivity level estimates

Years	GDP, Millions of dollars	GDP Adjusted to PPPs, millions of dollars	Hours worked (thousands)	Jobs (thousands)	Population aged 15 and over (thousands)	Population (thousands)
1994	770,873	637,512	23,592,213	13,482	23,041	28,999
1995	810,426	676,706	23,937,345	13,705	23,329	29,302
1996	836,864	708,824	24,331,781	13,831	23,625	29,611
1997	882,733	741,496	24,652,260	13,971	23,930	29,907
1998	914,973	771,322	25,210,472	14,285	24,199	30,157
1999	982,441	815,426	25,954,398	14,676	24,485	30,404
2000	1,076,577	875,257	26,533,869	15,023	24,805	30,689
2001	1,108,048	911,924	26,735,217	15,188	25,167	31,021
2002	1,152,905	954,605	27,121,163	15,559	25,547	31,373
2003	1,213,408	992,568	27,523,201	15,881	25,884	31,669
2004	1,290,788	1,054,574	28,327,299	16,176	26,233	31,974
2005	1,371,425	1,119,083	28,543,458	16,438	26,585	32,271

Table A5 United States data for productivity level estimates

Years	GDP, millions of dollars	Hours worked (thousands)	Jobs (thousands)	Population aged 15 and over (thousands)	Population (thousands)
1994	7,072,200	241,616,008	131,675	205,323	263,455
1995	7,397,700	246,406,214	134,738	208,007	266,588
1996	7,816,900	252,829,892	137,101	210,690	269,714
1997	8,304,300	259,150,256	140,165	213,560	272,958
1998	8,747,000	265,032,245	143,001	216,374	276,154
1999	9,268,400	270,372,149	145,436	219,085	279,328
2000	9,817,000	276,863,193	147,993	221,891	282,429
2001	10,128,000	274,748,578	147,652	224,610	285,371
2002	10,469,600	270,095,412	145,950	227,344	288,253
2003	10,960,800	269,196,302	145,950	230,072	291,114
2004	11,712,500	273,290,774	147,590	232,864	293,933
2005	12,455,800	277,193,593	149,789	234,960	296,677

Appendix 3. Questions on hours from LFS and CPS

Since 1994 in the United States; from 1976 to 1996 in Canada
Employees and self-employed workers

- How many hours does he/she usually work at his/her principal employment? At his/her other employment?
- Last week, how many hours of overtime did he/she work?
- Last week, how many hours was he/she absent from work for any reason?
- What was the main reason for this absence?
- Last week, how many hours did he/she work at his/her principal employment? At his/her other employment?

Since 1997 in Canada
Employees

- Not counting overtime, does the number of paid hours worked by ... vary from week to week?
- Not counting overtime, how many paid hours does he/she work per week?
- Not counting overtime, how many paid hours does he/she work on average per week?
- Last week, how many hours was he/she absent from work because of vacation, illness or any other reason?
- What was the main reason for this absence?
- Last week, how many hours of paid overtime did he/she work at this employment?
- In total, how many hours did ... work at his/her job last week?

Self-employed workers

- Does the number of hours … works vary from week to week?
- How many hours does he/she work per week?
- Last week, how many hours did he/she work at this job?

Employee or self-employed worker (secondary job)

- How many hours does he/she usually work per week at this job?
- Last week, how many hours did he/she actually work at this job or for himself/herself?

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The Canadian Productivity Review

The Canadian Productivity Review is a series of applied studies that address issues involving the measurement, explanation, and improvement of productivity. Themes covered in the review include, but are not limited to, economic performance, capital formation, labour, prices, environment, trade, and efficiency at both national and provincial levels. The Review publishes empirical research, at different levels of aggregation, based on growth accounting, econometrics, index numbers and mathematical programming. The empirical research illustrates the application of theory and techniques to relevant public policy issues.

The primary distribution medium for this series is the Internet. These studies can be downloaded from the Internet at www.statcan.ca for free.

All papers in *The Canadian Productivity Review* go through institutional review to ensure that they conform to Statistics Canada's mandate as a government statistical agency and adhere to generally accepted standards of good professional practice.

The papers in the series often include results derived from multivariate analysis or other statistical techniques. It should be recognized that the results of these analyses are subject to uncertainty in the reported estimates.

The level of uncertainty will depend on several factors: the nature of the functional form used in the multivariate analysis; the type of econometric technique employed; the appropriateness of the statistical assumptions embedded in the model or technique; the comprehensiveness of the variables included in the analysis; and the accuracy of the data that are utilized. The peer group review process is meant to ensure that the papers in the series have followed accepted standards to minimize problems in each of these areas.