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Investigating the Canada-U.S. Productivity Gap: BLS Methods and Data

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ABSTRACT

Much has been written about the gap between the United States and Canadian productivity performance for the manufacturing sector. Often, comparative measures are based upon data from the respective national accounts of the two countries. Therefore, one may question whether the entire measured gap is real or whether it may be due, at least in part, to differences in procedures used by the two countries to compile the national accounts.

In this study we explore differences in methods used by the US and Canada in the preparation of the national accounts data which BLS uses to construct comparative trends of output per hour. These different methods are reviewed to assess their possible contribution to the measured difference in US and Canadian productivity performance. From this review we are unable to conclude that the measured gap in output per hour is a result of differences in measurement techniques.

In addition, data for 2-digit industries within the manufacturing sector are used to measure productivity for 19 comparable industries in the US and Canada. These data allow for a further exploration of relative productivity performance by industry, as well as an industry's contribution to productivity in that country's manufacturing sector. The industry data also provide insights into measurement differences that may contribute to the US-Canada comparative productivity performance. In particular, we reviewed certain price measurement issues for information technology (IT) products. Although some differences do exist in methods for certain important IT products, the impact on the productivity difference for aggregate manufacturing does not appear to be substantial.

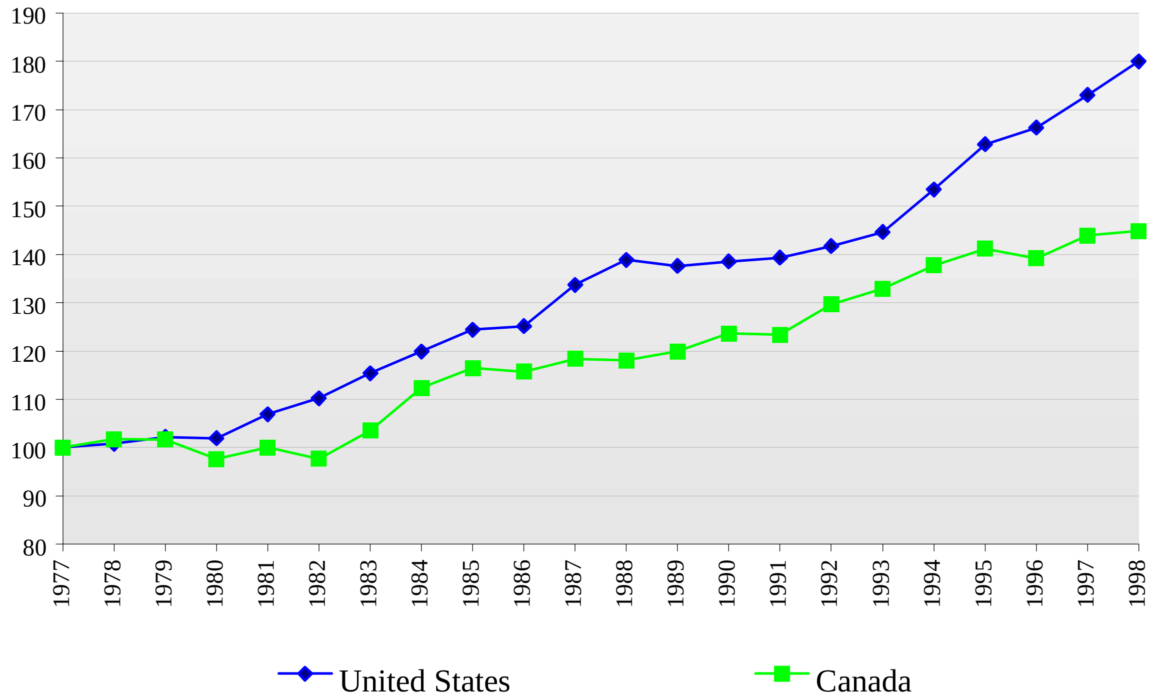
I. Introduction

Much has been written about the gap between the United States and Canadian productivity performance for the manufacturing sector. One set of comparative measures which indicates the presence of this gap is the series on output per hour produced by the US Bureau of Labor Statistics (BLS). These comparative measures are based upon data from the respective national accounts of the US and Canada. Therefore, one may question whether the entire measured gap is real, or whether it may be due, at least in part, to differences in procedures used by the two countries to compile the national accounts.

The gap in performance between the US and Canada is illustrated in Chart 1. The two lines represent each country's output per hour performance relative to its own performance in 1977.

CHART 1: Output per hour in manufacturing, US and Canada, 1977-98

(index 1977=100)



Over the entire period, 1977-98, the US has improved its productivity performance at the rate of 2.8 percent per year, while Canada has improved its performance by 1.8 percent per year. Of particular interest for this Conference is the way this differential in US versus Canadian productivity improvement has grown since 1992 -- 4.1 percent per year for the US versus 1.9 percent per year for Canada.

In this paper, we review the procedures BLS uses to produce international productivity comparisons, along with the methods used by each country's statistical agencies to compile the underlying data used by BLS. We explore differences between the two countries in industrial classification; concepts and estimation of real value-added output (including index aggregation formula and valuation of prices); and the estimation of labor hours worked. In general, we found that the methods used by the two countries to construct the components of output per hour are quite similar. Although some differences exist, they do not appear to be impacting measured productivity growth over the period of interest.

Productivity data for 2-digit industries within the manufacturing sector are also reviewed. These industry data allow for a further examination of the impact of possible differences in measurement procedures on the performance difference. As other researchers have found, a substantial amount of the difference in productivity performance can be explained by the outstanding productivity growth in the information technology (IT) sector of the US economy. Given this finding, we explore deflation techniques used to construct real value-added measures for certain products within the IT sector. Although procedures to deflate the output and inputs of IT industries need to be studied more thoroughly, we find that there are some important similarities in methods and where there are differences, the impact on the productivity gap does not appear to be large.

Thus, we conclude that a significant amount of the gap cannot be attributed to measurement differences.

II. Manufacturing Productivity Gap

In this study, we define the productivity gap as the ratio of the US output per hour index to the Canadian output per hour index (both with 1977=100).[1] During a particular time period, the gap increases if this ratio increases and the gap decreases when the ratio declines. Chart 2 presents US-Canada ratios of indexes of output per hour, as well as output and labor input.[2] An increase in a line indicates faster growth (or slower decline) of that variable in the US relative to Canada. A declining line indicates that the US variable either rose slower or fell faster than the Canadian variable.

From 1979 (an output peak for each country) forward, a gap in relative productivity performance has existed between the US and Canada. However, there have been two major back to back periods in which the gap narrowed before increasing again. From 1982 to 1984 Canadian productivity grew faster than in the US and contributed to a decline in the gap before a slower growth rate in Canada increased the gap through 1988. From 1988 to 1992 the gap began again to decline. However, since 1992, there has been a much more rapid increase in US productivity relative to Canadian productivity.

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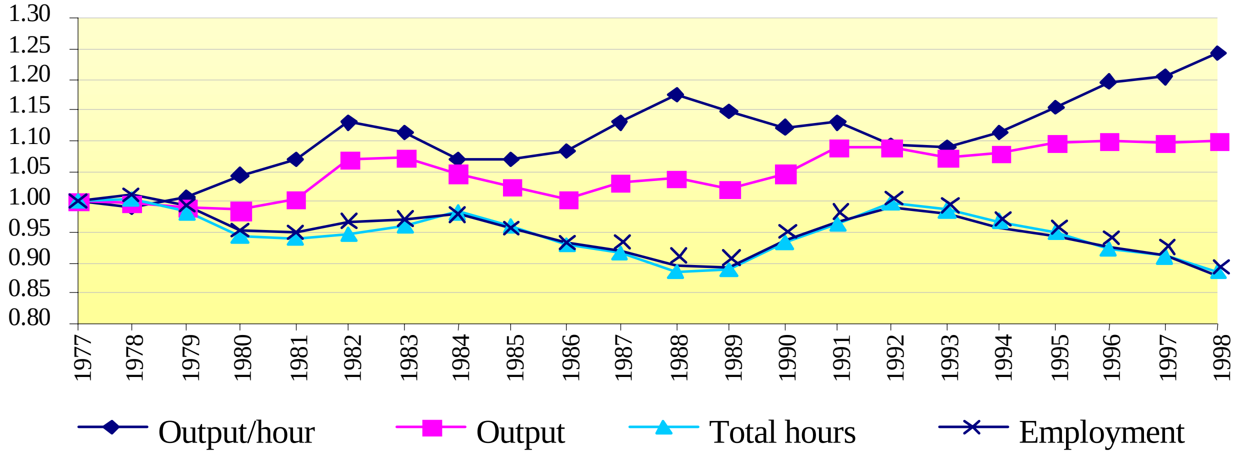
[1] Since US data are not available before 1977, this paper focuses on the period since 1977.
[2] Trend data do not allow for comparisons of productivity levels expressed in a common currency.

CHART 2: Ratio of US-Canada indexes of output per hour and related series, 1977-98
(index 1977=100)



In this study, we focus on the period from1988 to 1998. This period corresponds to a time period in which dynamic activity has occurred in certain industries in manufacturing, especially IT industries. Also, this period allows for analysis between an output peak (1988), a near-trough (1992), and an end point (1998) for each country. Finally, it is a period, presumably, of more interest to policy makers than earlier or longer periods.

Although the behavior of the productivity gap between 1988 and 1998 is explained in part by the different growth rates of output, the interesting finding is that the gap in productivity performance is a near mirror image of the gap in employment. (A US-Canada ratio of average hours grows little during the entire 1977 to 1998 period and is not shown in Chart 2.) The increase in the productivity gap between 1992 and 1998 appears to be driven by growth in Canadian employment.

The growth in the ratio of output/hour in Table 1 shows that over the period 1988-98, productivity growth in the US was only slightly greater than that in Canada. However, as depicted in Chart 2, the two sub-periods reveal more dynamic results. The growth of the ratio of US-Canadian output per hour compared with the growth in the US-Canada ratios for output and hours, underscores the importance of relative output and labor movements in each country. (Table 1)

TABLE 1: Growth of US-Canada ratio of output per hour, output, and hours in manufacturing, 1988-98
(average annual rate)

	Output/hour	Output	Hours
1988-98	0.6	0.5	0.0
1988-92	-1.8	1.1	3.0
1992-98	2.2	0.2	-2.0

III. Measurement Techniques

The BLS publishes comparative measures of the annual growth in output per hour and unit labor costs for the manufacturing sector in the US and in 11 foreign competitor countries.[3] The length of the historical series varies by country but comparisons among all countries may be made from 1977 to 1998.

Output is measured on a value-added basis although current year estimates may be based upon current indicators such as industrial production indexes.[4] To the extent that data are available for each country, employment, average hours and aggregate hours are measured on an hours worked basis for all employed persons. The category of all employed persons includes wage and salary workers, self employed and unpaid family workers.[5]

In this paper we examine the US and Canadian methodologies for measuring manufacturing outputs and labor inputs in an attempt to identify differences that can lead to a lack of comparability of the aggregate manufacturing productivity measures. Possible sources of differences to be explored are industrial classification, concept and estimation of output, and concept and estimation of labor input. An exploration of differences in estimating prices to deflate output will be conducted in section IV on industry measures.

These areas are reviewed with the objective of identifying differences in methods that may contribute to the gap between US and Canadian productivity. We note here that quantifying the impact of various measurement differences would require a major effort to re-estimate significant portions of the national accounts in each country. With data available to us, we speak to only the probability that methodological differences contribute to differences in measured productivity.

III.A. Industrial classification

Aggregate manufacturing data for the United States are published on the 1987 Standard Industrial Classification system (US-SIC87). Although the classification change in 1987 did

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[3] The series was updated to 1998 and published on August 27, 1999 in the US Department of Labor news release, USDL: 99-235, *International Comparisons of Manufacturing Productivity and Unit Labor Cost Trends, 1998*. The series may be found at http://stats.bls.gov/flshome.htm. (Levels of productivity are not included in the series.)

[4] BLS publishes quarterly measures of output per hour for US manufacturing in its news release on US productivity and costs. This series is based upon the concept of sectoral output. Sectoral output is gross output (shipments or sales plus changes in inventories) less intrasectoral sales and transfers. The concept of sectoral output is also used in the production of output per hour and multifactor productivity measures for the U.S. manufacturing sector and component industries.

Value added has been used for the international comparisons series because the data are more readily available in the countries' national accounts whereas sectoral output would require a complex estimation procedure. Also, although BLS has determined that sectoral output is the correct concept for US measures of single factor productivity (output per hour), there are other considerations that may make value added a better concept for international comparisons, such as differences among countries in the extent of vertical integration.

[5] Generally, data on output and labor input are available in the national accounts of the various countries. For some countries, for the labor input, BLS makes estimates of average hours worked from alternative sources in order to combine with employment to derive aggregate hours input.

result in the reclassification of several industries within manufacturing, there were no modifications to the classification of the aggregate manufacturing sector.

The aggregate manufacturing data for Canada are published on the Canadian 1980 Standard Industrial Classification system (C-SIC80). In 1997, Canada completed a major revision to the national accounts. This historical revision did not result in any changes to the classification of the manufacturing sector or to 2-digit industries within manufacturing.[6]

At the aggregate level, the classification of the manufacturing sector for the United States and Canada are quite similar. The main difference between the two systems is the treatment of the logging industry.[7] The logging industry is a component of the manufacturing sector in the US, but it is not a component of manufacturing in Canada.[8]

To investigate the significance of the difference in the classification of the logging industry on manufacturing performance, we adjusted the Canadian aggregate measures to include logging. Within the Canadian national accounts, the logging industry and the forestry services industry make up the logging and forestry sector (C-SIC80 3). With data available to us, it was not possible to separate the logging industry from the rest of the logging and forestry sector. Because logging is the largest component in the logging and forestry sector in Canada,[9] we added the entire sector to the published manufacturing series.[10] Logging and forestry account for a small portion of the new manufacturing aggregate, approximately 3.6 percent of labor hours in 1995.

Trends in output per hour for US manufacturing, Canadian manufacturing and the adjusted series for Canada (Canada*) are shown in the Table 2.[11]

TABLE 2: Growth in manufacturing output per hour, US and Canada, 1979-95
(annual average percent change)

	US	Canada	Canada*
1988-95	2.3	2.6	2.4
1988-92	0.5	2.4	2.2
1992-95	4.7	2.9	2.7

[6] The historical revision modified the numbering structure for industries within manufacturing.
[7] There are several other components of Canadian manufacturing that are not in US manufacturing that we were unable to adjust for. These include portions of photo finishing (C-SIC80 2821), vehicle engine repair services (C-SIC80 3081, 3261), and clay products (C-SIC80 3511,3512,3591).
[8] Under the 1997 North American Standard Industrial Classification System, the logging industry will not be included in the manufacturing sector.
[9] Logging accounted for over 85 percent of employment in logging and forestry over the period from 1987-95, and more than 93 percent of current dollar GDP (Statistics Canada).
[10] Throughout this study a consistency in aggregation theorem (Diewert, 1978) was used when making modifications to chained indexes.
[11] Data are shown through 1995 rather than 1998 because industry data for were only available thorough 1995.

The two series for Canada are very similar. However, due to negative productivity growth in the logging industry, the adjusted measure of productivity in Canada is growing approximately 0.2 percentage points less than the published Canadian measure in the 1988-95 period.[12] Thus, based upon the adjustments we were able to make, it appears that including logging in the Canadian measure of aggregate manufacturing productivity could actually increase the gap between the US and Canadian productivity measures.

III.B. Estimation of real output

III.B.1 Output Concept

The BLS uses the value-added output concept for international comparisons of productivity. For both the United States and Canada, value-added output data are available for aggregate manufacturing and for 2-digit industries within manufacturing. The value-added data for both countries are defined as the value of gross output less the value of intermediate purchases of materials, energy, and services.

Although the output concept is the same, the two countries differ in the concept of prices at which gross output is valued.[13] The US Bureau of Economic Analysis (BEA) measures gross output at market prices, while Statistics Canada measures gross output at factor costs.[14] Both countries measure intermediate purchases at producer prices.

The main difference between output valued at market prices versus factor costs is the treatment of taxes and subsidies. The value of output at market prices is the amount receivable by the producer from the purchaser for a unit of a good produced. The value of output at factor costs is the value of output at market prices less any tax payable[15] by the producer plus any subsidies received. The different treatment of taxes and subsidies among countries could be a source of non-comparability in international comparisons.[16]

The different treatment of subsidies between the US and Canada is not a major issue. From 1987 forward there have been no subsidies assigned to manufacturing in the US, while in Canada subsidies have accounted for less than one percent of manufacturing income. Thus, the current difference in practices concerning subsidies in each country does not lead to differences in growth.[17]

The different treatment of taxes however requires further discussion. Although taxes are a component of nominal output in the US, a change in taxes would not be reflected in the growth of real output in the US. Prices for the US PPIs, which are used extensively for deflation, are

[12] There was no difference in the 1979-95 period.
[13] The 1993 System of Nation Accounts recommends the use of basic prices or modified basic prices to value gross output.
[14] Statistics Canada, 1999. Production is valued at market price less indirect business taxes, plus subsidies.
[15] These taxes include sales and excise taxes, licenses, and property taxes.
[16] Lal 1999, which discusses comparisons of value added among countries, has alerted us to this issue.
[17] Prior to 1987, subsidies in US manufacturing never accounted for more that .05 percent of nominal gross output in manufacturing, and are treated as negligible.

collected exclusive of taxes. These PPIs are applied to shipments data that do not include taxes. BEA then makes an adjustment so that real shipments plus taxes grows at the same rate as real shipments. For other taxes, such as real estate taxes, if a producer were to raise the product's price to compensate for a tax increase, the PPI would treat this as a price increase in the product. Using this PPI as a deflator will remove the effect of the tax change from the real value of shipments.[18]

Therefore, it is unlikely that the US-Canada productivity gap is affected by the different treatment of taxes.

III.B.2. Primary data sources

For the US, output data are taken from the Bureau of Economic Analysis (BEA) series "Gross Product Originating by Industry". This value-added output series for benchmark years is mainly based on data from the 1987 input/output (I/O) tables, which combine data from the Annual Survey of Manufacturers and the 5-year Census of Manufacturers.[19] Data for intermediate purchases are based on input compositions from the I/O tables. Input composition estimates are applied to total intermediate inputs derived as gross output less gross domestic income.[20] Data for non-benchmark years are interpolated between benchmark years and extrapolated from the last benchmark (1987) to the current year. Interpolators and extrapolators are developed from the Census Bureau's Annual Survey of Manufacturers.[21] BLS derives the most current measure for 1998 from the growth of the industrial production index published by the Federal Reserve Board.

Statistics Canada is the source of Canadian data for both output and input data for the BLS comparative productivity measures. The Industry Measures and Analysis Division publish the measures of real GDP by industry. These data are based primarily on data from the I/O tables derived from the Annual Survey of Manufacturers and the 5-year Census of Manufacturers. The last I/O table is for 1995. Statistics Canada estimates the current 2 years of data on real GDP by

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[18] The impact of taxes on GPO is fairly complex. Thus, even though in concept the US measure of output will not reflect the increase in taxes, we assessed the significance of the inclusion of indirect business taxes (IBT) in the US value added measures. We simulated US GPO for manufacturing to exclude IBT using a published BEA series for indirect business taxes and non-tax liabilities. This series includes taxes on sales, property, and production but excludes employer contributions for social insurance and taxes on corporate income; non-tax liabilities include regulatory and inspection fees, rents and royalties, and donations.

We removed IBT from the nominal value added of US manufacturing and then applied the implicit price deflator for published GPO to the difference. (Over the entire 1979-95 period, indirect business taxes and non-tax liabilities accounted for approximately 4 percent of nominal GPO in manufacturing.) Using the same implicit price deflator for prices valued with and without taxes is only an approximation because an increase (decrease) in the implicit price due to increased (decreased) taxes results in an over- (under-) deflation of the adjusted series. Productivity was then calculated using this new output series.

Between 1988-92, the adjusted US series grows at approximately 0.2 percentage points per year less than the official series, due in part to the rapid growth in IBT over the period 1988-92 (approximately 8.5 percent per year). However the decline in the growth of IBT to 2.1 percent per year from 1992-95, resulted in the same adjustment actually increasing the growth of US output per hour.

[19] Additional information from the 1992 Census of Manufacturers is also used.

[20] Gross domestic income is constructed as the sum of costs incurred and profits earned.

[21] Yusgavage 1996, pp.133-155.

industry using monthly data.[22] These monthly estimates are based on proxy indicators such as gross output and the assumption that the relationship between inputs and outputs is fixed.

III.B.3. Real Output

To measure real output it is necessary to separate the growth of current dollar output into price change and quantity change. The quantity change represents real output growth. Both the US and Canada construct real measures of gross output and intermediate purchases and then measure real value-added as the difference between these deflated components. This is the technique of double deflation.

In both countries deflation is conducted at the most detailed level possible. In the US, current dollar gross output is deflated primarily using BLS PPIs.[23] Intermediate purchases are deflated with prices based largely on those used to prepare constant dollar gross output and imported intermediate inputs are deflated mainly using BLS import price indexes.[24] In Canada, current dollar gross output and intermediate purchases are deflated primarily using producer price indexes.

In general, the two countries use similar deflation techniques to measure real output and inputs. However, there may be any number of differences (and limitations) associated with the quality of particular data available for deflation, as well as with other practical procedures that must be employed when data are not available.

Although it is not feasible to examine the quality of all data that goes into the estimation of real value added, we will explore data for industries that appear to be contributing to the measured gap in aggregate productivity. Later in this paper we evaluate implicit prices of gross output and intermediate inputs for selected industries and discuss their influence on the aggregate measures.

III.B.4. Index formula

The US and Canada differ in their choice of index number formula used to construct measures of real value added. The US uses a chain-type annually-weighted index, a Fisher index, while Canada employs a fixed-base-volume index, in which the base period is changed with each benchmark, approximately every five years.

The US uses the chain-type index to measure real gross output, intermediate inputs and gross product originating by industry. This measure is a geometric mean of the conventional fixed-weighted Laspeyres index and a fixed-weighted Paasche index. Changes in this measure are calculated using weights for adjacent years. This annual chain index avoids the substitution bias that exists in fixed-weighted measures.

[22] Statistics Canada , 1997.
[23] Notable exceptions are price indexes constructed by BEA for computers, telephone-switching equipment, selected semiconductor products, and government purchases.
[24] Yusgavage, 1996, pp.133-155.

Substitution bias refers to the inability of a fixed-weighted index number to account for changes in relative prices over time. This substitution bias is especially apparent in manufacturing, because the continuous decline in computer prices has had a major impact on relative prices in manufacturing.[25]

Statistics Canada measures real GDP by industry using a fixed-base-volume index, in which the base year is updated periodically. For any given interval between base periods, Canada constructs a fixed-weighted Laspeyres index. Since 1981, Statistics Canada has been updating the base year approximately every five years.[26] When the base year is updated, Statistics Canada does not recalculate the movements of volume in the previous series, but chains the series prior to the update to the period from the base year forward. This technique is used to maintain historical growth rates. For the period from the last update forward, the series is a Laspeyres index. Thus, the constant price values of components add up to their aggregates during this current period, but such components do not add up for the earlier periods.[27]

The US adopted the chain-type index in the comprehensive revision of 1996. In a study following the revision, BEA indicated that over the period 1987-93, the annual growth rate of real value added for manufacturing was revised downward approximately 0.9 percent.[28] Previous measures for this period were constructed with a fixed-weighted index with a 1987 base year, while revised measures used the chain-type index. BEA stated that the change in index formula was a major factor in this downward revision of manufacturing real value added. During periods when prices fall rapidly for important products, an annual-chained index could be expected to grow slower than a fixed-weighted index over the period following the base period of the fixed-weight index. Thus, it seems likely that the US use of the annual chained formula rather than a fixed weight 1992 based formula is contributing to a reduction of the US-Canada productivity gap over the 1992-95 period.

However, to assess further the possible influence of the choice of index formula to the gap, we examined two alternative output series construct by the productivity division in Statistics Canada. Output measures are available for both the chained Lasperyes index as in the Canadian System of National Accounts and the Fisher Index used for Canadian productivity measures. Both measures use the same output concept, although this output concept does not underlie the series published in the national accounts. [29] Table 3 presents a comparison of growth rates for both series.

[25] Yusgavage, 1996, p.138.
[26] Base years are 1971, 1981, 1986, and 1992.
[27] Kishori Lal, 1998, pp.23.
[28] Yuskavage, 1996, p. 138.
[29] Gross output for the Canadian productivity program takes the national accounts gross output at factor costs and adds non-commodity taxes and subtracts non-commodity subsidies. This is a measure of gross output at basic prices (market prices less net commodity taxes).

TABLE 3: Growth in real value-added in manufacturing for Canada, 1988-95
(annual average percent change)

	Fisher Index	Chained Laspeyres
1988-95	0.94	0.93
1988-92	-2.38	-2.42
1992-95	5.55	5.58

From the table, it appears that the choice of index number formula is not having a significant impact on the growth in aggregate real value added over the period from 1988-95. This result is due perhaps to the relatively frequent re-weighting of the chained Laspeyres and/or to a possible absence of very large differences in price movements among important products in the Canadian manufacturing sector.

Thus, this result combined with the behavior of the US series after it was revised by BEA led us to conclude that the difference in index formulae is not contributing significantly to the gap. It should be noted that at the industry level, though, there might be differences that are not observable in the aggregate measures.

III.C. Estimation of Labor input

III.C.1. Hours Concept

The appropriate labor input for measuring output per hour is hours worked, rather than hours paid. For the US, hours at work exclude all forms of paid leave, but include paid time to travel between job sites, coffee breaks, and machine downtime. Similarly, Canada's measure of hours worked excludes time lost to strikes, holidays, vacations, illness, maternity leave, or personal reasons, but includes normal hours, overtime, coffee breaks, on the job training, and time lost to unanticipated interruptions. Both countries attempt to include hours data for all employed persons. [30]

III.C.2. Primary data sources

Hours data for the US are taken from the BLS series on hours and employment underlying its quarterly productivity statistics. The primary data source for the employment and average hours-paid series is the BLS Current Employment Statistics program (CES).[31] Data from the BLS Hours at Work Survey are used to convert average weekly hours paid to an hours-at-work

[30] Unpaid family workers are negligible in manufacturing and thus are not actually included in the BLS estimates of employment and hours

[31] Jobs rather than persons are counted, so that multiple jobholders are counted more than once. Hours of labor input are treated as homogeneous units; no distinction is made among workers with different skill levels or wages.

basis.[32] Secondary data sources include the BLS Current Population Survey (CPS), a labor force survey, and BLS studies of wages and supplements.

Statistics Canada is the source of Canadian input data for productivity measurement. The Industry Measures and Analysis Division publish the measures of total jobs and hours worked for all jobs. These data are primarily based on data from the Canadian Annual Survey of Manufacturing and the labor force survey.

III.C.3. Estimation of hours

Hours worked data in each country are estimated separately for production workers, non-production workers, and other-than-paid workers. Both countries collect employment data based on the number of jobs and estimate hours worked as the product of employment and estimates of average weekly hours.[33]

In the US, employment data for production and non-production workers are from the CES, as are data on average weekly hours-paid for production workers. For the period 1977 forward, average weekly hours-paid for non-production workers are extrapolated using trends in the regularly scheduled workweeks of production workers.[34] Average hours-worked data are constructed by applying the ratio of hours-at-work to hours-paid to the series on average hours paid. Proprietors' data are collected on an hours-worked basis in the CPS.

In Canada, employment data for production and non-production workers are collected in the Canadian Annual Survey of Manufacturing.[35] Employment data for other-than-paid workers are collected in the labor force survey. Average hours-worked data, including unpaid overtime, for all employed persons are also collected in the labor force survey.

Note that the US collects data on average hours-paid from an establishment survey and then applies a ratio for hours-worked/hours-paid, which is also collected in an establishment survey. Alternatively, Canada collects average hours-worked data directly in a labor force survey. Studies have shown that there can be differences in hours trends from household labor force surveys and establishment surveys.[36] However, employment, rather than average hours-worked, is contributing the most to the gap in hours between the US and Canada (Chart 1).[37]

It was beyond the scope of our study to assess the two countries' choices of sources for the hours data. We presume that each country chose the more appropriate series. However, exploring this

[32] For non-production workers, the ratio hours-worked to hours-paid is only available for durable and non-durable groups within manufacturing. Therefore, industry data on hours paid are adjusted with a ratio for the appropriate group.
[33] The US collects hours worked of proprietors in the labor force survey.
[34] Average weekly hours-paid for non-production workers are developed from BLS studies of wages and supplements in manufacturing which provide data before 1978 on the regularly scheduled workweek of white-collar employees.
[35] The employment data for aggregate manufacturing from the ASM is benchmarked to an adjusted series from the labor force survey.
[36] Abraham et al, 1998.
[37] We compared the employment data used in the measures with data from each country's labor force survey for the periods 1988-98, 1988-92, and 1992-98. In general, the labor force surveys data tell the same story. (BLS, 1999)

issue further would be a useful exercise. We concluded that there is no obvious reason to believe that the two countries' measurement procedures for labor input are contributing significantly to the productivity gap.

IV. Industry Measures

Recently, BLS obtained data for both Canada and the US enabling us to measure productivity trends through 1995 for approximately 19 2-digit industries within manufacturing. These data are consistent with the aggregate manufacturing numbers, although real values of the industries' outputs will not aggregate to the manufacturing level (except in Canada after 1992) due to the output index formulae.

The industry level data allow us to compare productivity performance between two countries for an individual industry. In addition, we are able to identify industries that contribute substantially to a country's manufacturing output per hour growth.

We first summarize adjustments that were made in order to put the two countries' data on the same industrial classification. This is followed by a review of the difference in each country's productivity performance by industry. Next, we analyze the contribution industries make to manufacturing output per hour growth. For certain industries making substantial contributions, we examine implicit prices for inputs and outputs, as well as certain pricing procedures.

IV.A. Industrial Classification

Before conducting an industry by industry analysis, it was necessary to adjust the 2-digit industry data to a comparable industrial classification. As mentioned in section III.A., the aggregate manufacturing sectors in the US and Canada are very similar, with the exception of the treatment of logging. However, within the manufacturing sectors, there are additional classification differences that must be taken into account.

To the extent possible, we adjusted the Canadian 2-digit industry data to conform to the US-SIC87 industrial classification system. Using data supplied by Statistics Canada and BEA, we constructed 19 comparable 2-digit industries.[38] These reflect the US-SIC87, with the exception of textiles mill products (US-SIC87 22) and apparel and other finished products made from fabrics and similar material (US-SIC87 23) which we were forced to combine.[39] For brevity we refer to industries with a short rendition of the full title in the US-SIC87 manual. A mapping of the full titles and their abbreviated versions follows.

[38] We were unable to match industries perfectly, but made every effort to adjust components of industries that seemed significant in size, and for which data could be obtained.
[39] Since the BEA measures are constructed using a chain-type index, a consistency in aggregation theorem was used to combine industries. (See Diewert, 1978, for a discussion of this theorem.)

US-SIC87

Code	Short title	Full title
20	Food	Food and kindred products
21	Tobacco	Tobacco products
22/23	Textiles & apparel	Textile mill products/Apparel and other finished products made from fabrics and similar materials
24	Lumber	Lumber and wood products, except furniture
25	Furniture	Furniture and fixtures
26	Paper	Paper and allied products
27	Printing	Printing, publishing, and allied industries
28	Chemicals	Chemicals and allied products
29	Petroleum	Petroleum refining and related industries
30	Rubber & plastic	Rubber and miscellaneous plastic products
31	Leather	Leather and leather products
32	Stone & clay	Stone, clay, glass and concrete products
33	Primary metals	Primary metal industries
34	Fabricated metals	Fabricated metal products, except machinery and transportation equipment
35	Machinery & computers	Industrial and commercial machinery and computer equipment
36	Electronics	Electronic and other electrical equipment and components, except computer equipment
37	Transportation equipment	Transportation equipment
38	Instruments	Measuring, analyzing, and controlling instruments; photographic, medical, and optical goods; watches and clocks
39	Miscellaneous	Miscellaneous manufacturing industries

Of the 19 2-digit industries that are compared in this paper, 8 industries were considered one-to-one matches (tobacco; furniture; printing & publishing; chemicals; leather; stone & clay; primary metals; and transportation equipment).[40] Food and rubber & plastics required aggregation of Canadian industries, while textiles & apparel required aggregation of both US and Canadian industries. For the remaining industries we obtained data from Statistics Canada at approximately the 3-digit level to move components among industries. The following adjustments were made: asphalt roofing (Canada L-51) was moved from the paper to the petroleum industry; machine shop (Canada L-69) was moved from fabricated metals to machinery; office equipment (Canada L-86), which includes computers, was moved from electronics to machinery & computers; logging (Canada L-3) was added to lumber & wood; and scientific instruments (Canada W-154 & 155) was separated out of miscellaneous to become the instruments industry.[41]

[40] To make these determinations an industry concordance was constructed based upon 4-digit industry descriptions. Where these descriptions were vague, the NAICS concordance was used as a bridge to map US-SIC87 to Canada-SIC80.

[41] To make these adjustments the consistency in aggregation theorem was employed (Diewert, 1978). Because the Canadian data are chained in five-year intervals they are only additive from 1992 forward. Although the Canadian

IV.B. Productivity by industry

Charts 3, 4 and 5 present a comparisons of growth in output per hour for 19 industries over the 1988 to 1995 period and two sub-periods.

Over the entire 1988-95 period, growth in output per hour in the U.S. has been particularly strong in the machinery & computers and electronics industries. The rubber & plastic and leather industries can also be considered top performers in the US. However, over this same time period, lumber, printing and instruments have recorded the poorest performance. In Canada over the period 1988-95, the machinery & computers and electronics industries have also been showing the greatest growth in output per hour; petroleum has also had strong growth in output per hour over this period. Canada has experienced declining growth in productivity in lumber, printing, and stone & clay.

For the sub-period 1992-95, the US has experienced strong productivity growth in the tobacco, as well as the machinery & computers, and electronics industries. Within this sub-period, lumber, printing and instruments continued to have the most significant declines in output per hour growth. In Canada, the tobacco and machinery & computers industries are also productivity leaders along with the chemicals and transportation equipment industries. For this sub-period, just as in the longer period, productivity growth declined in lumber and printing, as well as in instruments and leather.

When comparing industry performance between countries, we find that over the period 1988-95 the US demonstrates stronger productivity growth than Canada in 8 of the 19 industries. The largest gap between US and Canadian growth in output per hour appear in the electronics, leather, and stone & clay industries. Canada demonstrates faster productivity growth in 9 of the 19 industries. The largest differences appear in the petroleum, transportation equipment, and instruments industries. Over the period 1992-95 the US and Canada each demonstrate superior performance in 8 and 9 of the industries, respectively. The US out performs Canada most notably in electronics, tobacco, food, petroleum, and leather, while Canada out performs the US most notably in instruments, transportation equipment, and paper.

Charts 3, 4, and 5 enable us to identify differences in productivity performance across industries within each country and to compare an industry's performance between the two countries. However, in order to assess an industry's contribution to aggregate productivity growth, the industry's relative importance must be taken into account.

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indexes are not superlative, we decided that the consistency in aggregation theorem would be an improvement over adding and subtracting industries directly. In most instances the consistency in aggregation theorem did not differ significantly from direct addition over the period from 1988-1992. The complete concordance is available upon request.

INSERT PAGE CONTAINING CHARTS 3, 4 and 5

IV.C. Contribution to productivity growth

To examine the contribution an industry makes to the manufacturing sector's output per hour growth, we weighted the industry's productivity growth rate to reflect the industry's relative importance in the manufacturing sector. In the case of output per hour measures, a relevant weight that can be selected is the industry's share of the manufacturing sector's labor hours.

Determining the contribution an industry makes to manufacturing productivity and to the gap between the two countries is not a precise determination. However, we estimated these contributions simply to identify the industries most important to productivity growth in each country. [42] We caution against interpreting the results as exact estimates of the contributions.

To establish estimates of an industry's contribution to aggregate manufacturing productivity growth, we weighted industry productivity growth rates with average hours shares between the two periods.

$$\theta_i^{1,0} = \left[\frac{a_i^1}{a_i^0} - 1 \right] w_i^{1,0}$$

in which $\theta i^{1,0}$ represents industry i contribution to aggregate productivity growth between periods 1 and 0, $a_i^1 / a_i^0 - 1$ represents an industry's productivity growth, and $w_i^{1,0}$ is the of the hours share for periods 1 and 0.

Notice that productivity growth within an industry can be low, yet contribute considerably to aggregate productivity performance because of a large weight. The table below presents each industry's contribution to productivity growth in aggregate manufacturing.

[42] Because industry contributions can be constructed in different ways, we also estimated industry productivity shares as output-share-weighted output growth less labor-share-weighted labor growth. This alternative resulted in the same industries contributing most significantly to the aggregate measures. As noted earlier, the real values of the industries' outputs will not aggregate exactly to the manufacturing real output in years other than the base year (except for years after 1992 in Canada). In the US, levels of real output for an industry are measured by extrapolating 1992 nominal values by the growth in the real quantity index for the industry. This output share is dependent upon the base year chosen; choosing a different base year can result in different contributions. (See Lum and Moyer, 1998 for a discussion of these issues.) In order, to determine how sensitive our results are to the choice of base period, we re-estimated real outputs using 1995 nominal data for the base year and then recalculated industry contributions with output shares from this 1995 series. The resulting series produced the same top performers for each country. Results are available upon request.

TABLE 4: Contributions to manufacturing output per hour growth, US and Canada, 1988-95
(annual average contribution)

Industry (US-SIC87)	1988-1995		1988-1992		1992-1995	
	US	Canada	US	Canada	US	Canada
Food	0.05	0.08	-0.11	0.14	0.12	0.05
Tobacco	0.00	0.00	-0.02	-0.01	0.01	0.01
Textile/apparel	0.12	0.12	0.37	0.16	0.06	0.09
Lumber	-0.05	-0.07	-0.12	-0.04	-0.04	-0.10
Furniture	0.02	0.04	0.02	0.04	0.02	0.04
Paper	-0.01	0.05	0.00	0.06	-0.01	0.04
Printing	-0.05	-0.06	-0.11	-0.08	-0.04	-0.06
Chemicals	0.06	0.07	0.06	0.02	0.08	0.12
Petroleum	0.00	0.02	-0.05	0.04	0.01	0.00
Rubber & plastics	0.08	0.05	0.25	0.04	0.04	0.06
Leather	0.01	0.00	0.04	0.01	0.00	0.00
Stone & clay	0.02	-0.01	0.10	-0.03	0.00	0.01
Primary metal	0.03	0.09	0.07	0.18	0.02	0.02
Fabricated metal	0.04	0.05	-0.04	0.05	0.08	0.04
Machinery & computers	0.27	0.18	0.31	0.05	0.27	0.26
Electronics	0.49	0.17	0.68	0.24	0.38	0.11
Transportation equipment	-0.05	0.19	-0.44	0.07	0.06	0.30
Instruments	-0.04	0.01	0.02	0.02	-0.05	0.00
Miscellaneous	0.01	0.04	-0.02	0.04	0.02	0.03

Over the 1988 to 1995 period there are two industries that stand out as top contributors to US productivity -- machinery & computers and electronics industries. The textiles & apparel industry also appears as a significant performer in the US over this period. These industries, along with the transportation industry, were also the biggest contributors in Canada. The largest differences in contributions between the two countries are observed for the machinery & computers, transportation, and electronics industries.

For the period 1992-95, machinery & computers and electronics remain dominant forces in the US, while machinery & computers and transportation equipment are contributing the most to productivity growth in Canada. In the US, the textiles & apparel industry is replaced by food as one of the top contributors in the US. During this period the largest differences between the countries are for electronics and transportation.

The Canadian transportation equipment industry had superior productivity performance over its US counterpart for the longer period and for the sub-period 1992-95. This superior performance, coupled with a bigger relative contribution to the manufacturing sector's productivity growth, would work to reduce the gap in manufacturing productivity.

The performance of the electronics industry appears to be widening the gap in manufacturing productivity. The electronics industry shows relatively higher productivity growth, as well as a larger contribution in the US. The machinery & computer industry in both countries is showing significant productivity growth relative to other industries, although the performance is similar between the countries. Because other studies have also noted the impact of the IT industries on productivity performance, we felt it was important to review each industry further.

IV.D. Analysis of measurement differences

In order to explore whether possible differences in pricing and deflation methods may be leading to the productivity gap, we examined the implicit price deflators for intermediate purchases and gross output from the two countries. Differences in implicit price growth between the countries can be due to differences in the growth of prices for similar individual products in the two countries. Implicit price changes can also differ because the relative importance of items varies by country and through time or because different aggregation schemes underlie the price measures. Even though the change in an implicit price index is difficult to interpret, a significant gap in implicit prices at least suggest that there may be underlying price measurement differences.

Table 5 includes the growth rates of ratios of the implicit price indexes for the two countries' machinery & computers and electronics industries. Data for instruments are included for later analysis. Negative values indicate that the US implicit price is falling faster (or rising slower) than the Canadian price.

TABLE 5: Growth of the ratio of US implicit price to the Canadian implicit price, 1988-95
(annual average percent change)

	1988-95	1988-92	1992-95
GROSS OUTPUT			
Machinery & computers	0.4	1.5	-1.0
Electronics	-1.9	2.0	-6.9
Instruments	-1.6	-0.5	-2.9
INTERMEDIATE INPUTS			
Machinery & computers	2.0	3.3	0.2
Electronics	0.3	3.5	-3.8
Instruments	-2.6	-0.3	-5.5

For 1988-95, the data show different growth rates for prices of both intermediate purchases and gross output. Our main interest is in the 1992-95 period, in which all but one of the US implicit prices for outputs and inputs fell faster or increased slower than its Canadian counterparts. Because of well-known issues in pricing IT goods, it is not surprising that a difference appears in machinery & computers and electronics. We reviewed the practices used for deflating the output of IT industries in the two countries to see if any differences seemed significant.

The IT products we reviewed are in these 4-digit industries: computers, printers and peripherals (US-SIC87 3571, 3572, 3575, and 3577); telecommunication equipment (US-SIC87 3661); and semiconductors (US-SIC87 3674). The Canadian industries which contain these products are electrical computing and peripheral equipment (C-SIC80 3361), telecommunications equipment (C-SIC80 3351), and electronic parts and components (C-SIC80 3352).[43]

We reviewed practices that the two countries use to measure prices of three important products within IT industries in the manufacturing sector --computers, semiconductors and telephone switching equipment. We selected these products because a BEA study of industry price measures noted that declines in machinery & computers and electronics gross output prices between 1992 and 1996 were primarily for prices for these three products.[44] Further, semiconductors are important inputs into several industries. We will discus the value-added output of the instruments industry to illustrate this.

IV.E. Estimation of IT output

The use of different methods to measure the output of IT products has been discussed as an impediment to constructing accurate international comparison of output and productivity.[45] Although a review of the general issue should include the consideration of all procedures for adjusting for quality change, the issue is sometimes framed in terms of different practices regarding the use of the hedonic method. We limited our review to this issue.[46]

There are two frequently noted measurement issues associated with IT goods -- goods which show large quality improvements and rapid price declines. First, real output measures for many countries are based upon weighting schemes such as the Laspeyre or Paasche formulations, in which base period price-weights are held fixed for some period of time.

If prices change more rapidly for some items, like IT products, the base period weights become rapidly obsolete. This problem is addressed by frequently changing the weights; a chain-type annual-weighted index formula such as that used by BEA is a specific method for changing the

[43] Other industries, such as radio and television broadcasting equipment (US-SIC87 3663) could be included in this list. Triplett, 1996, noted the importance of machinery used to produce semiconductors. Also, computer software could be considered an IT product. Computer software is not an output of the manufacturing sector but a different treatment in the national accounts may one day result in differences in manufacturing value added among countries. The 1993 United Nations System of National Accounts recommended that software be treated as a capital good and not as an expensed item. This change in the treatment of software would raise the value added of the industries purchasing the software. Although the US adopted this convention when carrying out the comprehensive revision of the national accounts in November 1999, this change has not yet been made to the GPO by industry series. BEA expects to incorporate the change when it updates and revises the GPO series in the spring of 2000. Due to data problems, Statistics Canada has not yet been able to introduce this change completely. (Lal, 1998). To the extent that it has been implemented in Canada and raised GPO, this would tend to reduce the productivity gap with the US which has not yet implemented the procedure for the manufacturing GPO series.
[44] Yuskavage, 1998, p.22.
[45] See for example Schreyer, 1996.
[46] Prices can vary for other reasons associated with the price collection programs. For instance the timing of the updating of relative importance weight for items included in a product class could vary among countries.

weights frequently. We have already noted that the choice of index formula is having little impact on the US-Canada productivity growth differential for the total manufacturing sector.[47]

Second, the methods used to account for quality changes in price indexes of IT products vary among countries. In particular, some countries use the hedonic method to estimate a deflator for IT goods, while other countries use a more traditional method such as the matched model procedure.

The hedonic technique is a regression-based technique that estimates prices for various quality characteristics of an item. When the quality of an item changes, as reflected in changes in one or more of its characteristics, an adjustment can be made to the product's price to account for this quality change.[48] More traditional methods assume that a change in quality of a product will be associated with an increase in the cost of producing it -- this cost increase can be used to determine how much of the item's price change is due to quality change versus price change. For high tech goods, the cost and price of the improved version are often less than those of the earlier version.[49]

<u>US-SIC87 35,</u> Industrial and commercial machinery and computer equipment.

Although the productivity performance between the two countries is similar for this industry, for completeness, we note that both countries employ hedonic methods for computers.

The BEA uses a hedonic procedure for computers as well as printers, displays, direct access storage devices, and tape drives. BEA constructed a hedonic price index for micro computers in 1987. The BEA links its computer price indexes for 5-digit product classes to the BLS PPIs which became available in 1990 and also are derived with the hedonic technique.

The Canadian price index incorporates some prices from the US series, as well as some from Canada. From 1981 forward, the Canadians have used an average of the BEA series for processors, direct access storage drives, printers and displays with weights based upon Canadian production. The BEA tape drive index was not used because this was a small output in Canada.

The BEA index for personal computers was incorporated into the Canadian price index through 1992, at which point, price indexes for microcomputers and printers were based on prices collected in Canada and adjusted with a hedonic procedure.

[47] However, it may be an issue at the industry level.
[48] There are actually various ways the technique is employed, including estimating a price index from the regression coefficients for variables representing time periods or combining its results with more conventionally derived prices in order to derive a price index for a product class.
[49] See Grimm, 1998, p.9 for a brief discussion of the issues associated with the measurement of output and prices for high-tech goods.

US-SIC87 36, Electronic and other electrical equipment and components, except computer equipment.

This industry is made up of 37 4-digit industries. Two of these -- telephone and telegraph apparatus (US-SIC87 3661) and semiconductors and related devices (US-SIC87 3674) -- contain telephone switching equipment and semiconductors. The closest equivalent Canadian industries are C-SIC80 3351, telecommunications equipment, and 3352, electronics parts and components.

US-SIC87 3661/C-SIC80 3351 In 1992, the shares of nominal shipments for telephone and telegraph apparatus within the electronics industry were 10 percent and 21 percent for the US and Canada, respectively. [50]

The implicit price series for shipments of these two industries are:

	1992	1995
US (US-SIC87 3661)	100	86.4
Canada (C-SIC80 3351)	100	105.3

BEA produced a hedonic price index for telephone switching equipment (US-SIC87 36611) within this 4-digit industry. (In 1992, the nominal output of this product accounted for about 41 percent of the 4-digit industry shipments.) After 1996, the BEA price series was linked to the appropriate BLS PPI series. The PPI is not derived using the hedonic method.

Canada produces a price series for telephone switching equipment based upon purchase prices collected from Canadian telephone companies. A matched model approach is used. We don't have the relative importance of telephone switching equipment but telephone equipment accounts for almost all of C-SIC80 3351.[51]

Because of the importance of telephone switching equipment within US-SIC87 3661 in the US, it is possible that the different implicit prices in the two countries for this 4-digit industry are due to the use of the hedonic method for telephone switching equipment. However, because this product was a relatively small part of the overall electronics industry within the US (at least in 1992), it seems unlikely that the different practices with respect to the application of the hedonic method to telephone switching equipment is contributing substantially to the aggregate electronics industry. The products of other 4-digit industries in the electronics industry are also contributing substantially to the aggregate price decline.[52] One of those 4-digit industries is semiconductors and parts.

[50] Gross output is equal to shipments plus changes in inventories. The Canadian share is based upon the ratio of shipments to gross output.
[51] Statistics Canada.
[52] We reviewed the implicit prices for shipments for all 4-digit industries in the US within electronics. Over half of the electronics industry's nominal shipments in 1995 is accounted for by 4-digit industries whose prices fell over the 1992-95 period.

US-SIC 3674/C-SIC80 3352 For the US this 4-digit industry is defined as semiconductors and related parts. The closest comparable industry in Canada is electronic parts and equipment[53].

In 1992, the shares of nominal shipments of this 4-digit industry within the electronics industry are 15 percent in the US and 20 percent in Canada; by 1995 the shares had grown to about 22 percent in both countries. The price behavior of this 4-digit industry has a significant impact on the electronics industry shipments in both countries.

The implicit prices for shipments (gross output in Canada) in the semiconductor industry (US) and electronic parts and equipment (Canada) are:

	1992	1995
US (US-SIC87 3674)	100	49.0
Canada (C-SIC80 3352)	100	109.8

The BEA used a mixture of the hedonic method for microprocessors and matched model methods for memory chips until 1996.[54] The hedonic method was used to adjust for missing prices for matched models for 32 percent of one type of microprocessor and 7 percent of a second type.[55]

Canada does not collect prices for semiconductors, but rather uses the BLS PPIs for several products within the semiconductor industry as a proxy for deflating integrated circuits and semiconductors and parts. The PPIs are adjusted for exchange rate differences in order to express prices in terms of Canadian prices.[56] The hedonic method was not used in the derivation of the PPIs.

For the electronics industry it appears that different methods are likely yielding the different price behavior and resulting real gross output differences. However, because the hedonic technique is only used to adjust for quality change for some microprocessor price observations, the difference in the price behavior for the entire electronics industry is not likely due to BEA's use of the hedonic technique. A further examination of the difference between the BEA and PPI series would be required to determine what is causing the difference.

So far, we have reviewed the impact of different practices on real shipments measures. It appears that the different practices regarding the use of the hedonic method are not responsible for a substantial part of the difference in the growth of real shipments for the machinery & computer

[53] In 1992, about two thirds of C-SIC80 3352 is made up of integrated circuits and semiconductors and parts. (Statistics Canada)
[54] Beginning with 1996, a link was made to the appropriate BLS PPIs; the PPIs are not derived with the hedonic technique. BEA did not extend its price estimates beyond 1996 because recent improvements in the methods used by BLS to calculate PPIs for semiconductors make them superior to those that could be generated with BEA's methods. (Grimm, 1998, p.9)
[55] Grimm, 1998, p.22.
[56] The PPI for the aggregate industry US-SIC87 3674 fell about 7 percent between 1992 and 1995. Some of the increase in the Canadian series for C-SIC80 3352 may be due to adjustments made to the PPIs to reflect changes in exchange rates plus rising prices for other industry outputs.

and electronics industries. However, a more thorough evaluation requires an assessment of the impact of the IT product prices on value-added output. In particular, it is also necessary to consider the impact of the prices on intermediate purchases. This is particularly the case for semiconductors.

Semiconductors are an output of the electronics industry, as well as an important input into several manufacturing industries in addition to machinery & computers. The real value of semiconductors will affect the real intermediate purchases and value added of several industries. Consequently, the impact of different pricing and deflation methods in the US and Canada will be dampened with respect to the manufacturing total. That is, to the extent that the semiconductors produced within the US manufacturing sector are consumed within the manufacturing sector, rapid gross output growth due to price declines in semiconductors will be offset to a considerable extent due to a more rapid increase in real intermediate inputs.

Further, the BEA price measures for semiconductors are also weighted and combined with prices for other items to yield an import price. Using these falling prices to deflate intermediate purchases of imports will also lead to reductions in value added. Both impacts on intermediate purchases will ameliorate some of the impacts of different measurement techniques for semiconductors in the two countries on output per hour.

For example, in the instruments industry, there is a more rapid relative implicit price decline for intermediate purchases than for shipments (Table 5). This relationship leads to a reduction in value-added growth. In fact, since 1990, the value-added output for instruments has been falling in the US while rising in Canada. The BEA has noted the declining real value added of instruments is due in part to the falling prices for semiconductor inputs.[57] This difference in performance between the two countries' instruments industries would tend to lessen the US-Canada gap based upon value-added output per hour.

V. Conclusion

In this paper, we reviewed the procedures BLS uses to produce international productivity comparisons, along with the methods used by each country's statistical agencies to compile the underlying data used by BLS. We explored differences between the two countries in industrial classification; concepts and estimation of real value-added output (including index aggregation formula and valuation of prices); and the estimation of labor hours worked input. From this review, we are unable to conclude that differences in methodology between the US and Canada are significant contributors to the gap in the US-Canada productivity performance in manufacturing over the last ten years. As other researchers have found, a substantial contribution to the gap is made by IT related industries. Although the different procedures to deflate the output and inputs of information technology industries need to be studied more thoroughly, the use of the hedonic technique by the US and not by Canada for some important IT products appears not to contribute to the gap. It seems that a significant portion of the gap is real.

[57] Lum and Moyer, 1998, p.29.

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CHART 3: Productivity growth in manufacturing by industry, US and Canada, 1988-95
(annual average percent change)

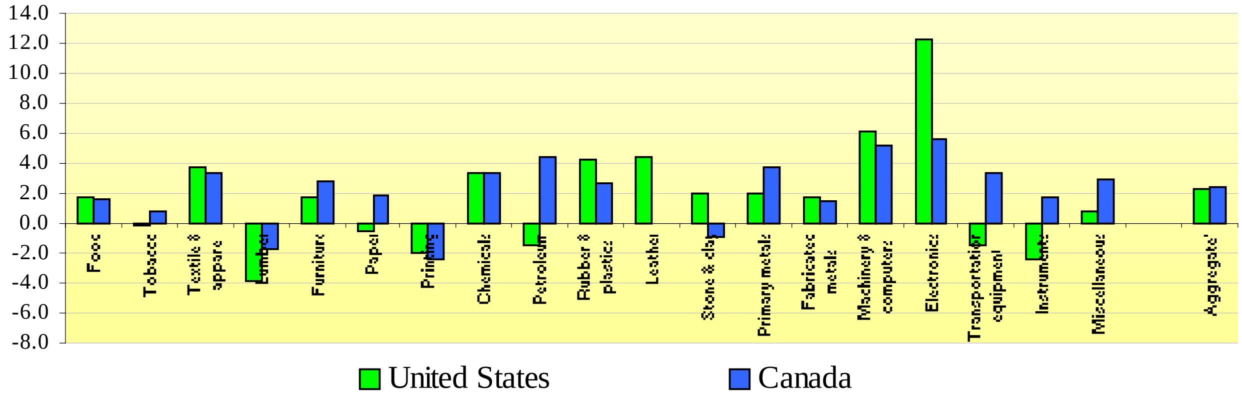

CHART 4: Productivity growth in manufacturing, US and Canada, 1988-92
(annual average percent change)

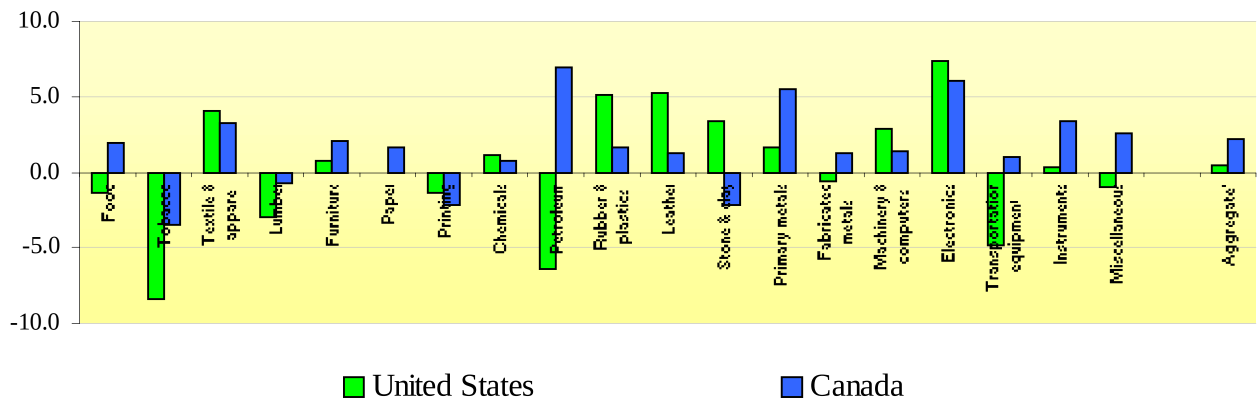

CHART 5: Productivity growth in manufacturing by industry, US and Canada, 1992-95
(annual average percent change)