Editor's Overview

THIS ISSUE OF THE *International Productivity Monitor* contains five articles on: recent productivity developments in the world economy; aggregate measures of income and their implications for productivity and living standards; the role of sectoral employment shifts in aggregate productivity growth in Canada; productivity trends in regulated industries in Canada and the United States; and international productivity comparisons in the financial and business services sectors.

Please note that because of funding matters, a Fall 2009 issue of the *International Productivity Monitor* was not produced. The last issue published was Number 18 in the Spring of 2009. This current issue, Spring 2010, is hence Number 19 because of the non-publication of the Fall 2009 issue.

For the first time since the early 1980s, world labour productivity fell (down 0.2 per cent) in 2009, a victim of the global economic crisis. In the lead article, a team of economists headed by **Bart van Ark** from the Conference Board provide a detailed analysis of recent productivity developments in the world economy based on the Conference Board's updated Total Economy Database. They find that because of continued strong labour productivity growth in China, and to a lesser degree India, productivity growth in the emerging and developing countries remained positive in 2009 at 1.8 per cent, although down from a robust 6.3 per cent in 2007. In contrast, labour productivity in the advanced economies fell 1.2 per cent in 2009 after a 1.3 per cent rise in 2007. Within the advanced economies productivity trends diverged significantly in 2009. Labour productivity advanced 2.5 per cent in the United States, but fell 1.0 per cent in the Euro Area, increasing the U.S. productivity level advantage.

To the general public, and even to most economists, Gross Domestic Product (GDP) is synonymous with income and output. But there are in fact eight aggregate measures of income and output (GDP, GNP, NDP, NNP, GDI, GNI, NDI, and NNI). In the second article, **Chris Ross** from the University of Toronto and **Alexander Murray** from the Centre for the Study of Living Standards define the eight measures, identify for which measures official estimates are available from Statistics Canada and the U.S. Bureau of Economic Analysis, construct estimates for the measures for which official estimates are not available, and examine trends in the eight measures for Canada and the United States for the 1980-2008 period and subperiods.

They argue that from a productivity perspective GDP and NDP are the most appropriate measures, while from a living standards perspective NNI is the best measure, as the latter measure includes terms of trade effects, focuses on the income received by the residents of the country and captures the sustainability of the capital stock. NNI has grown much more rapidly than the other income measures in Canada in the 2000s and even considerably faster than NNI growth in the United States. Indeed, NNI per capita in Canada in 2008 was 86 per cent of that in the United States, much higher than the 80.3 per cent figure for GDP per capita.

The Canadian economy has experienced major sectoral reallocations of labour in recent years and some have speculated that these shifts may have contributed to the slowdown of productivity growth in the post-2000 period. In the

third article, **Andrew Sharpe** from the Centre for the Study of Living Standards addresses this issue through a decomposition of aggregate labour productivity growth into within-sector effects and reallocation effects. The latter include both industry level effects and industry growth effects. He finds that reallocations of hours worked had little impact on aggregate labour productivity growth in the 2000-2007 period. There had been a negative effect in the 1973-2000 period and the loss of this effect between the two periods actually lessened the fall in productivity growth after 2000. It was rather the fall in manufacturing productivity growth from 2.9 per cent per year in the 1973-2000 period to 1.1 per cent per year in 2000-2007 that accounted for the overall fall in the growth of business sector output per hour. To explain Canada's poorer productivity performance in the 2000s, we must explain why manufacturing productivity growth in this country has tumbled.

Regulation is often considered a barrier, and deregulation a tonic, to productivity growth. In the fourth article, **Wulong Gu** and **Amelie Lafrance** from Statistics Canada examine productivity growth in nine regulated industries in Canada and the United States from 1977 to 2006, a period when deregulation took place in a number of industries. They find that in Canada the labour productivity growth rate in the regulated industries was faster than that experienced in the business sector in 1977-2006 and that it had picked up from that experienced by regulated industries in the pre-1977 period. They attribute this positive development to deregulation, which has been shown to reduce barriers to entry, increase competition, and enhance incentives to innovate and to adopt advanced technologies.

The financial services sector and the business services sector account for an important part of the business sector, yet these sectors receive considerably less attention from a productivity perspective than other industries, such as manufacturing. To address this relative lack of information on these key sectors, **Pamfili Antipa** and **Marie-Elisabeth de la Serre** from the Banque de France in the fifth and final article examine levels and rates of productivity growth in these two industries for the United States and four major EU countries (Germany, France, United Kingdom, and the Netherlands). They find that in 2005 three of the four countries (the exception was Germany) had significantly higher levels of output per worker in financial services than the United States. In contrast, three of the four countries (again the exception was Germany) had lower levels of output per hour in business services than the United States.

Recent Productivity Developments in the World Economy: An Overview from The Conference Board Total Economy Database

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ABSTRACT

The recession left its mark on global productivity, which fell in 2009. The productivity growth differential between the United States and Europe increased dramatically in 2009. Average long-term growth of labour productivity in advanced economies has stalled since 2000. The gradual improvement in world productivity is due to emerging and developing economies. In particular the long-term increase in TFP growth reflects a strengthening of the efficiency with which emerging and developing economies use labour and capital in productive economic activity.

AGAINST THE BACKDROP OF the recession, global productivity, measured as output per person employed, fell 1.0 per cent in 2009 according to preliminary estimates published as part of The Conference Board Total Economy Database in January 2010. This decline in world productivity is the first significant contraction of that benchmark since the early 1980s (Chart 1). The current productivity slowdown has hit countries across the world. Still there remains a large diversity between advanced economies, on the one hand, and emerging and developing economies, on the other. When measured as a group, advanced economies saw the growth rate of labour productivity fall from 1.3 per cent in 2007 to -1.2 per cent in 2009. In emerging and developing economies it dropped from 6.3 per cent in 2007 to 1.8 per cent in 2009.[2] Between the advanced economies themselves there has also been high diversity, with the United States performing at considerably higher labour productivity growth rates than most

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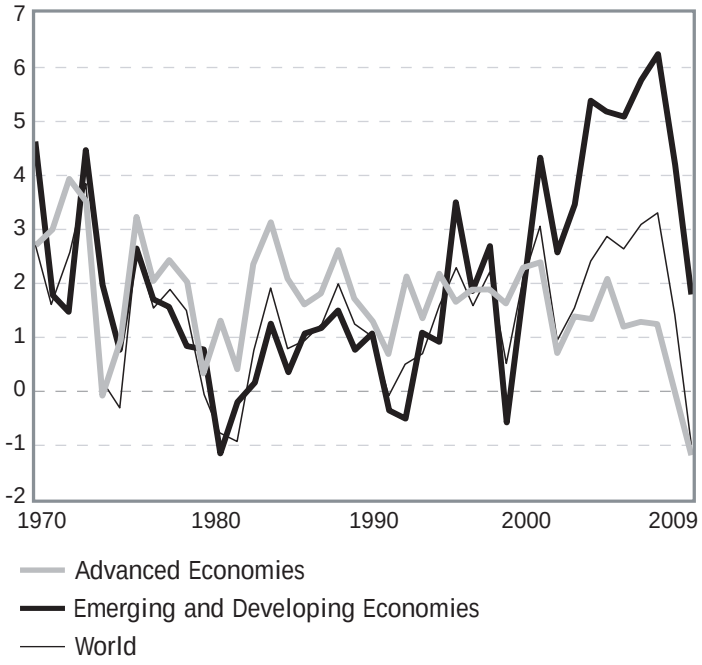
2 Advanced economies include United States, EU15, Japan, Canada, Switzerland, Norway, Israel, Iceland, Cyprus, Korea, Australia, Taiwan, Hong Kong, Singapore and New Zealand. Emerging and developing economies include China, India and countries in developing Asia, Latin America, Middle East, Africa, Central & Eastern Europe, Russia and other Commonwealth of Independent States countries.

Chart 1
Growth of GDP per Person Employed, 1970-2009
(Per Cent per Year)



Note: Growth rates are based on the difference in the log of the levels of each variable. Advanced economies includes North America, the EU-15 (pre-2004 membership), and the following countries in the Asia-Pacific: Australia, Hong Kong, Japan, Korea, New Zealand, Taiwan and Singapore. Also Cyprus, Iceland, Israel and Switzerland are included in the advanced category. The rest of the world relates to emerging and developing economies.

Source: The Conference Board Total Economy Database, January 2010.

European countries during 2009. Also Asian economies have generally performed better than other emerging economies.

While short-term productivity movements are highly volatile during peaks and troughs, the long-term trend worldwide over the past three decades has been toward faster productivity growth (Chart 2). This is mainly due to emerging and developing economies that have rapidly taken over leadership in productivity growth since the early 2000s. In contrast, the average long-term growth of labour productivity in advanced economies has stalled since 2000, even though the trend in the United States started slowing after 2004 only. However, levels of productivity in emerging and developing countries are still much lower than in the advanced economies, leaving substantial scope for catching up and a strengthening of competitiveness relative to advanced economies.

Total factor productivity (TFP) growth, which measures the change in GDP growth over the compensation-share weighted growth of combined factor inputs (labour and capital inputs, adjusted for change in their quality), has weakened in advanced countries, dropping from 0.4 per cent per year in the period between 1995 and 2005 to -0.1 per cent from 2005 to 2008. TFP growth in emerging and developing economies, on the other hand, has strongly improved from 1.0 per cent in 1995-2005 to 2.2 per cent in 2005-2008 (Chart 3). During the most recent years (2007-2009), total factor productivity has remained at much higher growth rates in emerging and developing economies than in advanced economies.

The above summary of measures of productivity, output and input is based on The Conference Board Total Economy Database. It is a detailed dataset that provides output, input and productivity for 123 countries around the world since 1950. The purpose of this database is to facilitate international comparisons of productivity performance at the macroeconomic level by providing consistent and reliable data; to support empirical and theoretical research in the area of productivity and growth accounting; to examine long term growth trends; and to provide a basis for growth forecasts and projections.

In this overview article, we first discuss the key characteristics of the database. We then introduce the growth accounting methodology and the construction of the variables. In the final section we present a brief analysis of some of the major results observed from the January 2010 release of the database.

Organization, Data Sources and Methodology of the Total Economy Database

Organization of the database and public access

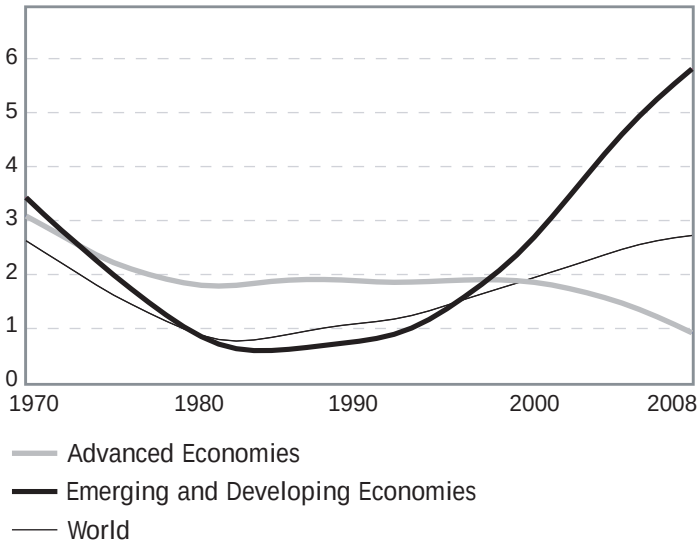
The Conference Board Total Economy Database was originally developed by the Groningen Growth and Development Centre at the University of Groningen in the Netherlands in the early 1990s. Since the late 1990s, it has been produced in partnership with The Conference Board, and as of 2007 the database was transferred from the University of Groningen to The Conference Board in New York, which has maintained and extended the database since then.

Two distinguishing features of the database are its wide country coverage and its timeliness. The scant and inconsistent data in emerging and developing economies is the bottleneck for most international comparisons. The Total Economy Database makes use of information from the latest national accounts, labour force surveys, and other employment statistics available for individual countries. In order to maximize international consistency, the figures are largely derived from the most reliable international sources, such as the Organization for Economic Cooperation and Development (OECD); the Statistical Office of the European Union (Eurostat); the International Monetary Fund (IMF); the International Labour Organization (ILO); and the World Bank. However, for many counties data from international sources have been supplemented with those from national statistical offices to increase timeliness when possible. Hence in most cases the estimates are updated to the year t-1, where t is the current year (in this case 2010), using a combination of forecasts and estimates up to the third quarter of the year.

The database provides annual estimates of the levels and growth rates of GDP, total population, employment, hours, labour quality, capital services, labour productivity, and total factor productivity starting from 1950 for 123 economies in the world, representing 97 per cent of the world's population and 99 per cent of global output. The level estimates are expressed in 2009 U.S. dollars, and converted at purchasing power parity to adjust for differences in relative price levels between countries. The database is publicly released every year in January, with series covered up to year t-2 (2008 in the current version), preliminary estimates for the year t-1 (i.e. 2009) and projections for the current year t (i.e. 2010).

With the latest release (January 2010), the database has been extended with a module on sources of growth, including labour quantity and quality, capital services (non-ICT and ICT), and total factor productivity. The extended module aims to integrate two previous data sets: the world economy productivity data set created

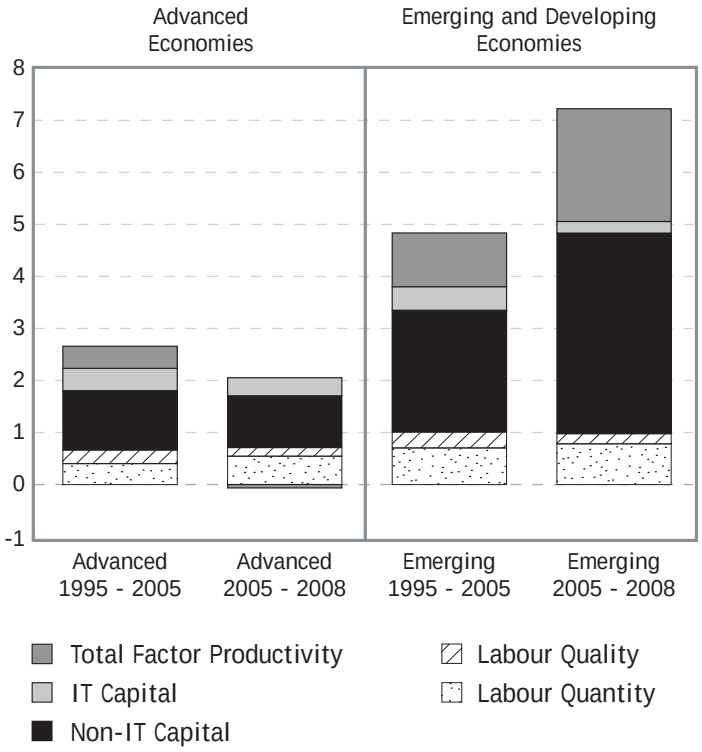
Chart 2
Labour Productivity Growth Trend, 1970-2008
(GDP per Person Employed)



Note: The trend was obtained from the annual estimates in chart 1a using a Hodrick-Prescott filter with a λ =100. The trend runs only to 2008, as the observations for 2009 are regarded as too volatile to determine the long-run trend at this point in time. See also Chart 1

Source: The Conference Board Total Economy Database, January 2010.

Chart 3
Decomposition of Sources of Output Growth, 1995-2008
(Average annual percentage point contributions)



Note: Growth rates for 1995-2005 and 2005-2008 are the averages of yearly growth rates. See also Chart 1

Source: The Conference Board Total Economy Database, January 2010

by Dale Jorgenson and Khuong Vu of Harvard University (Jorgenson and Vu, 2009)[3] and the Total Economy Growth Accounting Database of the Groningen Growth and Development Centre (Ypma, Timmer and van Ark, 2003; Timmer and van Ark, 2005).[4]

The data series are publicly available without charge from The Conference Board Total Economy Database website (http://www.conference-board.org/economics/database.cfm). The main results have been discussed in a short publication for members of The Conference Board in January, The Productivity Brief (The Conference Board, 2010), which is a prelude to The Conference Board's annual Performance Report to be released in the Fall with an updated version of the database.

Below we provide a brief description of data sources and methodology including the latest changes, in particular to the use of PPPs, the aggregation to regional and world averages and the introduction of TFP estimates. More detail on the methodology can be found in the document *Methodological Notes* and detailed source descriptions are given in *Detailed Sources.* These files are all downloadable from the database website.

Output: GDP and Purchasing Power Parities

The most frequently used measures of efficiency of an economy is labour productivity, which is the average output produced per unit of labour. Labour productivity estimates are obtained by dividing the real output measure (Gross Domestic Product) by the total labour input used to produce that output. Two measures of labour productivity are included: output per person employed and output per hour for countries with total hours data available.

The output measures in the database represent Gross Domestic Product at market prices, which are obtained from national accounts sources from international organizations and national statistical institutes.[5] The post-1990

3 See also Dale Jorgenson's website: http://www.economics.harvard.edu/faculty/jorgenson.

4 See also The Groningen Growth and Development Centre website: http://www.ggdc.net/databases/ted_growth.htm

5 Our focus here is on the aggregate economy, which includes non-market and semi-public services such as health and education services, as well as public administration and defense. Measurement problems in these industries are substantial, and in several cases (in particular for government), output growth is measured using input growth which is affecting the aggregate productivity numbers. Another problem case is real estate where output mostly reflects imputed housing rents rather than sales of firms. Productivity measures of the market economy, excluding these industries, are not available for as many countries as in this study.

measures are obtained from a variety of sources, including the National Accounts and Economic Outlook of the OECD, national accounts data from Eurostat, and the IMF World Economic Outlook Database. Pre-1990 measures are mostly obtained from historical series, collected by Angus Maddison (2007).[6]

To allow international comparisons of the levels of labour productivity, output levels are adjusted by purchasing power parities (PPPs) to take into account the differences in price levels. The measures of GDP and productivity levels are expressed in constant U.S.-dollar market prices for 2009, and are adjusted for cross-country differences in the relative prices of goods and services using PPPs. Two measures of GDP in dollars are available from the database, one which is converted at EKS PPPs and the other at Geary-Khamis (GK) PPPs.[7] The original EKS series, which are measured in constant 2005 U.S. dollars and are extrapolated to 2009 with GDP deflator changes, are unpublished estimates from Penn World Tables (PWT). These estimates, which were kindly provided by Alan Heston and will be used in the upcoming version of PWT 7, are benchmarked on the 2005 PPPs from the International Comparisons Project (ICP) at the World Bank (World Bank, 2008), and are available for 111 of the 123 countries in the database.[8] The adjustments made by PWT reflect:[9]

1) an adjustment for global weighting for individual countries using EKS weights over domestic absorption (DA) for all countries rather than over five main regions as was done in the ICP by the World Bank;
2) an adjustment for the net foreign balance using the PPP for domestic absorption (DA) rather than the exchange rate as in the ICP; and
3) a downward adjustment in the PPP for China, which originally was based on relatively high prices for 11 cities, in order to better reflect the impact of relatively lower prices in rural areas in China, which were not adequately reflected in the original World Bank estimate.

The effect of the first two adjustments increased GDP (in U.S. dollars) for the global economy (all countries excluding the United States) by 7.6 per cent relative to the U.S. in 2005. The China correction adds another 2 percentage points to global GDP (excluding the United States, which is the benchmark country). For China specifically the first two effects lead to an upward adjustment in GDP of 13 per cent relative to the World Bank measure, and together with the adjustment for prices (the third effect) even to an upward adjustment of 28.5 per cent of the World Bank GDP level for China.[10]

Geary-Khamis series of GDP are expressed in 1990 U.S. dollars and are available for all of the 123 countries in the database. The benchmark year estimates were in almost all cases derived from Maddison (2007). Maddison used a PPP for China which was constructed for 1986, and which is much lower than the

6 For the latest Maddison estimates, see: http://www.ggdc.net/Maddison/Historical_Statistics/horizontal-file_03-2009.xls

7 "EKS" stands for the originators of this PPP formula, Eltoto, Kovacs and Szulc, which essentially is a multilateral Fisher index. Geary and Khamis are the originators of a PPP formula, which is a multilateral index similar to binary Paasche index, giving relatively large weights to large countries.

8 The following 12 countries in the Total Economy Database are not covered by the PWT PPPs thus do not have GDPEKS series: Algeria, Barbados, Costa Rica, Dominican Republic, Guatemala, Jamaica, Myanmar, St. Lucia, Trinidad & Tobago, Turkmenistan, United Arab Emirates and Uzbekistan.

9 We thank Alan Heston for providing the PWT rework of the ICP PPP data. For a detailed description on the PWT PPPs, see Angus Deaton and Alan Heston (2009).

10 See also Ravaillon (2010) who defends the World Bank measures of the China PPP, but admits to an upward bias due to the undercoverage of rural prices in China.

recent PPP obtained by the ICP/World Bank. As a result Maddison's GDP level for China in U.S. dollars is roughly 40 per cent higher than that of the World Bank. We adjusted Maddison's GDP level for China downwards by 22.6 per cent, which brings it closer to the adjustments for China in the PWT PPP index, as described above.

Labour quantity: Employment and hours worked

From the perspective of productivity measurement, it is very important that the measures of employment used are consistent with the measures of output. In this regard, the key concern is that employment figures need to cover all persons engaged in productive activity that fall within the production boundary of the system.[11] In terms of production boundary, the domestic concept is adopted which includes all workers employed domestically, but excludes any nationals working abroad. Employment therefore should include employees, self-employed as well as unpaid family members that are economically engaged, apprentices and the military.

The employment data for most advanced countries since the 1990s are from the National Accounts (domestic concept) from the OECD and Eurostat, supplemented by the growth rates mostly from labour force surveys to extrapolate backward the employment levels for earlier years. For many developing countries, the employment figures do not strictly follow the international standard defined above due to the lack of qualified data sources.[12]

Still, output per person employed is a crude measure of labour productivity. Total hours worked measures the quantity of labour input more accurately, and is defined as the aggregate number of hours actually worked during the year in employee and self-employment jobs. Series of hours worked are currently available for 51 countries in the database with OECD and Eurostat National Accounts being the major data sources for recent years. These data sources aim to ensure that the total hours worked is within the production boundary and that it is consistent with the employment data used in the database.

Growth accounting

Output and labour quantity allow for the calculation of labour productivity. Another type of productivity measure is total factor productivity (TFP), which is average output produced by a combination of multiple inputs, including labour and capital input, and with adjustments for changes in the quality of labour and changes in the composition of capital assets. To obtain total factor productivity estimates, a standard growth accounting framework is used to compute the contribution of these inputs to aggregate output (GDP) growth. The growth accounting methodology has been pioneered by Solow (1957) and further developed by Jorgenson and associates (Jorgenson and Griliches, 1967; Jorgenson, Gollop and Fraumeni, 1987).

In the general production function below, output (Y) is produced by an input bundle X, consisting of capital services (K) and labour services (L_Q). Capital services are decomposed

11 Employment has been defined by the International Labour Organization (ILO) in the "Resolution concerning statistics of the economically active population, employment, unemployment and underemployment," adopted by the thirteenth International Conference of Labour Statisticians. It is defined consistently in the System of National Accounts 1993 (1993 SNA) and European System of Accounts 1995 (1995 ESA). ILO: http://www.ilo.org/public/english/bureau/stat/res/index.htm; 1993 SNA XVII: Population and Labour Inputs: http://unstats.un.org/unsd/sna1993/toctop.asp; 1995 ESA Chapter11 Population and labour Inputs: http://circa.europa.eu/irc/dsis/nfaccount/info/data/esa95/en/esa95en.htm.

12 For example, the employment figures for most African and Mid-East countries are actually labour force data, which are unadjusted for unemployment or underemployment.

into six asset types: computer hardware; software; telecommunications equipment; dwellings, buildings and structures; transport equipment; and machinery. Labour services (L_Q) are the product of labour quantity (L) and labour quality (Q). Input (X) is augmented by a Hicks-neutral total factor productivity (A).

1) $Y = AX(L_Q, K)$

Under the assumption of perfect competitive factor markets (where the marginal product of each input equals its price) and constant returns to scale, the above production function can be transformed into the following growth accounting framework:

2) $\Delta lnY = \Delta lnA + v_L \Delta lnL + v_L \Delta lnQ + \Sigma_{i=1}^{6} v_{K_i} \Delta lnK_i$

where ΔlnX denotes the growth rate of variable X over two time periods, v's stand for the average input shares in total factor income and because of constant returns to scale, $v_L + \Sigma_{i=1}^{6} v_{K_i} = 1$. Equation (3) can be arranged to per hour/worker terms:

3) $\Delta lny = \Delta lnA + v_L \Delta lnQ + \Sigma_{i=1}^{6} v_{K_i} \Delta lnk_i$

where y is labour productivity, defined as $y=Y/L$, the ratio of total output to labour quantity, and k is capital deepening, defined as $k=K/L$, the ratio of capital services to labour quantity. Total hours worked is a preferred measure of labour quantity. When this variable is not available in most developing and emerging economies, total employment is used instead under the assumption that the average hours worked per person do not change and the change in total hours worked equals the change in total employment. Equation (2) and (3) illustrate that the output growth is driven by a share weighted input growth and TFP growth, a residual that captures all sources of growth which are left unexplained by labour and capital services in the production function.

Labour quality

The labour input, whether in terms of total employment or hours worked, represents a series of labour quantity. In order to measure labour's contribution to output growth, an adjustment for changes in the quality of labour is needed. The labour quality index, which is constructed from a weighted summation of the percentage of labour force in low, medium and high skill levels using relative wages as weights for three skill levels respectively, ranges between 1 and 2.8 for developing economies and between 1 and 2.25 for advanced economies.[13] Thus a labour quality index of 1 indicates that all working force population is of low skill and an index of 2.8/2.25 shows that all is of high skill. These measures are calculated on an annual basis to determine trends in the labour quality index.

The labour force skill level distribution is compiled from three databases: (1) Barro and Lee (2000), (2) EU KLEMS Growth and Productivity Accounts (Timmer *et al.*, 2007), and (3) projections by the International Institute for Applied System Analysis (IIASA, 2010). Both Barro and Lee and the IIASA projection paper classify the population of 15+ into no schooling, primary, secondary and tertiary schooling for 5-year intervals, whereas EUKLEMS categorizes the percentage of total hours worked into low, medium and high skill level on an annual basis. There are discrepancies between the three datasets in terms of both coverage (i.e. population vs. hours worked) and definitions, and we lack information to consolidate the three datasets into a unified one due to these data limitations. Instead we have used a statistical relationship among these three datasets to construct an annual labour quality index for 104 countries from 1960 onwards divided into three skill levels for the labour force. The weights for three skill levels are calculated based on the EUKLEMS

13 The following weights are used: 1 for low skill, 1.42 (1.36) for medium skill, 2.8 (2.25) for high skill for developing (advanced) economies.

data, and reflect average relative wages for the aggregate of advanced and for that of emerging and developing countries, and subsequently allocated to each country belonging in one of the two country groups.[14]

Capital services: ICT and non-ICT

We obtained measures of capital services for two major asset groups, each including three asset types: non-ICT capital, including non-residential construction, transport equipment and machinery; and ICT capital, including IT hardware, telecommunication equipment and software. For each type of asset, a capital stock series, $K_{i,t}$, is constructed from the investment data, $I_{i,t}$. The perpetual inventory method with a geometric depreciation rate is used as follows:

4) $K_{i,t} = (1-\delta_i) \times K_{i,t-1} + I_{i,t}$

All values in the above equation are in real terms (quantities). The initial capital stocks $K_{0,i}$ are obtained by assuming initial values equal to $\frac{I_{i,0}}{(g+\delta_i)}$, where g is the average GDP growth rate and $I_{i,0}$ is the investment in asset type i in the initial period. The same set of depreciation rates, δ_i, is used for all countries:

- for non-ICT capital: construction – 0.03, Transport – 0.2, Machinery – 0.13
- for ICT capital: IT Hardware – 0.3, Telecom Equipments – 0.12, Software – 0.46

Growth in capital services flow is measured by the weighted sum of growth in different types of capital stock.

$\Delta \ln K = \ln K_t - \ln K_{t-1} = \Sigma_i \bar{v}_{i,t} \Delta \ln K_{i,t}$

The weights in the above equation are two-period average shares (that is, the average of the shares in period t and period t-1) of each asset type in the value of total capital compensation.

6) $\bar{v}_{i,t} = \frac{[v_{i,t} + v_{i,t-1}]}{2}$

7) $\bar{v}_{i,t} = \frac{p_{i,t} K_{i,t}}{\Sigma_i p_{i,t} K_{i,t}}$

The rental price $p_{i,t}$ of capital services from asset type i in period t is defined as

8) $p_i = r_t + \delta_i - \pi_{i,t}$

In the above rental price equation, r_t is the nominal rate of return and $\pi_{i,t}$ is the asset price inflation (or capital gains). The asset price inflation is calculated using *current* price and *constant* price investment series. The *ex-post* or internal rate of return is calculated by estimating the capital revenue for each time period from the labour compensation share data:

9) $(1 - LabShare_t) \times GDP_t^{Current} = \Sigma_i p_i \times K_{i,t}$

If labour share data are not available or the estimated internal rates of return are negative or very large, *ex-ante* rates of return are taken from the IMF International Financial Statistics series on central bank discount rate, government bond yield and lending rate.

The aggregated growth rates of capital services (ICT and non-ICT) are calculated as the weighted sum of growth rates of individual capital stocks, using the shares in capital compensation obtained from equation 6, 7 and 8 as weights. The total compensation share of capital input in output is derived as the residual, i.e. one minus the share of labour compensation in total factor income.

The data on non-ICT investment by asset type is based on the Penn World Tables investment dataset, as described and reworked by Erumban (2008). For OECD countries, the Penn World Tables dataset is extended by linking it with OECD investment series from the year 2004 onwards. For non-OECD countries, data are available only for aggregate gross fixed capital formation from United Nations National Accounts, and we used the 2004 distribution from Penn World Tables for later years. The asset-specific investment price deflators are obtained by using the rates of asset-price inflation in 2004 for individual

14 See Bonthuis, 2009, for a more detailed explanation.

countries obtained from PWT for the later years as well.

The Jorgenson & Vu (2009) dataset is used to integrate the data for ICT investment with non-ICT investment. These datasets are extended to more recent years using *WITSA Digital Planet Report 2008*, published by the World Information Technology and Services Alliance (WITSA). Since WITSA only reports total expenditure on ICT, the purchases made by consumers need to be removed to obtain the estimates for the investments in ICT assets. The estimation of business investment (out of the total reported in WITSA) is based on the latest values in the Jorgenson & Vu dataset for the year 2005. These series also need to be converted to constant prices or volume series. The price deflators for the years 2006–2008 are estimated by assuming the same rate of ICT asset-price inflation as in 2005 for the later years as well.

Labour share

The labour share, defined as the ratio of total labour compensation to gross value added at basic prices, is used to assign weights to labour and capital inputs in the growth accounting equation. The labour shares from EUKLEMS are used whenever the data are available. OECD and Eurostat also report data on labour compensation for employees, which are used to fill the gaps. In those cases we assume that the compensation for self-employed can be imputed from the average compensation for employees by adjusting the employee labour compensation share for the employee share among total employment to obtain the total labour compensation share among GDP.

For a number of large non-OECD, non-EU countries, we estimated the labour share using alternative sources. In the case of China, the labour share is estimated from input-output tables. For Brazil, India and Russia the labour share is calculated using compensation data from the ILO. For the other emerging and developing economies, we use 0.5 as the labour share. In much of the growth accounting literature, a labour share of 0.7 is widely used across time and countries.[15] However, we decided to use 0.5 as the labour share for emerging and developing economies, because capital is relatively scarce in most of those remaining economies, and thus its return is high, while labour is cheap compared to advanced countries, leading to a lower labour share. Also, the adjustment for the labour share that is allocated to self-employed remains relatively large in many developing economies.

Aggregation of levels and growth rates

Growth rates for individual countries are calculated using the log difference in levels instead of the percentage change in the actual level. We chose this method in order to facilitate aggregation as well as decomposition of the growth for individual countries and components.

With regard to the aggregation to regional country groupings, the following methods are used for GDP, labour input and labour productivity growth respectively:

10) $\Delta \ln Y_{region} = \Sigma_i \bar{w}_i \Delta \ln Y_i$

11) $\Delta \ln L_{region} = \Delta \ln \Sigma_i L_i$

12) $\Delta \ln y_{region} = \Sigma_i \bar{w}_i \Delta \ln y_i + (\Sigma_i \bar{w}_i \Delta \ln L_i - \Delta \ln \Sigma_i L_i) = \Sigma_i \bar{w}_i \Delta \ln y_i + R$

with w_i as the country share in PPP adjusted nominal GDP of the region for each year and a bar denoting the two-period average. Hence aggregate GDP growth is the weighted sum of the country GDP growth. Growth in labour quantity (employment or hours) is simply the

15 For example, Gollin (2002) identified and compared several adjustments for calculating labour shares and concluded that factor shares are approximately constant across time and countries within a range of 0.65 to 0.80.

log difference of the summed total labour quantity values for all the countries in one region. The aggregate labour productivity growth is the weighted sum of country productivity growth rates plus a reallocation term *R*. This reallocation term is positive if employment shifts from low productivity countries towards high productivity countries.

The levels of regional GDP and labour productivity are calculated by applying the above PPP-adjusted current GDP-weighted growth rates to the benchmark year, 2009.[16] The labour productivity in 2009 is simply calculated as $\Sigma_i Y_i / \Sigma_i L_i$.

Aggregate total factor productivity growth rates for different regions are calculated by using the aggregate output, input and labour shares from the growth accounting equation. Aggregate output and input (quality adjusted labour input[17] and capital services) growth rates are calculated by taking the weighted average of individual country growth rates. The weights used are two period averages of the country shares in the PPP-adjusted nominal GDP of the group for each year. The aggregate labour compensation share for each year, i.e., $v_{L,region,}$ is obtained by summing up the labour compensation (PPP adjusted) of individual countries and then dividing this sum by total nominal GDP (PPP adjusted) of the group. A bar on the regional labour compensation share indicates the two-period average. Thus the regional TFP growth rates are calculated using the formula below:

13) $$\Delta \ln A_{region} = \Delta \ln Y_{region} - \bar{v}_{L,region} \Delta \ln L_{Q,region} - (1 - \bar{v}_{L,region}) \Delta \ln K_{region}$$

A Bird's Eye View of Recent Productivity Measures

Table 1 summarizes the productivity, output and total hours growth rates for a selected group of advanced economies. Despite the deep recession, labour productivity growth in the United States strengthened in "per hour" terms in 2009 to 2.5 per cent, up from 1.4 per cent in 2008. Productivity growth in other advanced economies was much weaker in 2009: 0.3 per cent in Japan, -1.0 per cent in the Euro Area, and as much as -1.9 per cent in the United Kingdom. Hence the productivity growth differential between the United States and the Euro Area in 2009 is 3.5 percentage points, and between the United States and the United Kingdom, it stands at 4.4 percentage points. For comparison, the productivity growth differential between the United States and the Euro Area was only 1 percentage point between 1995 and 2005 and 0.2 percentage points between the United States and the United Kingdom.

While estimates for 2009 are still preliminary, and adjustments are made to both the output and hours numbers once more definitive data from the national accounts and employment statistics are published, the productivity growth differential is so large that some important observations already emerge. First, the differences among advanced countries (or regions) partly reflect differences in output declines during 2009, which were much higher in Japan (-5.6 per cent), the Euro Area (-4.1 per cent), and the United Kingdom (-4.8 per cent) than in the United States (-2.5 per cent). The second factor, however, is the much larger number of hours lost in the United States as a result of a very

16 2009 is set as the benchmark year for the aggregate levels in order to be consistent with other tables in the Total Economy Database (January 2010). Although the choice of benchmark year affects the levels, it does not affect the growth rates of GDP and labour productivity.

17 For countries with missing labour quality data, labour input reflects the change in labour quantity only, i.e., the change in employment or total hours worked. Consequently, total factor productivity growth in those countries is somewhat overstated due to this missing input component. However, because of the generally small contribution of the labour quality in the output growth, the TFP overestimation is relatively low in magnitude.

Table 1
Growth of Labour Productivity, Real GDP and Total Hours Worked for Advanced Countries, 1995-2009

	United States	Japan	Euro Area	United Kingdom	France	Germany	Italy	Spain	Canada
Labour Productivity Growth (GDP per hour, annual average, per cent)									
1995-2005	2.4	2.1	1.4	2.2	1.8	1.6	0.5	0.5	1.5
2005-2009	1.5	0.8	0.5	0.9	0.8	0.2	-0.8	2.0	0.1
2007	1.4	1.8	1.1	2.3	-0.2	0.7	0.1	1.6	0.4
2008	1.4	0.1	0.1	1.0	0.4	-0.3	-0.5	1.5	-0.7
2009 (estimate)	2.5	0.3	-1.0	-1.9	0.3	-2.2	-3.2	3.8	-0.2
Real GDP Growth (annual average, per cent)									
1995-2005	3.3	1.1	2.2	2.9	2.2	1.3	1.4	3.6	3.6
2005-2009	0.7	-0.5	0.6	0.4	0.6	0.4	-0.6	1.2	0.6
2007	2.1	2.4	2.7	3.0	2.2	2.4	1.4	3.5	2.5
2008	0.4	-0.7	0.6	0.5	0.3	1.0	-1.1	0.9	0.4
2009 (estimate)	-2.5	-5.6	-4.1	-4.8	-2.3	-5.0	-4.9	-3.7	-3.2
Growth in Total Hours Worked (annual average, per cent)									
1995-2005	0.9	-1.0	0.8	0.7	0.4	-0.3	0.9	3.1	1.7
2005-2009	-0.9	-1.3	0.1	-0.5	-0.2	0.1	0.2	-0.8	0.5
2007	0.7	0.5	1.6	0.7	2.4	1.8	1.3	1.9	2.1
2008	-0.9	-0.8	0.4	-0.5	-0.1	1.3	-0.5	-0.6	1.1
2009 (estimate)	-5.1	-5.9	-3.1	-2.8	-2.6	-2.8	-1.7	-7.5	-3.0

Note: Growth rates are based on the difference in the log of the levels of each variable
Source: The Conference Board Total Economy Database, January 2010

sharp reaction of firms to the crisis. Hours worked declined 5.1 per cent in the United States, with 3.6 percentage points caused by job shedding and another 1.5 percentage points attributable to a reduction in the working hours of workers who still had jobs. Labour hoarding in Europe was a much larger factor, as the Euro Area saw total working hours decline 3.1 per cent, of which 1.9 percentage points were related to job losses.

Greater flexibility in labour markets may be seen as one cause for the divergent patterns between the United States and the Euro Area, but it probably does not tell the whole story as Japan, which does not have a particularly flexible labour market either, also saw a large decline in total hours worked (-5.9 per cent), which reflected a loss of 3 per cent in workers and almost 3 per cent in hours worked per worker. In contrast, the United Kingdom which has among the most flexible labour markets in the European Union, showed a pattern that was not all that different from the Euro Area. In the United Kingdom hours fell 2.8 per cent, of which 2.0 percentage points were due to a decline in employed persons.

While productivity growth in 2009 was negative in most European countries, there were significant variations between major countries. Germany performed far worse than France (-2.2

Table 2
Growth of Labour Productivity, Real GDP and Persons Employed for Major Emerging Economies, 1995-2009

	Major Emerging Economies	Brazil	Russia	India	China	Mexico	Indonesia	Turkey
Labour Productivity Growth (GDP per persons, annual average, per cent)								
1995-2005	4.1	0.3	3.7	4.2	6.7	1.4	1.5	3.6
2005-2009	5.9	2.6	3.7	5.2	9.6	0.5	2.1	1.0
2007	7.6	3.5	7.0	6.2	11.5	1.6	3.6	3.1
2008	5.3	4.0	4.7	4.0	8.6	-0.9	1.0	-1.2
2009 (estimate)	3.6	1.5	-3.8	3.9	8.2	-0.3	-0.3	-3.2
Real GDP Growth (annual average, per cent)								
1995-2005	5.5	2.4	3.8	6.3	7.8	3.6	3.1	4.2
2005-2009	7.1	3.8	4.2	7.6	10.0	2.0	5.5	1.9
2007	9.1	5.5	7.8	8.6	12.2	3.2	6.1	4.6
2008	6.8	5.7	5.4	6.5	9.2	1.4	5.9	0.9
2009 (estimate)	4.1	0.0	-3.8	5.8	7.7	-1.5	4.7	-4.5
Growth in Persons Employed (annual average, per cent)								
1995-2005	1.4	2.0	0.1	2.0	1.1	2.2	1.6	0.7
2005-2009	1.3	1.2	0.5	2.3	0.4	1.5	3.4	0.9
2007	1.5	2.0	0.8	2.4	0.8	1.7	2.5	1.5
2008	1.6	1.7	0.8	2.4	0.6	2.2	5.0	2.1
2009 (estimate)	0.5	-1.5	0.0	2.0	-0.5	-1.2	5.0	-1.3

Note: Growth rates are based on the difference in the log of the levels of each variable
Source: The Conference Board Total Economy Database, January 2010

per cent in Germany and 0.3 per cent in France) due to a deeper contraction in output in Germany (-5.0 per cent) than France (-2.3 per cent). Interestingly, Germany lost no jobs in net terms, as all the loss in working hours (-2.8 per cent) was due to shortening of working hours of employees who stayed in employment. France's more moderate decline in output and slight increase in productivity relates to the smaller impact of exports on the economy, which was severely hit in Germany, and the sustained growth of the public sector. While both Italy and Spain suffered strong output declines (-4.9 per cent in Italy and -3.7 per cent in Spain), Spain shed hours five times as rapidly (-7.5 per cent) as Italy (-1.7 per cent). Much of the employment losses were in construction and tourism, which is characterized by a large share of temporary, less well-protected jobs. Consequently, labour productivity increased by 3.8 per cent in Spain while it declined by 3.2 per cent in Italy.

Table 2 provides a summary of the growth rates for seven leading emerging economies: Brazil, China, India, Indonesia, Mexico, Russia and Turkey. On average, labour productivity growth of these major emerging economies group was 3.6 per cent in 2009, which was down by 1.7 percentage points from the 5.3 per cent rate in 2008. But there were large differences among the emerging economies. China showed the strongest output and productivity performance in 2009 at 7.7 per cent and 8.2 per cent respectively.[18] This was largely the result of a boom in bank loans and

rapid investment in infrastructure, which stimulated output growth and at least temporarily boosted the investment-intensive activities of state-owned enterprises (SOEs). Although employment estimates are extremely difficult to obtain, the evidence from a variety of partial sources suggests that employment growth in China stalled as a result of layoffs by private companies, especially export-oriented firms. Hence, while overall productivity increased, there may have been important underlying structural changes that may impact China's productivity trend ahead. For example, SOEs and infrastructure construction probably occupied a larger footprint in the economy in 2009 than before.

While Brazil and Mexico have been among the weakest productivity performers historically, their performance diverged as Brazil's output, employment, and productivity performance strengthened in recent years. Productivity growth in Brazil stood at 1.5 per cent in 2009, down from 4.0 per cent in 2008, whereas productivity growth in Mexico continued to be negative in 2009 (-0.3 per cent in 2009 following a 0.9 per cent decline in 2008). In contrast, in addition to China, Indonesia and India strengthened their performance in recent years; as they were relatively shielded from the global crisis because of moderate exposure to exports and the global financial world, their performance remained reasonably strong during the recession. Labour productivity in India grew at 3.9 per cent in 2009 as a result of 5.8 per cent GDP growth and 2.0 per cent employment growth. The negative productivity growth in Indonesia (-0.3 per cent) is a result of faster growth in employment than GDP (4.7 per cent for GDP growth and 5.0 per cent for employment growth). In contrast, Russia and Turkey, which were both strongly exposed to the global crisis, suffered most in terms of output (-3.8 per cent and -4.5 per cent respectively), employment (0 per cent and -1.3 per cent respectively), and productivity (-3.8 per cent and -3.2 per cent respectively).

While the short-term improvements in productivity help countries position themselves to exploit their growth potential, the actual trigger for sustainable growth is the long-term productivity trend (see also Chart 2), which is also the main source for improvements in living standards. To accelerate the long-term productivity trend, growth needs to come from not only investment in inputs, which equip workers with higher skills and better tools to produce, but also from an increase in the efficiency with which these inputs (such as labour, workforce skills, machinery, and technology inputs) are used, i.e., the total factor productivity growth.

Table 3 and Chart 4 show the sources of output growth for major regions and countries. For the world economy, the output growth of 4.4 per cent from 2005 to 2008 was partly due to an increase in labour input, which contributed 0.7 percentage points to output growth. Another 0.2 percentage point was due to an improvement in the quality of the labour force, measured as the skill level of the labour force according to their level of educational attainment. Most of the output growth in the world, however, has been due to a rise in non-ICT capital: it accounted for half (2.2 percentage points) of total output growth (4.4 per cent). ICT capital contributed 0.4 percentage points to output growth from 2005-2008, leaving a residual growth (TFP) of 0.9 per cent. In contrast, during the earlier period 1995-2005, ICT capital contributed 0.5 percentage points to output growth, leaving a TFP residual of only 0.6 per cent. The acceleration of TFP growth after 2005 might represent a more efficient use of capital, which may relate to either ICT or non-ICT capital.

18 Note that growth rates are based on the difference in the log of the levels of each variable. For example, China's GDP growth rate in 2009 changed from 8.0 per cent, when calculated in percentage terms, to 7.7 per cent when using log differences.

Table 3

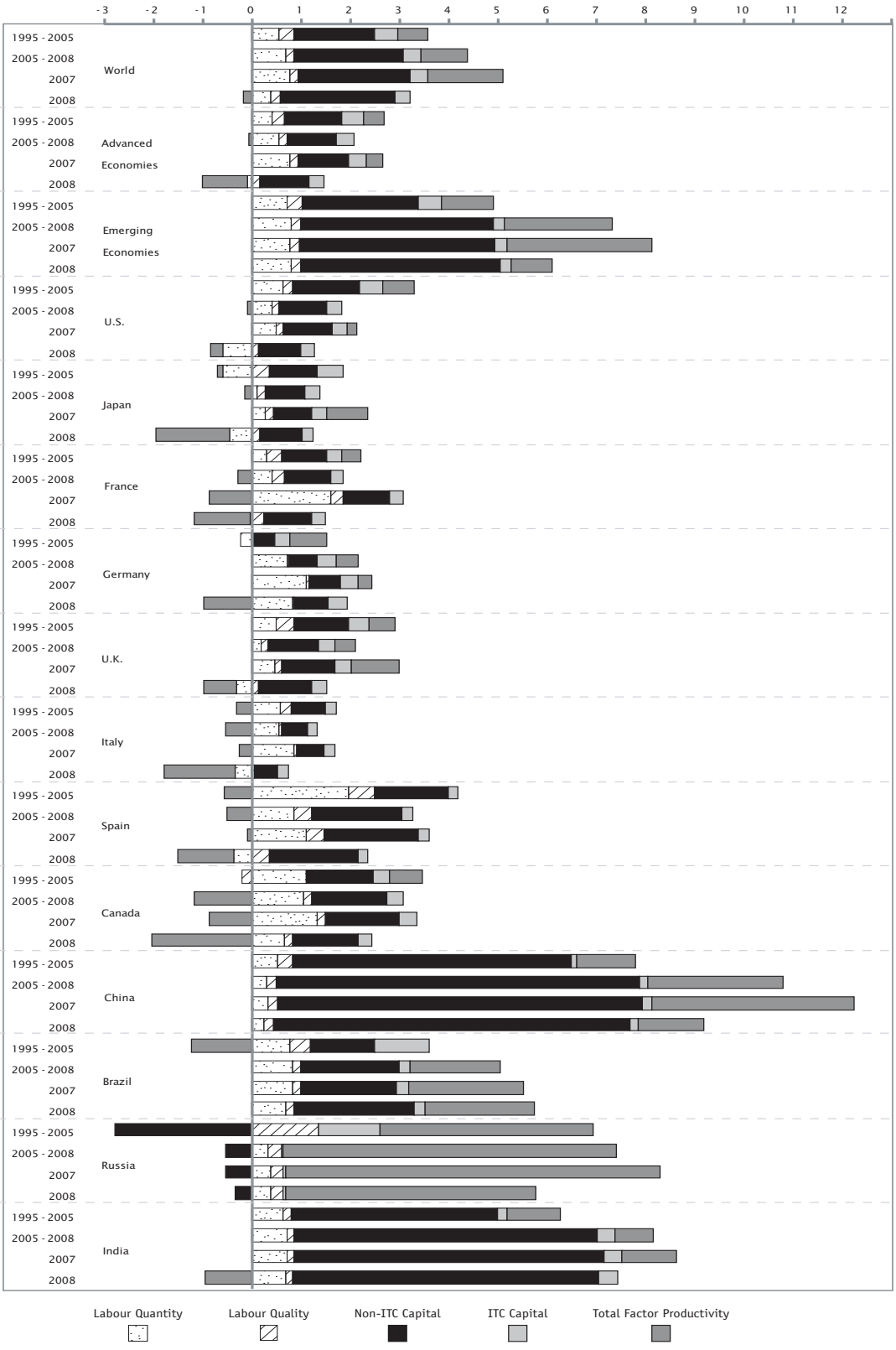
Contribution of the Change in Inputs and TFP to Average Annual Output Growth by Country and Region, 1995-2005, 2005-2008, 2007, 2008

(percentage points per year)

Country	Period	Labour Quantity	Labour Quality	Non-ICT Capital	ICT Capital	Total Factor Productivity	Total GDP Growth
World	1995-2005	0.55	0.29	1.64	0.47	0.62	3.6
	2005-2008	0.68	0.18	2.23	0.35	0.94	4.4
	2007	0.76	0.18	2.26	0.36	1.53	5.1
	2008	0.40	0.18	2.32	0.32	-0.18	3.0
Advanced Economies	1995-2005	0.41	0.26	1.16	0.43	0.43	2.7
	2005-2008	0.55	0.17	1.01	0.35	-0.07	2.0
	2007	0.77	0.17	1.04	0.35	0.34	2.7
	2008	-0.09	0.17	0.98	0.32	-0.92	0.5
Emerging Economies	1995-2005	0.71	0.31	2.37	0.46	1.04	4.9
	2005-2008	0.79	0.20	3.90	0.23	2.19	7.3
	2007	0.77	0.20	3.96	0.24	2.95	8.1
	2008	0.79	0.19	4.06	0.22	0.85	6.1
United States	1995-2005	0.63	0.19	1.37	0.48	0.63	3.3
	2005-2008	0.41	0.13	0.97	0.30	-0.09	1.7
	2007	0.50	0.13	1.01	0.30	0.18	2.1
	2008	-0.59	0.13	0.87	0.26	-0.24	0.4
Japan	1995-2005	-0.58	0.35	0.97	0.53	-0.14	1.1
	2005-2008	0.12	0.16	0.82	0.29	-0.15	1.2
	2007	0.28	0.16	0.78	0.31	0.84	2.4
	2008	-0.44	0.15	0.85	0.23	-1.50	-0.7
France	1995-2005	0.29	0.31	0.92	0.30	0.39	2.2
	2005-2008	0.41	0.24	0.94	0.28	-0.29	1.6
	2007	1.61	0.24	0.95	0.27	-0.86	2.2
	2008	-0.03	0.24	0.99	0.27	-1.14	0.3
Germany	1995-2005	-0.23	0.02	0.44	0.31	0.75	1.3
	2005-2008	0.71	0.04	0.59	0.38	0.46	2.2
	2007	1.11	0.04	0.64	0.38	0.27	2.4
	2008	0.82	0.04	0.70	0.39	-0.98	1.0
United Kingdom	1995-2005	0.49	0.36	1.12	0.41	0.52	2.9
	2005-2008	0.19	0.14	1.03	0.33	0.42	2.1
	2007	0.47	0.14	1.07	0.34	0.96	3.0
	2008	-0.31	0.13	1.08	0.32	-0.67	0.5
Italy	1995-2005	0.57	0.22	0.71	0.20	-0.32	1.4
	2005-2008	0.55	0.06	0.52	0.21	-0.54	0.8
	2007	0.87	0.06	0.55	0.21	-0.24	1.4
	2008	-0.34	0.05	0.47	0.21	-1.45	-1.1
Spain	1995-2005	1.98	0.53	1.49	0.19	-0.57	3.6
	2005-2008	0.85	0.36	1.84	0.22	-0.50	2.8
	2007	1.11	0.36	1.90	0.22	-0.09	3.5
	2008	-0.36	0.35	1.80	0.21	-1.15	0.9
Canada	1995-2005	1.12	-0.19	1.34	0.34	0.67	3.3
	2005-2008	1.06	0.16	1.51	0.35	-1.18	1.9
	2007	1.33	0.16	1.51	0.35	-0.87	2.5
	2008	0.67	0.16	1.32	0.30	-2.03	0.4
China	1995-2005	0.52	0.32	5.63	0.13	1.20	7.8
	2005-2008	0.30	0.19	7.37	0.18	2.74	10.8
	2007	0.32	0.19	7.41	0.18	4.12	12.2
	2008	0.25	0.19	7.23	0.18	1.32	9.2
Brazil	1995-2005	0.77	0.42	1.29	1.13	-1.23	2.4
	2005-2008	0.82	0.17	1.99	0.23	1.84	5.1
	2007	0.82	0.17	1.96	0.23	2.34	5.5
	2008	0.69	0.17	2.45	0.22	2.21	5.7
Russia	1995-2005	0.01	1.34	-2.78	1.26	4.33	4.2
	2005-2008	0.34	0.26	-0.55	0.05	6.77	6.9
	2007	0.37	0.26	-0.53	0.05	7.60	7.8
	2008	0.38	0.26	-0.32	0.05	5.10	5.4
India	1995-2005	0.62	0.19	4.18	0.19	1.09	6.3
	2005-2008	0.71	0.14	6.15	0.37	0.76	8.1
	2007	0.71	0.14	6.29	0.36	1.12	8.6
	2008	0.70	0.14	6.21	0.38	-0.94	6.5

Chart 4

Contribution of the Change in Inputs and TFP to Output Growth by Country and Region, 1995-2005, 2005-2008, 2007, 2008



The panels for the aggregate advanced and emerging economies show the diverging developments in TFP growth especially since 2005. While Germany and the United Kingdom still generated some TFP growth, largely related to the peak of the business cycle, TFP growth stalled in Japan and even somewhat declined in France — reflecting the greater inefficiency of the growth process.

The faster output growth rates of emerging and developing economies (at 7.3 per cent, relative to 2.0 per cent in advanced economies from 2005 to 2008) is largely due to the faster increase in non-ICT capital, especially in China and India, and a much higher efficiency by which the inputs are being used, especially in China. In 2008, the overall TFP growth rates for emerging and developing economies was still at 0.85 per cent, although lower than the average of 2.2 per cent from 2005-2008. This was mainly due to the start of the recession and the cooling of the Chinese and Indian economies. However, even among emerging economies there are substantial differences: China showed an increase of 1.3 per cent in TFP growth in 2008, which was modest compared to 2.2 per cent in Brazil and 5.1 per cent in Russia, but much better than the -0.9 per cent decline in India. The Brazilian and Russian economies probably received a TFP bonus from the price boom in natural resource production in 2008, while in India, the contribution of capital to growth remained at the same level despite a significant deceleration in output growth in 2008. The rise in the long-term TFP trend puts the emphasis for future growth even more strongly on the emerging economies. This raises their competitive strength, as it helps these countries to match higher costs, such as rising wages, by their ability to lower costs and prices through efficiency gains.

Conclusion

It should be stressed again that there are substantial uncertainties concerning the productivity estimates for recent periods. National statistical offices often make significant adjustments to their output and employment estimates as the measures from a range of surveys and administrative sources come in with a delay of several months, and are sometimes adjusted significantly during the process of reconciliation of the various sources. Annual GDP growth estimates can be adjusted by as much as one per cent upward or downward for advanced countries and sometimes more for emerging economies while the adjustments for employment are usually much smaller.

Nevertheless, we believe that "real time" productivity figures provide useful insights as they provide signals on how the direction of the productivity trend may be affected by the latest estimates, and how the differences between countries can play out. For example, while the post-1995 productivity growth differential between the United States and the EU-15 (i.e. the EU member state constellation before 2004) has been adjusted following several statistical revisions, the productivity growth differential remained at roughly 1 percentage point with the United States showing an approximately 2.5 per cent increase in GDP per hour in 1995-2005 vis-à-vis one and a half per cent in the European Union. The semi-annual updates in The Conference Board Total Economy Database, however, keep track of ongoing revisions in the data.

Projections of productivity growth are surrounded by even more uncertainties, particularly in times of structural shifts such as in current times. However, on the basis of GDP forecasts and assumptions on the degree of procyclicality of productivity growth, the following projections may be seen as plausible given the current economic situation in various countries.

Following its dismal performance in 2009, global productivity is expected to improve sharply to 2 per cent or even more in 2010. This increase will be the result of the combination of a projected recovery in world GDP of more than 3 per cent and a modest increase in world employment. Advanced economies will mostly see jobless productivity growth as labour markets recover slowly, although limited technology and innovation gains could lead to higher than expected job growth in less productive (in several non-market) service industries. Most emerging and developing economies will experience a combination of productivity and employment growth in 2010. This not only reflects their growing contribution to world output growth, but also a strengthening of their global competitiveness based not only on their low relative cost, but also on increasingly higher productivity.

A long-term improvement in the productivity trend will depend on a revival of global demand, stimulated by technological change and innovation. The growth accounting approach, which is now integrated in The Conference Board Total Economy Database, provides the framework for the next step which is to develop medium term projections of the sources of growth to strengthen the forecasts of GDP growth in international comparative perspective. This sets the agenda for the next version of the database, which will also include an increase in the number of countries included.

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Aggregate Measures of Income and Output in Canada and the United States: Implications for Productivity and Living Standards

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ABSTRACT

The objectives of this article are to clarify definitions and to produce estimates of the eight aggregate measures of income and product (gross domestic product, gross domestic income, gross national product, gross national income, net domestic product, net domestic income, net national product and net national income) for Canada and the United States over the 1980-2008 period. The article also discusses the implications of the eight measures for productivity and living standards analysis. It concludes that GDP and NDP are the most appropriate measures of output for productivity analysis, while NNI is the most appropriate measure of income for the analysis of living standards because it captures the impact on real income of terms of trade changes, net income received from abroad, and the sustainability of the capital stock.

THERE ARE EIGHT measures of aggregate income (or output) in national accounting. These aggregates are based on three dimensions of analysis: gross versus net, domestic versus national, and product versus income. The eight combinations of these concepts constitute the eight measures of aggregate income: gross domestic product (GDP), net domestic product (NDP), gross national product (GNP), net national product (NNP), gross domestic income (GDI), net domestic income (NDI), gross national income (GNI) and net national income (NNI).

The purpose of this article is to produce estimates of the eight income aggregates for Canada and the United States over the 1980-2008 period and to discuss the implications of the measures for the analysis of productivity and living standards.[2] The trends in the eight measures since 1980 have not been identical, and the dif-

1 Chris Ross is a graduate student in the Department of Economics at the University of Toronto. Alexander Murray is an economist at the Centre for the Study of Living Standards. The authors would like to thank Ryan Macdonald of Statistics Canada, Lisa Mataloni and Steve Landefeld of the Bureau of Economic Analysis, and Andrew Sharpe of the Centre for the Study of Living Standards. Email: christopher.ross@csls.ca; alex.murray@csls.ca.

2 The analysis ends in 2008 for two reasons. First, the 2009 estimates currently available for both Canada and the United States are preliminary and may change substantially when they are finalized. Second, and more important, 2008 represented an output peak (as did 1980, 1989, and 2000, the years we use to divide the 1980-2008 period into sub-periods). The inclusion of the recession year of 2009 would therefore reduce the cyclical neutrality of the growth rates we examine.

ferences between the measures provide important information about the Canadian and US economies. In addition, different measures may have different implications for the analysis of productivity and living standards. It is therefore important to consider which measures are most appropriate for such analysis.

The article is divided into six sections. The first defines the eight aggregates and explains how they relate to one another. The second addresses data availability and describes the methods used to estimate the aggregates. The third section analyzes within-country trends in the eight measures over the 1980-2008 period. Comparisons between gross and net measures, domestic and national measures, and product and income measures reveal important insights about the composition of the capital structure, the impact of net income flows from abroad, and the importance of terms of trade changes for real income. The fourth section compares the performance of the Canadian economy to that of the United States by comparing like aggregates on absolute and per-capita bases. The fifth section synthesizes the key empirical findings and discusses their implications for the analysis of productivity and living standards. The final section concludes.

National Accounts Definitions

National accounts data are collected on an internationally comparable basis as national statistical offices collect data consistent with accepted definitions. Currently, the international standard is outlined in a United Nations (1993) document, *The System of National Accounts 1993*.[3] Statistics Canada (1989) offers a user's guide that outlines data availability and the methods and concepts underlying Canada's national accounts. The agency also publishes updates to its methodology on a regular basis *(e.g.* Statistics Canada, 2009). The United States also follows the UN conventions. Bureau of Economic Analysis (2009) outlines how the Bureau of Economic Analysis (BEA) defines and estimates the aggregate measures in the United States national accounts. These resources are essential for understanding national accounting methodology, definitions and concepts.

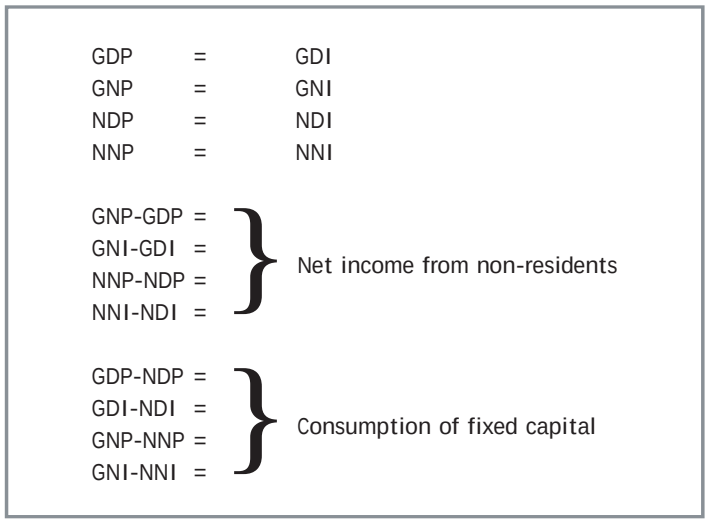
Income and Product Accounts – Nominal Estimates

There are eight aggregates of income and output: gross domestic product (GDP), gross domestic income (GDI), gross national product (GNP), gross national income (GNI), net domestic product (NDP), net domestic income (NDI), net national product and net national income (NNP). Since one person's output is another person's income, each aggregate output measure should by definition be equal to its corresponding income measure when they are measured in current prices (Figure 1). In practice, corresponding nominal output and income measures may differ because they are based on different data sources. Gross measures differ from net measures in that the latter is equal to the gross measure less consumption of fixed capital. Domestic measures differ from national measures in that the latter measure sums the domestic measure with net income from non-residents. As an example, if a Canadian firm owns a factory in Belize and the factory earns $10 in profit which it pays in dividends to Canadian investors, Canadian GNP increases by $10, but GDP is unaffected.

The most widely watched measure is GDP, which is the value of all goods and services produced inside the country and sold to final users

3 The system of national accounts advocated by the United Nations in 1993 remains the official outline to which countries should conform. The 2008 update is largely consistent with the 1993 system. Luige (2008) clarifies that "recommendations do not change the fundamental framework, so countries are encouraged to continue development in line with 1993 SNA."

Figure 1
Relationship Between Nominal Income and Product Accounts



in a year. This can be valued by summing personal consumption expenditures, fixed investment, change in inventories, net exports of goods and services as well as government consumption. The corresponding income measure is GDI, which sums income payments incurred in the production of goods and services. GDI is the sum of compensation of employees, taxes on production and imports, and net operating surplus less subsidies. GDP and GDI, expressed in current dollars, are by definition equal. GNP is equal to GDP less net income payments to the rest of the world, and GNI relates to GDI in the same way. NDP is equivalent to GDP less the consumption of fixed capital and NDI relates to GDI in the same fashion. NNP is the same as GNP less the consumption of fixed capital (capital consumption allowance, or CCA) and NNI relates to GNI in the same manner.

Income and Product Accounts – Real or Chained Estimates

The eight measures of income and output also exist in real, or chained, estimates.[4] While each product measure has a corresponding income measure that is exactly equal in nominal terms, this is not true for chained estimates except in the base year. Chained estimates of product measures reflect output volumes, while chained income measures are meant to reflect volumes of consumption possibilities, or purchasing power. Macdonald (2007a) notes that "economic theory and statistical practice dictate that nominal gross domestic product (GDP) and nominal gross domestic income (GDI) are equal, the difference between real GDP and real GDI will be determined by their respective deflators."

United Nations (1993) stresses that the choice of deflator can have a substantial impact on the perceived trend in the observed indicator. Unfortunately, there is disagreement among major statistical agencies, as well as economists in general, as to which deflator is most appropriate for use in calculating real GDI. United Nations (2008) argues that "as there may often be no obvious, or uncontroversial choice of numeraire there has always been some reluctance to show real incomes in national accounts" but adds "it can be argued that compilers of statistics are under an obligation to present at least some measures of real income." The Bank of Canada (2009) and Kohli (2006) both suggest the use of the final

4 A chain index is rebased on a period to period basis (annually in the case of output), and is then accumulated multiplicatively from a reference period value. In other words, a chain volume index calculates the volume index in each pair of consecutive years, always treating the earlier year as the base period (while the base period is changing every year, the reference period - which is the year in which the volume and nominal index are identical – is fixed and arbitrary). Growth rates for a chain index are thus unaffected by changes in the reference period. A Fisher volume index is a measure of change in volume from period to period which is calculated as the geometric mean of a Paasche volume index and a Laspeyres volume index. In other words, it is the mean of two distinct measures of change in volume: one calculated as if prices were constant in the first of two consecutive periods (Laspeyres volume) and the other calculated as if prices were constant in the second of the two consecutive periods (Paasche volume). A chain Fisher index is thus the geometric mean of a chain Laspeyres index and a chain Paasche index.

domestic demand deflator, which is the methodology that was adopted by Statistics Canada until quite recently. Currently, Statistics Canada uses the final domestic expenditure (FDE) deflator, as this is the broadest aggregate available; this measure differs from the final domestic demand deflator only due to the inclusion of inventories in the final domestic expenditure deflator.[5] The Bureau of Economic Analysis (BEA) in the United States uses an import price deflator for calculating "command based" GNP,[6] as does the Australian Bureau of Statistics. Eurostat uses the mean of import and export price indexes. All of these methods are valid and there is a case to be made for them, though the differences in methodology used by Statistics Canada and the BEA mean that the trends reflected in official data are not completely consistent when comparing across countries for GDI.

Estimation Methodology and Data Availability

Current Price Measurements

The U.S. BEA makes data on income and output measures easily accessible. Current-price estimates for the United States were almost all accessible from NIPA Table 1.7.5 and available on a consistent basis (market prices).[7] Net national income (NNI) is not included in the table, but all the data needed to calculate this measure are available. The difference between "gross" and "net" measures is simply that gross measures include the consumption of fixed capital.[8] This identity has been used to compute the U.S. NNI estimates discussed in this article.

Table 1
Availability of Official Aggregate Income and Product Estimates for Canada and the United States

	United States		Canada	
	NOMINAL	CHAINED	NOMINAL	CHAINED
GDP	Yes	Yes	Yes	Yes
GDI	Yes	Yes[b]	Yes	No[e]
GNP	Yes	Yes	Yes	No[f]
GNI	Yes	Yes[b]	Yes[c]	Yes[g]
NDP	Yes	Yes	No[a]	No[a]
NDI	Yes	Yes[b]	Yes[a,d]	No[e]
NNP	Yes	Yes	No[a]	No[a]
NNI	No[a]	No[b]	Yes[a,d]	No[e]

a. Values are calculated by the authors by subtracting capital consumption allowances from the gross measures.

b. For this report, we calculate estimates of these measures by deflating the nominal income measures by the gross domestic purchase price deflator. We do not use the existing official estimates because they are based on the GDP deflator (or, in the case of the BEA's 'command-based GNP' measure, an import price deflator). This is inconsistent with the Canadian methodology for estimating aggregate income measures.

c. Official data are available back to 1982. For earlier years, we construct estimates by subtracting net foreign income flows from nominal GDI.

d. We do not use the official estimates because they are expressed in basic prices rather than market prices.

e. We calculate estimates by deflating the nominal product measure by the final domestic expenditure deflator.

f. We calculate estimates by deflating the nominal product measures by the GDP deflator.

g. Official data are available back to 1982. For earlier years, we construct estimates by deflating the nominal measure using the final domestic expenditure deflator.

GDP and GDI are in principle equal when expressed in current dollars, even though the former is based on expenditure and the latter is based on income data. (Statistics Canada refers to both measures as GDP, but adds the labels "expenditure-based" and "income-based" to dis-

5 The FDE price deflator has increased at an average annual rate of 2.71 per cent per year compared with the FDD price index growth rate of 2.79 per cent over the 1981 to 2008 period.

6 The BEA's measure of 'command-based GNP' is conceptually analogous to Statistics Canada's 'real GNI' except in the use of the import price deflator. Reinsdorf (2009), a BEA researcher, recommends that the BEA switch to the gross domestic purchases deflator. As we explain below, this is precisely the approach we take in estimating real aggregate income measures for the United States.

7 All NIPA tables are available through http://www.bea.gov/national/nipaweb/SelectTable.asp.

8 Consumption of fixed capital, in the context of the NIPA Table 1.7.5, was larger than capital consumption allowance in the table because that capital consumption referenced only capital consumed by businesses; generally speaking, capital consumption allowance is used to refer to the entire consumption of fixed capital by all economic agents.

tinguish between them.) As a practical matter, however, the income- and expenditure-based estimation approaches lead to slightly different estimates because of measurement error and the fact that different data sources are used.

The United States and Canada differ in how they address this issue. In the United States, the BEA publishes the two different numbers with the understanding that the discrepancy is the result of measurement error. The discrepancy between nominal GDP and GDI in the United States amounted to $101 billion (or about 0.7 per cent of GDP) in 2008.

In contrast, Statistics Canada publishes one number called GDP, and that number is the average of the expenditure- and income-based estimates. They also publish a "statistical discrepancy," which is the difference between the officially published GDP and the underlying expenditure- and income-based estimates. In 2008, for example, Canadian nominal GDP was $1,601.49 billion according to the income-based approach and $1,598.67 billion according to the expenditure-based approach. Statistics Canada published $1,600.08 billion as the official estimate and reported $1.41 billion and -$1.41 billion as the statistical discrepancies for the income- and expenditure-based approaches, respectively.[9]

While it is possible to use the statistical discrepancies to construct estimates of GDP and GDI for Canada that would be consistent with the U.S. approach, we have chosen to use Statistics Canada's official estimates of nominal GDP as our estimates of both GDP and GDI. For similar reasons, GNP is equal to GNI, NDP is equal to NDI, and NNP is equal to NNI (all in nominal terms).

Net measures of national output and income are not generally published by Statistics Canada. The exception to this is NNI, which is published. Unfortunately, these data are published at basic prices, and the values in our table are in market prices; this number could be changed to reflect market prices through the addition of taxes less subsidies. An alternative method that could be used to estimate NNI, which would differ only negligibly, is to subtract capital consumption allowances from the gross measure. This would be an equally valid method of calculating the net measure, and this is actually the methodology that we chose to use to calculate all four of the net measures for Canada, thus ensuring that all net measures were calculated on a perfectly consistent basis. Currently, Statistics Canada does not publish data for NDP, NDI or NNP in either basic or market prices.

Real or Chained Estimates

Data in chained 2005 dollars for the product measures (GDP, GNP, NDP, and NNP) in the United States were all accessible from NIPA Table 1.7.6. Of the four, only GDP is officially published in real terms by Statistics Canada. Real income measures are published by the BEA, but they are inconsistent with the Canadian definition. The inconsistency lies in the price deflators used. In order to produce real income measures reflective of the *purchasing power* associated with production, Statistics Canada uses the final domestic expenditure price deflator, which accounts for changes in the prices of final goods and services purchased by domestic economic agents. The BEA, in contrast, publishes real income measures that simply deflate nominal income measures by the relevant *product* deflator. For example, real GDI is the result of deflating nominal GDI (that is, nominal GDP estimated by the income approach) with the GDP deflator implied by the expenditure approach.

9 These calculations are based on the 2008 income- and expenditure-based GDP estimates from Statistics Canada CANSIM Tables 380-0016 and 380-0017.

The GDP deflator and the final domestic expenditure deflator do not capture the same price changes, so the official Canadian and US real income estimates are not comparable.

In order to make the data comparable, real income measures for the United States have been calculated by deflating nominal product measures using the gross domestic purchases deflator, a deflator similar to Canada's final domestic expenditure deflator.[10]

Data for Canada are less readily available. Statistics Canada publishes chain-dollar estimates of only two of the eight measures, GDP and GNI. We estimate the three remaining income aggregates (GDI, NDI and NNI) by deflating the nominal measures by the final domestic expenditure price deflator, consistent with the methodology of Statistics Canada in producing GDI and GNI volume indexes.[11] Until recently, Statistics Canada used the final domestic demand price deflator rather than the final domestic expenditures price deflator in order to estimate real income measures; the deflators are very similar in terms of growth rate and differ only in terms of the treatment of inventories.[12]

We estimate the net product measures (NDP and NNP) by a two-step process. First, we construct chained estimates of the of capital consumption allowance (CCA) in Canada. A price deflator for investment is estimated by calculating price deflators for government and private investment and multiplying these deflators by their respective shares of total investment. The nominal CCA series is deflated by the investment index to produce estimates of real CCA. [13] In the second step, we generate the real NDP and NNP estimates by subtracting real CCA from the real gross product measures (GDP and GNP). Chained data are not additive, strictly speaking, so the above methodology does not give an exact estimate of net measures.[14] Nonetheless, the above methodology provides a good approximation of the proper value; testing this methodology on U.S. data, for which official gross and net data are available, shows that the estimates were never even a half of a per cent different from the official data for the entire 1980-2008 period. Chained GNP data were calculated by deflating nominal GNP with the GDP price deflator.

Summary

In this article, we analyze the eight income (or output) aggregates for Canaad and the United States, expressed in both real and current dollars. This amounts to 32 time series altogether. Whenever possible and appropriate, we have used official estimates from Statistics Canada and the Bureau of Economic Analysis. For Canada, we use official estimates of nominal GDP, GDI, GNP, and GNI; and real GDP and GNI. For the United States, we use official estimates of nominal GDP, GDI, GNP, GNI, NDP, NDI, and NNP; and real

10 Gross domestic purchases deflator is found in NIPA Table 1.4.4, line 4.

11 The earliest year for which the final domestic expenditure deflator is available through CANSIM is 1982. Ryan Macdonald of Statistics Canada provided us with a final domestic expenditure deflator series beginning in 1961. It is the series used in Macdonald (2007b), with data revisions and additional years added by summing the quarterly data found in CANSIM series v44182032.

12 The final domestic expenditure deflator includes prices for private consumption, gross fixed capital formation, government consumption and inventories, whereas the final domestic demand deflator includes only private consumption, gross fixed capital formation and government consumption prices.

13 Strictly speaking, the investment deflator is not applicable to CCA because the old capital being depreciated and the new capital being invested in are likely to have different compositions. Nevertheless, our approach provides a good approximation.

14 The Bureau of Economic Analysis (2009) offers a very insightful summary of the properties of chained measures as well as an overview of national accounting practices.

Table 2

Levels of Product and Income Measures in Canada and the United States, $Billions, 2008

	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GDP	13,312	14,441	1,321	1,600
GDI	13,157	14,340	1,423	1,600
Difference	156	101	-101	0
GNP	13,443	14,583	1,308	1,584
GNI	13,286	14,482	1,409	1,584
Difference	157	101	-100	0
NDP	11,597	12,594	1,141	1,393
NDI	11,474	12,493	1,238	1,393
Difference	123	101	-97	0
NNP	11,728	12,736	1,128	1,377
NNI	11,603	12,635	1,224	1,377
Differences	124	101	-96	0

Source: Appendix Table 6.

Table 3

Growth Rates of Product and Income Measures in Canada and the United States, Per Cent per Year, 1980-2008

	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GDP	2.99	6.05	2.71	5.98
GDI	2.99	6.09	2.89	5.98
Difference	-0.01	-0.04	-0.18	0.00
GNP	2.98	6.04	2.77	6.05
GNI	2.99	6.08	2.95	6.05
Difference	-0.01	-0.03	-0.18	0.00
NDP	2.80	6.03	2.55	5.93
NDI	2.98	6.07	2.84	5.93
Difference	-0.17	-0.04	-0.29	0.00
NNP	2.79	6.02	2.62	6.01
NNI	2.97	6.06	2.91	6.01
Differences	-0.17	-0.04	-0.29	0.00

Source: Appendix Table 6.

GDP, GNP, NDP and NNP. Thus, 17 of the 32 time series are drawn directly from official sources: six of 16 for Canada, and 11 of 16 for the United States.

We produce estimates of the remaining aggregates using methods consistent with the UN guidelines, as described above.

Within Country Analysis

Product versus Income

Product and income measures provide insight into different aspects of the economy. Product measures (GDP, GNP, NDP, NNP) provide the volume of output while income measures (GDI, GNI, NDI, NNI) represents the total income for the participants in the economy, thus the amount available for consumption. By definition, the current dollar value for a given income and product measure is identical, so any difference, such as is seen in the U.S. data, arises from the fact that they are based on different data sources.

As discussed earlier, however, real measures of product and income differ as a result of different deflators. In Canada the real value for product measures is lower than that of income measures, due to a higher deflator (Table 2).[15] In the United States, the opposite is true. When measured in chained dollars, the product and income measures are equal to one another in the base year of the defators (2005 for the United States and 2002 for Canada). Differences between them in 2008 reflect only the relative growth rates of the underlying deflators since the base year. If the deflator for income measures grows faster than the deflator for product measures after the base year, then the income measures will be lower than the product measures in 2008. The reverse is also true. As we discuss below, differences between the growth rates of the two price deflators reflect changing terms of trade.

The growth rates for real product measures (GDP, GNP, NDP and NNP) reflect changes in the volume of output produced by the economy. In contrast, the consumption possibility set for a country is determined by volumes of production as well as the changes in the prices of produced goods and services relative to prices of consumed goods and services. Real income mea-

15 All the complete time series used in this article are contained in a set of appendix tables, which are available online at http://www.csls.ca/ipm/19/appendix_ross_murray.pdf.

sures (GDI, GNI, NDI and NNI) represent the consumption possibility set for a country. Given these definitions, one may correctly infer that the difference between GDP and GDI is due to changing trade gains or losses caused by changes in the real exchange rate (price ratio of traded to non-traded goods) and changing terms of trade (ratio of export prices to import prices). Macdonald (2007a) notes that the growth in output volume is generally a more important determinant of prosperity in the long run than relative price changes are, because changes in terms of trade are generally transitory. Nonetheless, the impact of changes in terms of trade can be quite large in the short term.

There was virtually no difference in the annual growth rates for GDP and GDI in the United States over the 1980-2008 period; growth was 2.99 per cent per year for both measures (Table 3). This is as we would expect if the effects of terms of trade shocks on aggregate income tend not to persist over long time periods. In Canada, the annual growth rates of the income aggregates exceeded those of the corresponding product aggregates by about 0.20 to 0.30 percentage points over the 1980-2008 period. As we show below, this is entirely attributable to a significant terms of trade improvement since 2000.

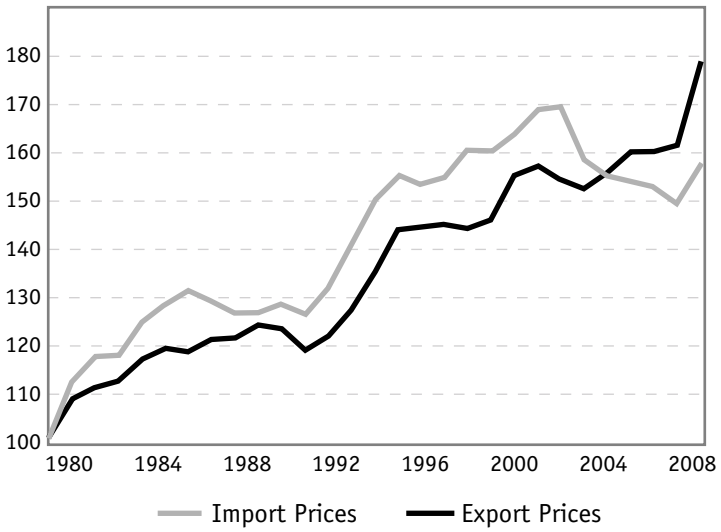
Over the 2000 to 2008 period, real GDI in the United States grew at an average annual rate of 1.98 per cent compared to GDP growth of 2.15 per cent (Appendix Table 6). This implies a large decline in terms of trade for the United States (Chart 1). Such an observation follows from the large increase in energy prices from 2003-2008 and the fact that the United States is a large energy net importer. The sensitivity of U.S. terms of trade to energy prices is so significant that Reinsdorf (2008) suggests a need for terms of trade measure excluding petroleum products!

While the United States was handicapped by unfavourable price changes, Canada was the beneficiary of a large boost in economic fortunes for the same reasons (Chart 1). Over the 2000-2008 period, Canada experienced average annual real GDI growth of 3.03 per cent, 0.72 percentage points higher than the real GDP growth rate of 2.31 per cent per year. The gap in growth rates between net product and net income measures was 0.80 percentage points per year (Table 3).

These numbers largely reflect the increase in natural resource prices, especially energy. Can-

Chart 1
Export and Import Price Indexes in the United States and Canada, 1980-2008, 1980=100

Canada



United States

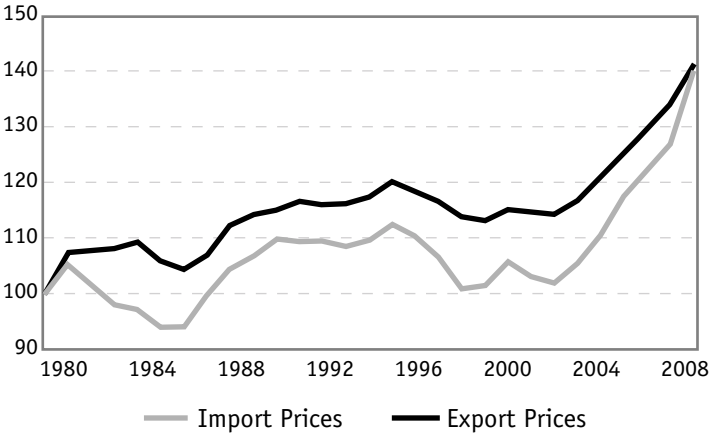


Chart 2
Gap between Real GDI and GDP Growth in Canada and the United States
(percentage points)

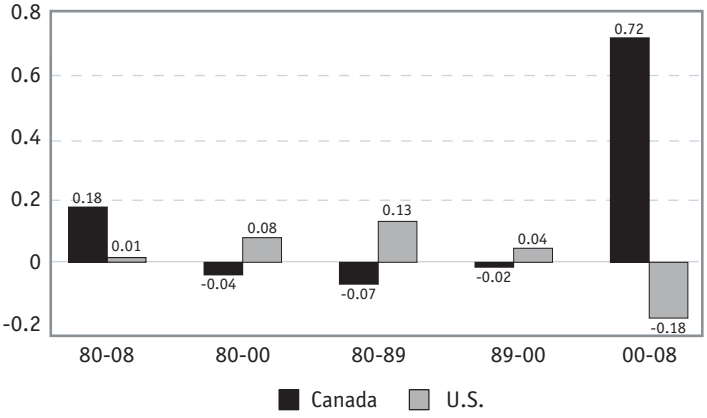


Table 4
Levels of National and Domestic Measures in Canada and the United States, $Billions, 2008

	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GNP	13,443	14,583	1,308	1,584
GDP	13,312	14,441	1,321	1,600
Difference	130	142	-13	-16
GNI	13,286	14,482	1,409	1,584
GDI	13,157	14,340	1,423	1,600
Difference	129	142	-14	-16
NNP	11,728	12,736	1,128	1,377
NDP	11,597	12,594	1,141	1,393
Difference	130	142	-13	-16
NNI	11,603	12,635	1,224	1,377
NDI	11,474	12,493	1,238	1,393
Difference	129	142	-14	-16

Source: Appendix Table 6.

ada, being a net exporter of such commodities, and the United States, a net importer, experienced opposite changes in terms of trade. While the short term implications of this development are clearly favourable for Canada, the long-term prospect is not unambiguously positive. If the terms of trade improvement turns out to be transitory, as Macdonald (2007a) suspects such changes generally are, Canadians could experience losses in consumption possibilities equivalent to the recent gains not tied directly to output volumes.

Over the 1980-2000 period, the annual GDI-GDP growth gap in the United States was 0.08 percentage points. The gap was larger in the 1980s than in the 1990s and, as discussed above, it became negative after 2000 (Chart 2). The United States experienced the short-term price fluctuations that one would expect over the 1980-2008 period, such that the GDI-GDP gap for the entire period was essentially zero.

In Canada, the GDI-GDP growth gap was -0.04 percentage points over the 1980-2000 period. While the 0.18 percentage-point gap for the 1980-2008 period may seem to suggest that GDI has outperformed GDP in Canada for a long time, it is clear from Chart 2 that the positive long-term gap is entirely attributable to the large post-2000 gap. It is reasonable to suppose that this development will yet prove to be transitory.

National versus Domestic Measures

National measures (GNP, GNI, NNP and NNI) reflect all production or income arising from labour from residents of the country or capital owned by residents of the country. Domestic measures (GDP, GDI, NDP and NDI) relate to production and factor income within the borders of the country, regardless of where the proprietor of the capital lives. The difference between the two measures is net income receipts from non-residents.

In 2008, the national measures were at lower levels than the domestic measures in Canada and at higher levels than the domestic measures in the United States (Table 4). Thus, in Canada, the net income from non-residents was negative; that is, income from capital owned in Canada by non-Canadians was higher than income earned from capital outside of Canada by Canadians. In contrast, the income received by Americans

from capital outside of the United States was higher than the income earned by non-Americans within American borders.

Comparing the growth rates of domestic and national measures allows for the analysis of how these factors change over time and reveals information about the importance of net income receipts for the welfare of those living in the United States or Canada.

National measures of aggregate income have increased faster than domestic measures over the 1980 to 2008 period in Canada, but not in the United States (Table 5 and Chart 3). Canada witnessed GNP growth that was 0.06 percentage points per year higher than GDP growth over the period (Chart 3). Counter to what one might expect in this age of increasingly integrated markets and international investments, payments from Canada to non-residents have fallen as a proportion of GDP (Chart 4). In 1980, the gross outflow amounted to 5.16 per cent of GDP, and reached as high as 6.63 per cent in 1982. Since 1998, there has been a downward trend in payments to non-residents as a proportion of GDP; these payments amounted to only 4.41 per cent of GDP in 2008.

During the 1980 to 2008 period, not only did the outflow as a proportion of GDP decrease in Canada, but gross income received from non-residents increased. In 1980, investment income from non-residents amounted to 2.44 per cent of GDP, and fell to 1.95 per cent in 1992 before falling further to reach a low of 1.72 per cent in 2002. In the years following 2002, income receipts from the rest of the world increased dramatically, peaking at 3.71 per cent in 2006 and leveling off to 3.43 per cent in 2008.

Given that the proportion of Canada's GDP paid to non-residents has decreased and income receipts from the rest of the world increased, net income from non-residents increased. Net income payments to non-residents amounted to 2.72 per cent of GDP in 1980, and increased further to reach 3.63 per cent in 1992. Since 1992, this trend has reversed. Net income received from non-residents as a proportion of GDP has been increasing, reaching a high of 0.98 per cent of GDP in 2008. Cross (2004) argues that this trend is the result of lower interest rates domes-

Chart 3
Gap between Real GNP and GDP Growth in Canada and the United States
(percentage points)

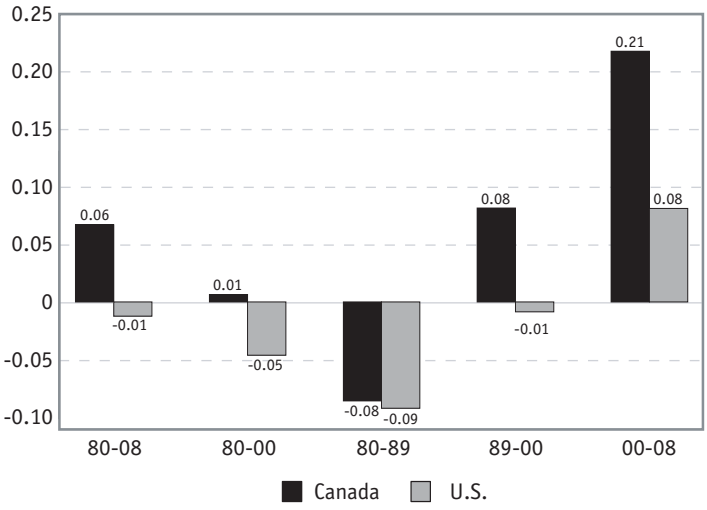
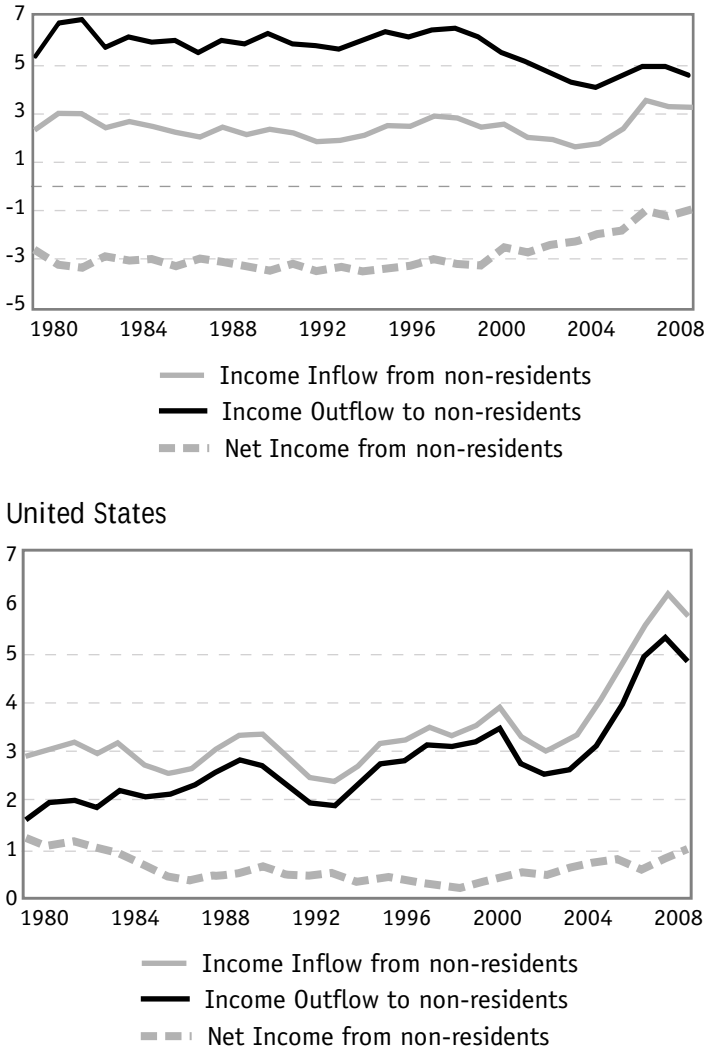


Table 5
Growth Rates of National and Domestic Measures in Canada and the United States, Per Cent per Year, 1980-2008

	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GNP	2.98	6.04	2.77	6.05
GDP	2.99	6.05	2.71	5.98
Difference	-0.01	-0.01	0.06	0.07
GNI	2.99	6.08	2.95	6.05
GDI	2.99	6.09	2.89	5.98
Difference	-0.01	-0.01	0.07	0.07
NNP	2.79	6.02	2.62	6.01
NDP	2.80	6.03	2.55	5.93
Difference	-0.01	-0.01	0.07	0.08
NNI	2.97	6.06	2.91	6.01
NDI	2.98	6.07	2.84	5.93
Difference	-0.01	-0.01	0.07	0.08

Source: Appendix Table 6.

Chart 4
Inflow, Outflow and Net Income Received from Non-residents as a Proportion of GDP, Canada and the United States, 1980-2008
(per cent)



tically, falling foreign debt and increased foreign direct investment on the part of residents of Canada.

Unlike Canada, the United States experienced slightly faster growth in domestic measures of aggregate income than national measures over the 1980-2008 period (Chart 4). The rate of GNP growth was 0.01 percentage points lower than GDP growth in the United States over the period. Gross income payments to non-residents were equivalent to only 1.61 per cent of GDP in 1980. With increasing economic integration and reduced barriers to and capital flows, foreign capital became a more important component of investment; gross outflows of investment income almost tripled over the period, going from 1.61 per cent in 1981 to a peak of 5.30 per cent in 2007 before reaching 4.66 per cent in 2008. Contrasting the growth of gross outflows in Canada and the United States over the 1980-2008 period yields the observation that gross outflows as a share of GDP have increased by 3.01 percentage points in the United States, but fallen by 0.75 percentage points in Canada. Looking over the entire period for which data are available for both countries (the 1961 to 2008 period), 2006 is the first year on record for which gross payments to non-residents were larger in the United States then in Canada as a proportion of GDP, a situation that repeated itself in 2007 as well as 2008.

Gross income received from non-residents amounted to 2.84 per cent of GDP in the United States in 1980, and it fluctuated around that value for the next twenty-two years. It 2002, gross income inflows amounted to 2.95 per cent of GDP, not much different from the 1980 value. After 2002, however, gross income receipts experienced strong growth. They peaked at 6.12 per cent of U.S. GDP in 2007, before falling to 5.60 per cent in 2008.

Net income from non-residents in the United States declined from 1.23 per cent of U.S. GDP in 1980 to 0.98 per cent in 2008. The proportion declined between 1982 and 1987, reaching 0.37 per cent of GDP in 1987. The proportion ranged from 0.20 per cent to 0.59 per cent over the 1987 to 2002 period, but has since increased.

Gross versus Net Measures

Gross measures (GDP, GDI, GNP and GNI) reflect all production or income and do not subtract the depreciation of fixed capital. Net measures (NDP, NDI, NNP and NNI) subtract capital consumption from the corresponding gross measures. A comparison of gross and net measures allows for an analysis of changing capital composition. Changes in capital composition have changed the rate at which capital depreciates, due to the rapid growth of investment in short-lived ICT capital in recent years (Sharpe and Arsenault, 2009).

Since net measures of national income or output are equal to gross measures minus the consumption of fixed capital, the gross measure is always greater in magnitude than the net measure. By definition, the difference is always identical in all current dollar measures and for real measurements, the difference is identical for national and domestic accounting, although it can differ between product and income measures because of the use of different deflators.

Over the entire period of 1980 to 2008, both Canada and the United States experienced faster growth in gross than in net measures (Table 7). Real GDP grew 2.99 per cent per year over the period in the United States, while real NDP grew 2.80 per cent per year. In Canada over the same period, real GDP grew 2.71 per cent per year and real NDP grew 2.55 per cent per year. The implication is that both countries experienced a change in the composition of capital in favour of fast depreciating assets, as one would expect given the increased importance taken by information and communications technology over the period. The increases in capital consumption allowances as a share of real GDP (illustrated in Chart 5) were responsible for the fact that annual NDP growth lagged GDP growth by 0.18 percentage points in the United States and by 0.16 percentage points in Canada over the 1980-2008 period.

Table 6
Levels of Gross and Net Measures in Canada and the United States, $Billion, 2008

	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GDP	13,312	14,441	1,321	1,600
NDP	11,597	12,594	1,141	1,393
Difference	1,715	1,847	180	208
GDI	13,157	14,340	1,423	1,600
NDI	11,474	12,493	1,238	1,393
Difference	1,683	1,847	185	208
GNP	13,443	14,583	1,308	1,584
NNP	11,728	12,736	1,128	1,377
Difference	1,715	1,847	180	208
GNI	13,286	14,482	1,409	1,584
NNI	11,603	12,635	1,224	1,377
Difference	1,683	1,847	185	208

Source: Appendix Table 6.

Table 7
Growth Rates of Gross and Net Measures in Canada and the United States, Per Cent per Year, 1980-2008

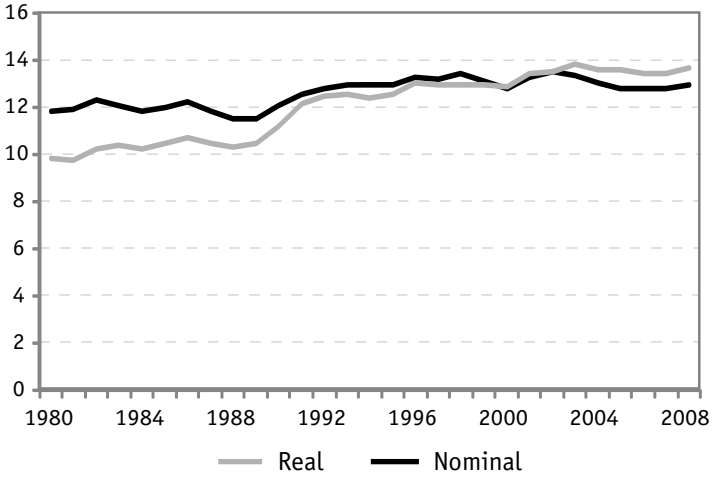
	United States		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
GDP	2.99	6.05	2.71	5.98
NDP	2.80	6.03	2.55	5.93
Difference	0.18	0.02	0.16	0.05
GDI	2.99	6.09	2.89	5.98
NDI	2.98	6.07	2.84	5.93
Difference	0.02	0.01	0.05	0.05
GNP	2.98	6.04	2.77	6.05
NNP	2.79	6.02	2.62	6.01
Difference	0.18	0.02	0.15	0.04
GNI	2.99	6.08	2.95	6.05
NNI	2.97	6.06	2.91	6.01
Difference	0.02	0.02	0.04	0.04

Source: Appendix Table 6.

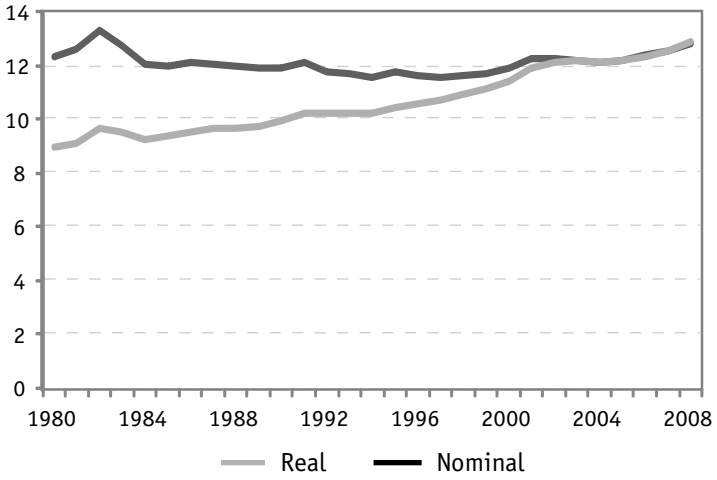
Between 1980 and 2000, rising capital consumption amounted to 0.17 percentage points of real GDP growth in the United States and 0.18 percentage points of real GDP growth in Canada (Chart 6). Most of this increase in the importance of CCA in both countries occurred in the 1990s, when ICT investment

Chart 5
Capital Consumption Allowance as a Proportion of GDP in Canada and the United States, 1980-2008
(per cent)

Canada



United States



significantly increased. Throughout the 1990s, CCA accounted for 0.26 percentage points of annual GDP growth Canada and 0.20 percentage points of annual GDP growth in the United States.

In the 2000-2008 period, the growth gap between GDP and NDP declined to 0.11 percentage points in Canada (Chart 6). In the United States, in contrast, the gap increased to 0.23 percentage points.

Table 8
Growth of Real Income and Product Measures in the United States and Canada, 1980-2008

	United States	Canada	U.S. - Canada Gap
GDP	2.99	2.71	0.28
GDI	2.99	2.89	0.11
GNP	2.98	2.77	0.20
GNI	2.99	2.95	0.04
NDP	2.80	2.55	0.26
NDI	2.98	2.84	0.14
NNP	2.79	2.62	0.17
NNI	2.97	2.91	0.05

Source: Appendix Table 6.

Canada-United States Cross-Country Analysis

Aggregate Basis

Over the 1980 to 2008 period, the United States saw higher growth than Canada for every measure (Table 8 and Chart 7). The gap in growth rates was smallest for income measures, which had the four lowest gaps. This is the result of the improved terms of trade that the Canadian economy benefitted from. National measures had lower gaps than domestic measures, reflecting the greater improvement in net income earned from non-residents experienced in Canada relative to the United States. Product measures increasing faster in the United States than in Canada indicate that output volumes increased faster.

The growth rate in the 1980-2000 period was higher than the 1980-2008 average in the United States for every measure and in Canada for product measures. The percentage point gap between the U.S. and Canadian growth rates was greater in the 1980-2000 period than in the full 1980-2008 period (Table 9). As in the 1980-2008 period, the gaps for the national measures were smaller than for the domestic measures between 1980 and 2000. However, there is a significant dif-

Table 9
Growth of Real Income and Product Measures in the United States and Canada, 1980-2000

Measure	United States	Canada	U.S.-Canada Gap
GDP	3.32	2.87	0.46
GDI	3.40	2.83	0.58
GNP	3.28	2.87	0.40
GNI	3.36	2.83	0.53
NDP	3.15	2.69	0.46
NDI	3.43	2.77	0.66
NNP	3.10	2.69	0.41
NNI	3.38	2.78	0.60

Source: Appendix Table 6.

ference in the comparison between income and product measures. In the period from 1980-2000, the U.S.-Canada gap between the growth rates was larger for income measures than for product measures. This demonstrates that Canada's terms of trade advantage discussed earlier did not occur before 2000. In the 1980-2000 period, the growth rate for gross income measures was lower than that for the gross product measures in Canada and higher than that for the gross product measures in the United States, so the United States had increasing terms of trade and Canada had decreasing.

In recent years, however, there has been a catch-up effect; Canada experienced higher growth than the United States for all eight measures of income and product over the 2000-2008 period (Table 10 and Chart 7). Product measures had the smallest absolute gaps between Canada and the United States, reflecting similar growth in actual output volumes while income measures saw a larger gap due to trading gains for Canada and trading losses for the United States. The growth rate gap was larger for national measures than domestic measures, reflecting increasing net income received from non-residents in Canada. The gap in net measures was higher than

Chart 6
Gap between Real GDP and NDP Growth in Canada and the United States
(percentage points per year)

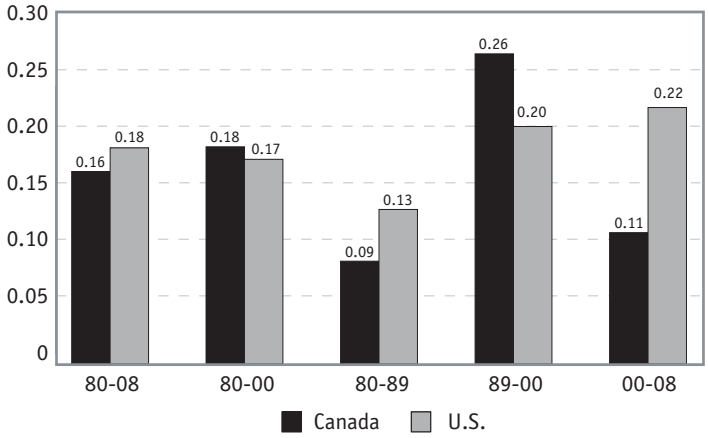


Table 10
Growth of Real Income and Product Measures in the United States and Canada, 2000-2008

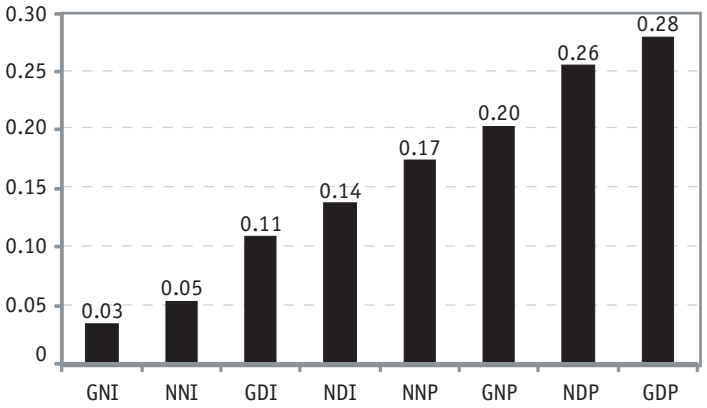
Measure	United States	Canada	U.S.-Canada Gap
GDP	2.15	2.31	-0.16
GDI	1.98	3.03	-1.06
GNP	2.23	2.52	-0.29
GNI	2.05	3.25	-1.19
NDP	1.94	2.20	-0.27
NDI	1.85	3.00	-1.16
NNP	2.03	2.45	-0.42
NNI	1.94	3.25	-1.31

Source: Appendix Table 6.

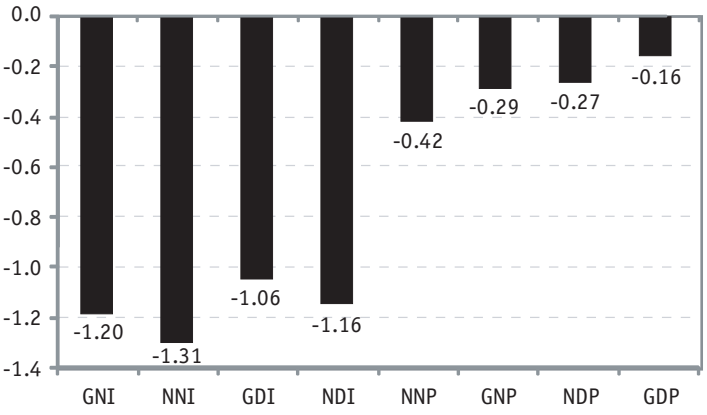
the gap in gross measures due to the quicker pace of capital consumption growth in the United States as compared to Canada over the period. Overall, Canada outperformed the United States in the most recent period while the opposite was true for the 1980-2000 period.

It is not unprecedented for Canada to outperform the United States in product and income measures. While Canada performed poorly compared to the United States for the 1980-2000 period, Canada exhibited a superior per-

Chart 7
Canada-U.S. Real Income Growth Gap, 1980-2008
(percentage points)
1980-2008



2000-2008



Source: Appendix Table 6.

formance over the 1961-2008 period.[16] Over this period, Canada experienced an average real GDP growth rate of 3.48 per cent while the United States experienced growth of 3.30 per cent. Similarly, real income measures indicate higher growth for Canada at 3.66 per cent average annual growth compared to 3.23 per cent growth in the United States.

Table 11
Growth of Per-capita Real Income and Product Measures in the United States and Canada, Per Cent per Year, 1980-2008

Measure	United States	Canada	U.S.-Canada Gap
GDP	1.92	1.59	0.33
GDI	1.93	1.76	0.16
GNP	1.91	1.65	0.26
GNI	1.92	1.83	0.09
NDP	1.74	1.43	0.31
NDI	1.91	1.72	0.19
NNP	1.73	1.50	0.23
NNI	1.90	1.79	0.11

Source: Appendix Table 10.

Per Capita Basis

Using per-capita measures allows us to control for differences between Canada and the United States in terms of the size and growth rates of their populations. As it turns out, this does not affect our conclusions regarding the growth rates of the eight aggregate measures. Population growth was virtually identical in the two countries over the 1980-2008 period: 1.05 per cent per year in the United States and 1.10 per cent per year in Canada (Appendix Table 9). (The population growth rates were also very similar within the 1980-2000 and 2000-2008 sub-periods.) Thus, the relative growth rates of the eight aggregates measures in Canada and the United States are essentially the same whether the aggregates are expressed in absolute or per-capita terms. Note that the growth rate gaps presented in Table 11 differ from those in Table 8 by only 0.05 percentage points -- the difference between the population growth rates in Canada and the United States over the 1980-2008 period.

16 This analysis is limited to gross measures. While the net measures are estimated with a very reliable and sound methodology for the 1980 to 2008 period, looking at earlier years yields conclusions that we cannot be as confident in. This follows for two reasons: data for the United States are official, but subject to the observation by Spant (2003) concerning the difficulty in estimating capital depreciation. The second reason, which applies to Canadian net product measures, is that CSLS estimates these data by subtracting chained CCA from the chained gross measures; the summation or subtraction of chained indexes becomes less accurate as you get farther away from the base year.

The use of per-capita measures is essential, however, for the purpose of level comparisons between Canada and the United States. In per-capita terms and adjusted for purchasing power parity (Appendix Table 13), the U.S. values are higher than the Canadian values for each of the eight measures (Table 12). The gaps, measured in 2002 U.S. dollars at PPP, range from $4,131 for NDI to $8,621 for GNP. The differences between the gaps illustrate many of the issues discussed earlier. The terms of trade advantage that Canada has means that the gap is much smaller for income measures than for product measures. The disadvantage in terms of income from non-residents means that the gap between Canada and the US is higher for national than domestic measures.

The U.S.-Canada gap is greater for gross than for net measures. This is partly a size effect. GDP is about 15 per cent larger than NDP in both the United States and Canada, but the same *proportional* GDP-NDP differential corresponds to different *absolute* GDP-NDP differentials in the two countries because NDP is larger in the United States than in Canada. Thus, the U.S.-Canada GDP gap exceeds the NDP gap.

Note that by the same reasoning, the U.S.-Canada gaps should be about equal for gross and net measures when the gaps are measured in proportional terms rather than in absolute dollar terms. Indeed, the data in Table 13 show that this is the case. As a proportion of the U.S. values, the Canadian gross aggregates are roughly the same as the net ones (Chart 8). (In fact, they are slightly larger.)

It is possible to find the level of depreciation per capita by subtracting the net measures from the gross measures. This gives values for the United States of $5,241 and $5,047 (in 2002 U.S. dollars) for product and income measures and for Canada the values are $4,411 and $4,512 (in 2002 U.S. dollars at PPP). Thus the United States does have a slightly higher value of depreciation per capita by both measures.

Chart 8
The Canada-U.S. Per-capita Income Gap, Canada as a Proportion of the United States, 2008
(per cent)

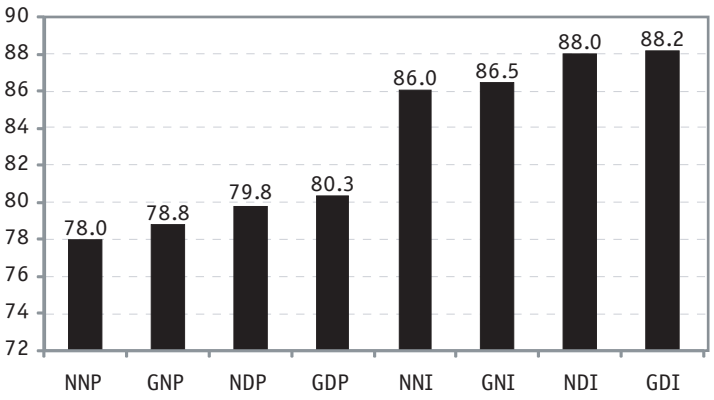


Table 12
Real Per-capita Income and Product Measures in the United States and Canada, 2002 $U.S. at PPP, 2008

Measure	United States	Canada	U.S.-Canada Gap
GDP	40,228	32,317	7,912
GDI	39,458	34,793	4,665
GNP	40,620	31,999	8,621
GNI	39,846	34,451	5,394
NDP	34,987	27,905	7,082
NDI	34,411	30,280	4,131
NNP	35,379	27,588	7,791
NNI	34,799	29,939	4,860

Source: Appendix Table 16.

Table 13 and Chart 8 also illustrate the importance of terms of trade for the living standards of Canadians relative to Americans in recent years. As a proportion of the U.S. level in 2008, Canada's GDI was 7.9 percentage points greater than its GDP (88.2 per cent versus 80.3 per cent). In terms of NNI, which captures terms of trade, net income from abroad, and the sustainability of the capital

Table 13
Real Per-capita Income and Product Measures in the United States and Canada, Canadian Measures as a Proportion of American Measures, per cent, 1990, 2000, and 2008

Measure	1980	2000	2008
GDP	88.0	79.8	80.3
GDI	92.2	81.6	88.2
GNP	84.6	77.4	78.8
GNI	88.6	79.2	86.5
NDP	86.8	78.5	79.8
NDI	92.8	80.8	88.0
NNP	83.0	75.9	78.0
NNI	88.7	78.1	86.0

Source: Appendix Table 17.

stock, Canada's aggregate income was 86.0 per cent of the U.S. level in 2008.

Synthesis of the Findings

This article has presented estimates of the levels and growth of eight measures of aggregate income for Canada and the United States for the 1980-2008 period. This section highlights the key empirical findings. It also discusses which of the aggregate income measures is most appropriate for analysis of productivity and living standard trends.

Empirical Findings

By definition, the absolute level of a net income measure is less than that of a gross measure because of depreciation or capital consumption allowances (CCA). The relative growth rates of the two measures reflect trends in the share of CCA in total income. A rising share means that net measures grow at a slower rate than gross measures. As this share was indeed rising during the 1980-2008 period in both Canada and the United States because of the shift to assets with shorter service lives, net measures of income advanced at a slightly slower pace than gross measures (0.02 to 0.20 percentage points per year).

The size of domestic measures of aggregate income relative to national measures depends on whether net income flows from non-residents are positive or negative. If the former, then national measures of income exceed domestic measures; if the later, then domestic measures exceed national measures. In Canada, domestic measures of aggregate income levels have traditionally exceeded national measures because of a negative balance on net income from non-residents. The opposite has been the case in the United States.

The relative growth rates of the domestic and national income measures depend on the growth trend in net income flows from non-residents and the importance of these flows in aggregate income. In the United States, net income from non-residents is a relatively small share of aggregate income. The growth rates of US domestic and national income measures were virtually identical over the 1980-2008 period as the share of net income flows from non-residents in income was stable. In Canada, by contrast, growth of national measures exceeded that of domestic measures of aggregate income by 0.06-0.08 percentage points per year as the negative balance on net income from non-residents, as a share of total income, fell in magnitude.

In theory, current price estimates of product and income measures are by definition identical (in practice, this is not the case in the United States because of the methodology used to construct these estimates). In contrast, constant price estimates of income and product differ because of differences in the deflators used to calculate these estimates. Such deflators are of course not needed for current price estimates. Differences between estimates of real income and real product depend on the relative level of the two deflators used to construct the estimates (the GDP deflator for product estimates and the final domestic expenditure deflator for income estimates). In the United States in 2008, product

estimates exceeded income estimates because the level of the domestic demand deflator (relative to the base year) exceeded that of the GDP deflator. The opposite was the case in Canada, with real income estimates exceeding real product estimates.

The growth rates of real income and product estimates also reflect the relative growth rates of the GDP and final domestic expenditure deflators, which in turn represent changes in the terms of trade. In the United States, there was little difference in the growth rates of the GDP and final domestic demand deflators over the 1980-2008 period, and hence little difference in product and income measures of aggregate income growth. This was not the case in Canada, where GDP deflator growth exceeded final domestic demand growth, as a result of positive terms of trade effects. Growth in measures of aggregate income exceeded that of aggregate product by around 0.2 percentage points per year. This effect was uniquely due to developments in the 2000-2008 period.

In terms of the growth of aggregate income or output, our findings are the same whether we consider the income measures in absolute or per-capita terms. This is because population growth was virtually identical in Canada and the United States over the 1980-2008 period. In terms of the per-capita levels of the aggregates, we find that Canada's aggregate income measures are greater as a proportion of their U.S. levels than the corresponding output measures.

Implications for Analysis of Productivity and Living Standards

Gross Domestic Product (GDP) is by far the most widely used of the eight possible measures of aggregate income, but it is not necessarily the most appropriate measure for all purposes. Figure 2 provides the author's perspective on the most appropriate income measure for the analysis of productivity and living standards, broken down by the three specific areas: gross versus net; domestic versus national; and product versus income.

Figure 2
Most Appropriate Output or Income Measure for Analysis of Productivity and Living Standards

	Productivity Analysis	Living Standards Analysis
Gross versus Net	Either	Net
Domestic versus National	Domestic	National
Product versus Income	Product	Income
Overall	GDP or NDP	NNI

From a theoretical perspective, a case can be made that either gross or net measures are appropriate for productivity analysis.[17] The strength of a gross measure is that it captures all the value produced by the economy, which corresponds to the physical quantity of output. The strength of the net measure is that it adjusts for the output needed to maintain the capital stock.[18] Concerning domestic versus national measures, a domestic measure is more appropriate than a national measure because the output measure for productivity calculations should reflect only production within the country. National measures include net income from non-residents, which reflects production that occurs outside of the country. Finally, regarding real product versus income measures, a product measure is much more appropriate than an income measure for productivity analysis as the latter incorporates terms of trade effects, which are not directly linked to physical or quantity-

17 Spant (2003) argues that net measures are more important from a welfare perspective, as these measures account for the changing capital depreciation rates; gross measures are poor indicators of economic growth, productivity and differences in growth rates across countries.

18 Baker and Rosnick (2007:43) make the case for a net productivity measure.

based input-output relationships. Consequently, the most appropriate aggregate income measure for productivity analysis is GDP or NDP.

In terms of living standards analysis, a net measure of aggregate income is more appropriate than a gross measure as it reflects sustainability considerations. A national measure is more appropriate than a domestic measure because net income from non-residents augments the command over resources, and hence the living standards, of the population. Finally, an income measure is more appropriate than a product measure because the former incorporates terms of trade effects, which can again increase or decrease command over resources and hence living standards. Consequently, the most appropriate aggregate income measure for living standards analysis is Net National Income (NNI).

The NNI statistic is little used in discussion of trends in living standards. It is noteworthy that Canada's performance in recent years, both in absolute terms and in comparison to that of the United States, has been better when measured by NNI than when measured by GDP, the much more common indicator. In 2008, Canada was at 86.0 per cent of the US level in terms of NNI, but only 80.3 per cent in terms of GDP (Table 12). Over the 2000-2008 period, Canada's per capita NNI growth of 2.20 per cent per year was 0.93 percentage points higher than Canadian GDP growth of 1.27 per cent per year (Table 15). The Canada-US gap in NNI growth rates for the 2000-2008 period was 1.23 percentage points in Canada's favour, versus just 0.09 percentage points for GDP growth.

Conclusion

There are eight aggregate measures of income and product and each yield somewhat different information. Gross and net measures differ in that net measures subtract capital consumption allowances from the corresponding gross measures. National and domestic measures differ in that national measures reflect all production or income dependent on labour from residents of the country or capital owned by residents of the country, whereas domestic measures include all production within the national borders. Real product and income measures differ in that product measures are concerned with output volumes and real income measures may increase due to changes in volume or prices; real income measures are concerned with the volume of consumption attainable rather than the volume produced. Real income and product measures differ because different deflators are used to attain the volume of production and the volume of consumption attainable. Given that all eight aggregates convey important information, it is important to understand each one.

Over the 1980 to 2008 period, the United States experienced higher growth than Canada in all aggregate income and product measures. Canada did, however, outperform the United States in all eight aggregates for the 2000 to 2008 period. While Canada continues to lag the United States in terms of levels, the most recent period indicates Canada is catching up. Canada has been fortunate to see trading gains such that GDI growth outpaced GDP growth while the United States experienced almost identical growth rates for both measures over the 1980 to 2008 period.

Canada's growth advantage since 2000 has been most pronounced in terms of NNI, the measure most relevant for living standards; it has been smallest in terms of GDP and NDP, the measures most relevant for productivity analysis. It is likely that most readers were unaware of this, since NNI is almost never discussed. Because NNI captures terms of trade effects, net income received from abroad, and the sustainability of the capital stock, it is a key measure of an economy's aggregate command over consumption opportunities. A recommendation arising from

this report is that Statistics Canada and other statistical agencies should publish data on all eight income aggregates, so that analysts will be able to easily choose the most appropriate measure for their purposes.

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Aggregate Measures of Income and Output in Canada and the United States: Implications for Productivity and Living Standards

Index of Appendix Tables

Appendix Table 1: Government and Business Investment and Investment Deflator, Canada, 1961-2008

	Government Investment, Billions of Current Dollars	Business Investment, Billions of Current Dollars	Government Investment, Billions of Chained 2002$	Business Investment, Billions of Chained 2002$	Total Investment, Billions of Current Dollars	Government Investment Price Deflator	Business Investment Price deflator	Investment Price Deflator
	A	B	C	D	E	F	G	H
					A+B	100*A/C	100*B/D	(A/E)*F+(B/E)*G
1961	1.9	7.0	8.9	35.9	8.9	21.1	19.4	19.8
1962	2.1	7.2	9.9	36.8	9.3	21.3	19.6	20.0
1963	2.2	7.8	9.9	38.9	10.0	22.0	20.0	20.4
1964	2.3	9.4	10.1	45.3	11.7	22.5	20.7	21.1
1965	2.8	10.9	11.5	50.2	13.6	24.1	21.7	22.2
1966	3.2	12.7	12.6	55.7	15.9	25.6	22.7	23.3
1967	3.3	13.0	12.9	55.1	16.3	26.0	23.5	24.0
1968	3.4	13.2	13.0	55.3	16.6	26.2	23.9	24.3
1969	3.5	14.8	12.8	59.2	18.3	27.2	25.0	25.4
1970	3.5	15.6	12.5	60.0	19.2	28.3	26.0	26.5
1971	4.2	17.5	14.1	63.9	21.7	29.8	27.4	27.9
1972	4.4	19.7	13.9	67.6	24.0	31.4	29.1	29.5
1973	4.6	24.4	13.2	75.7	29.0	34.9	32.2	32.6
1974	5.7	30.3	13.5	80.9	36.0	42.5	37.5	38.3
1975	6.6	35.4	14.0	85.3	42.0	47.2	41.5	42.4
1976	6.7	40.1	13.5	90.5	46.8	49.6	44.3	45.1
1977	7.3	43.1	13.8	92.2	50.4	52.6	46.8	47.6
1978	7.7	47.3	13.6	94.3	55.0	56.3	50.2	51.0
1979	8.1	55.7	13.3	102.3	63.8	61.0	54.5	55.3
1980	9.2	63.8	13.6	106.8	72.9	67.6	59.7	60.7
1981	10.9	77.5	14.0	116.3	88.5	77.9	66.7	68.1
1982	12.2	71.1	14.6	100.4	83.2	83.0	70.8	72.6
1983	12.0	71.9	14.1	99.8	84.0	84.9	72.1	73.9
1984	13.0	75.2	14.8	101.8	88.2	88.2	73.9	76.0
1985	14.7	83.4	16.5	110.1	98.1	89.0	75.7	77.7
1986	14.6	90.9	16.5	116.2	105.5	88.9	78.2	79.7
1987	15.3	105.6	17.1	129.6	120.9	89.3	81.5	82.5
1988	16.4	120.2	17.9	142.6	136.7	91.7	84.3	85.2
1989	18.6	130.5	19.8	149.6	149.1	93.8	87.2	88.0
1990	20.2	124.6	21.1	141.5	144.9	95.8	88.1	89.2
1991	20.3	114.1	22.2	131.4	134.4	91.3	86.8	87.5
1992	20.0	111.3	21.9	127.5	131.2	91.3	87.2	87.9
1993	19.8	111.3	21.6	124.8	131.1	91.8	89.1	89.5
1994	21.6	123.3	23.1	134.2	145.0	93.5	91.9	92.1
1995	21.4	121.6	22.4	131.6	143.0	95.5	92.4	92.9
1996	20.6	129.4	21.5	139.4	149.9	95.9	92.8	93.2
1997	20.1	154.7	20.8	164.7	174.8	96.8	94.0	94.3
1998	20.0	161.8	20.6	169.3	181.8	97.2	95.5	95.7
1999	23.0	171.4	23.8	179.9	194.5	96.7	95.3	95.5
2000	24.5	181.7	24.7	188.6	206.3	99.2	96.4	96.7
2001	27.3	190.0	27.6	194.2	217.3	99.0	97.9	98.0
2002	28.6	196.6	28.6	196.6	225.2	100.0	100.0	100.0
2003	30.1	208.1	30.1	209.0	238.2	99.9	99.6	99.6
2004	32.5	229.8	32.0	225.7	262.3	101.5	101.8	101.8
2005	37.1	255.6	35.7	246.0	292.7	103.9	103.9	103.9
2006	40.6	283.4	37.6	263.6	324.0	107.8	107.5	107.5
2007	44.5	302.2	39.9	272.6	346.8	111.7	110.9	111.0
2008	53.3	309.2	44.8	270.4	362.5	119.1	114.4	115.0

Source: Statistics Canada CANSIM Table 380-0017. A: v646944, B: v646946, C: v3860068, D: v3860070

Appendix Table 2a: Consumption of Fixed Capital by Business and Government, United States, 1961-2008

	CCA, Billions of Current Dollars	CCA, Billions of Chained 2005$
1961	58.2	231.5
1962	60.6	239.3
1963	63.3	248.7
1964	66.4	259.0
1965	70.7	272.0
1966	76.5	287.5
1967	82.9	303.1
1968	90.4	318.2
1969	99.2	333.6
1970	108.3	347.3
1971	117.8	358.7
1972	127.2	372.1
1973	140.8	391.8
1974	163.7	409.6
1975	190.4	423.8
1976	208.2	437.3
1977	231.8	454.6
1978	261.4	475.3
1979	298.9	499.7
1980	344.1	522.9
1981	393.3	543.8
1982	433.5	566.2
1983	451.1	585.1
1984	474.3	609.5
1985	505.4	643.1
1986	538.5	674.1
1987	571.1	705.5
1988	611.0	735.1
1989	651.5	766.2
1990	691.2	796.5
1991	724.4	821.2
1992	744.4	844.0
1993	778.0	872.3
1994	819.2	906.5
1995	869.5	947.0
1996	912.5	994.8
1997	963.8	1,051.4
1998	1,020.5	1,120.5
1999	1,094.4	1,199.4
2000	1,184.3	1,282.4
2001	1,256.2	1,350.8
2002	1,305.0	1,399.8
2003	1,354.1	1,441.3
2004	1,432.8	1,488.3
2005	1,541.4	1,541.4
2006	1,660.7	1,598.4
2007	1,760.0	1,660.0
2008	1,847.1	1,715.2
Average annual growth rates		
80-08	6.19	4.33
80-89	7.35	4.34
89-00	5.58	4.79
00-08	5.71	3.70

Source: Nominal CCA data are from the Bureau of Economic Analysis NIPA table 1.7.5. Chained CCA data are from NIPA table 1.7.6.

Appendix Table 2b: Consumption of Fixed Capital by Business and Government, Canada, 1961-2008

	CCA, Billions of Current Dollars	CCA, Billions of Chained 2002$
1961	5.0	25.3
1962	5.4	26.8
1963	5.7	28.0
1964	6.2	29.3
1965	6.7	30.4
1966	7.4	31.9
1967	8.1	33.6
1968	8.7	35.7
1969	9.5	37.3
1970	10.3	39.0
1971	11.2	40.3
1972	12.2	41.4
1973	14.2	43.5
1974	17.2	44.9
1975	19.7	46.4
1976	22.5	49.8
1977	24.9	52.3
1978	27.8	54.5
1979	32.1	58.0
1980	37.2	61.3
1981	43.0	63.2
1982	46.7	64.3
1983	49.6	67.2
1984	53.3	70.2
1985	58.4	75.1
1986	62.6	78.6
1987	66.3	80.3
1988	70.5	82.7
1989	75.9	86.3
1990	82.2	92.2
1991	85.9	98.2
1992	89.6	101.9
1993	94.0	105.0
1994	99.6	108.1
1995	105.0	113.1
1996	110.8	118.8
1997	116.6	123.6
1998	122.7	128.1
1999	129.0	135.1
2000	137.4	142.1
2001	147.5	150.6
2002	155.6	155.6
2003	161.8	162.5
2004	167.8	164.9
2005	176.2	169.7
2006	185.4	172.4
2007	195.7	176.3
2008	207.5	180.4
Average annual growth rates		
80-08	6.33	3.93
80-89	8.25	3.87
89-00	5.54	4.64
00-08	5.29	3.03

Source: Nominal CCA data are from CANSIM series v647787. Chained measure calculated by deflating the current dollar amount by the investment deflator from Appendix Table 1.

Appendix Table 3a: Net Investment Income from Non-Residents, United States, 1961-2008

	Inflows from Non-Residents, Billions of Current Dollars	Outflows to Non-Residents, Billions of Current Dollars	from Non-Residents, Billions of Current Dollars	Inflows from Non-Residents, Billions of Chained 2005$	Outflows to Non-Residents, Billions of Chained 2005$	of Non-Residents, Billions of Chained 2005$
1961	5.3	1.8	3.5	31.5	10.3	21.2
1962	5.9	1.8	4.1	34.5	10.4	24.1
1963	6.5	2.1	4.4	37.3	11.5	25.8
1964	7.2	2.3	4.9	40.7	12.7	28.0
1965	7.9	2.6	5.3	43.1	13.9	29.2
1966	8.1	3.0	5.1	42.6	15.5	27.1
1967	8.7	3.3	5.4	44.5	16.5	28.0
1968	10.1	4.0	6.1	49.4	19.2	30.2
1969	11.8	5.7	6.1	54.9	25.6	29.3
1970	12.8	6.4	6.4	56.8	27.7	29.1
1971	14.0	6.4	7.6	58.7	26.2	32.5
1972	16.3	7.7	8.6	65.2	30.3	34.9
1973	23.5	10.9	12.6	88.4	40.4	48.0
1974	29.8	14.3	15.5	103.6	48.4	55.2
1975	28.0	15.0	13.0	89.1	46.9	42.2
1976	32.4	15.5	16.9	96.7	46.2	50.5
1977	37.2	16.9	20.3	104.1	47.2	56.9
1978	46.3	24.7	21.6	120.1	63.7	56.4
1979	68.3	36.4	31.9	163.5	86.5	77.0
1980	79.1	44.9	34.2	174.0	97.8	76.2
1981	92.0	59.1	32.9	184.0	117.2	66.8
1982	101.0	64.5	36.5	190.2	120.3	69.9
1983	101.9	64.8	37.1	184.6	116.8	67.8
1984	121.9	85.6	36.3	213.2	149.2	64.0
1985	112.4	85.9	26.5	190.5	145.3	45.2
1986	111.0	93.4	17.6	183.2	153.4	29.8
1987	122.8	105.2	17.6	195.8	167.1	28.7
1988	151.6	128.3	23.3	233.0	196.4	36.6
1989	177.2	151.2	26.0	261.2	222.9	38.3
1990	188.5	154.1	34.4	265.7	217.4	48.3
1991	168.1	138.2	29.9	228.6	187.9	40.7
1992	151.8	122.7	29.1	201.0	161.5	39.5
1993	155.2	124.0	31.2	200.1	160.2	39.9
1994	184.1	160.0	24.1	231.9	202.1	29.8
1995	229.3	199.6	29.7	282.2	246.7	35.5
1996	245.8	214.2	31.6	297.1	260.0	37.1
1997	279.5	256.1	23.4	332.2	305.2	27.0
1998	286.2	268.9	17.3	337.6	317.5	20.1
1999	319.5	291.7	27.8	371.0	339.1	31.9
2000	380.5	342.8	37.7	431.1	388.7	42.4
2001	323.0	271.1	51.9	358.8	301.5	57.3
2002	313.5	264.4	49.1	343.1	289.4	53.7
2003	353.3	284.6	68.7	377.7	304.3	73.4
2004	448.6	357.4	91.2	465.1	370.5	94.6
2005	573.0	475.9	97.1	573.0	475.9	97.1
2006	721.1	648.6	72.5	697.8	628.0	69.8
2007	861.8	746.0	115.8	811.9	703.2	108.7
2008	809.2	667.3	141.9	739.3	609.1	130.2
Average annual growth rates						
80-08	8.66	10.12	5.21	5.30	6.75	1.93
80-89	9.38	14.44	-3.00	4.62	9.59	-7.36
89-00	7.19	7.73	3.44	4.66	5.19	0.93
00-08	9.89	8.68	18.02	6.97	5.78	15.06

Source: Bureau of Economic Analysis NIPA tables 1.7.5 and 1.7.6.

Appendix Table 3b: Net Investment Income from Non-Residents, Canada, 1961-2008

	Investment Income Inflows from Non-Residents, Millions of Current Dollars	Investment Income Outflows to Non-Residents, Millions of Current Dollars	Net Investment Income of Non-Residents, Billions of Current Dollars	Net Investment Income of Non-Residents, Billions of Chained 2002$
1961	320	1,044	-0.7	-4.6
1962	318	1,092	-0.8	-4.9
1963	337	1,190	-0.9	-5.3
1964	557	1,473	-0.9	-5.5
1965	609	1,611	-1.0	-5.8
1966	625	1,748	-1.1	-6.2
1967	618	1,859	-1.2	-6.6
1968	785	2,001	-1.2	-6.2
1969	1,150	2,303	-1.2	-5.6
1970	1,419	2,760	-1.3	-6.2
1971	1,541	2,999	-1.5	-6.4
1972	1,654	3,129	-1.5	-6.2
1973	2,435	4,249	-1.8	-7.0
1974	3,417	5,727	-2.3	-7.9
1975	3,256	5,910	-2.7	-8.2
1976	2,892	6,505	-3.6	-10.2
1977	3,315	7,998	-4.7	-12.3
1978	4,748	10,838	-6.1	-14.9
1979	7,178	14,814	-7.6	-17.1
1980	7,674	16,223	-8.5	-17.4
1981	11,415	23,551	-12.1	-22.2
1982	11,951	25,200	-13.2	-22.2
1983	10,493	22,729	-12.2	-19.5
1984	12,674	26,846	-14.2	-21.8
1985	12,661	27,737	-15.1	-22.4
1986	12,115	29,561	-17.4	-24.9
1987	12,151	29,456	-17.3	-23.9
1988	15,738	35,539	-19.8	-26.3
1989	14,821	37,364	-22.5	-28.8
1990	16,827	41,271	-24.4	-30.1
1991	15,812	38,666	-22.9	-27.2
1992	13,662	39,059	-25.4	-29.7
1993	14,641	39,810	-25.2	-28.8
1994	16,898	44,892	-28.0	-31.7
1995	21,357	49,907	-28.6	-31.9
1996	21,672	50,002	-28.3	-31.3
1997	27,257	54,961	-27.7	-30.2
1998	27,207	57,627	-30.4	-32.8
1999	25,324	58,556	-33.2	-35.4
2000	29,143	57,175	-28.0	-29.2
2001	23,859	55,212	-31.4	-32.1
2002	23,462	52,330	-28.9	-28.9
2003	20,883	49,473	-28.6	-28.2
2004	23,829	50,135	-26.3	-25.5
2005	33,703	59,451	-25.7	-24.5
2006	53,819	68,389	-14.6	-13.5
2007	53,206	72,551	-19.3	-17.6
2008	54,803	70,502	-15.7	-14.0
Average annual growth rates				
80-08	7.27	5.39	2.19	-0.79
80-89	7.59	9.71	11.38	5.72
89-00	6.34	3.94	2.00	0.12
00-08	8.21	2.65	-6.99	-8.80

Source: Nominal gross inflows and outflows are from CANSIM series v647321 and v647326. Nominal net income data are from CANSIM series v647784. Chain-dollar data are calculated using the nominal data and the Final Domestic Expenditure price index (v44182032).

Appendix Table 4a: Export and Import Volumes and Price Indexes, United States, 1967-2008

	Exports, nominal	Imports, nominal	Exports, volume index (2005 = 100)	Imports, volume index (2005 = 100)	Exports of goods and services, chained 2005$	Imports of goods and services, chained 2005$	Exports of goods and services, Price Index (2005 = 100)	Imports of goods and services, Price Index (2005 = 100)
1961								
1962								
1963								
1964								
1965								
1966								
1967	43.5	39.9	10.7	9.2	140.1	186.8	31.0	21.4
1968	47.9	46.6	11.6	10.6	151.1	214.7	31.7	21.7
1969	51.9	50.5	12.1	11.2	158.4	226.9	32.8	22.3
1970	59.7	55.8	13.4	11.7	175.5	236.6	34.0	23.6
1971	63.0	62.3	13.7	12.3	178.5	249.2	35.3	25.0
1972	70.8	74.2	14.7	13.7	191.8	277.2	36.9	26.8
1973	95.3	91.2	17.5	14.3	228.0	290.1	41.8	31.4
1974	126.7	127.5	18.9	14.0	246.0	283.5	51.5	45.0
1975	138.7	122.7	18.7	12.4	244.5	252.0	56.7	48.7
1976	149.5	151.1	19.6	14.9	255.1	301.3	58.6	50.2
1977	159.4	182.4	20.0	16.5	261.3	334.2	61.0	54.6
1978	186.9	212.3	22.1	17.9	288.8	363.2	64.7	58.4
1979	230.1	252.7	24.3	18.2	317.5	369.2	72.5	68.4
1980	280.8	293.8	26.9	17.0	351.7	344.7	79.8	85.2
1981	305.2	317.8	27.3	17.4	356.0	353.8	85.7	89.8
1982	283.2	303.2	25.2	17.2	328.8	349.3	86.1	86.8
1983	277.0	328.6	24.5	19.4	320.3	393.4	86.5	83.5
1984	302.4	405.1	26.5	24.1	346.5	489.1	87.3	82.8
1985	302.0	417.2	27.4	25.7	357.0	520.9	84.6	80.1
1986	320.3	452.9	29.5	27.9	384.4	565.4	83.3	80.1
1987	363.8	508.7	32.6	29.5	425.7	598.8	85.5	84.9
1988	443.9	554.0	37.8	30.7	493.9	622.4	89.9	89.0
1989	503.1	591.0	42.2	32.0	550.7	649.8	91.4	91.0
1990	552.1	629.7	46.0	33.2	600.2	673.0	92.0	93.6
1991	596.6	623.5	49.0	33.1	640.0	672.1	93.2	92.8
1992	635.0	667.8	52.4	35.5	684.0	719.2	92.8	92.9
1993	655.6	720.0	54.1	38.5	706.4	781.4	92.8	92.1
1994	720.7	813.4	58.8	43.1	768.0	874.6	93.8	93.0
1995	811.9	902.6	64.8	46.6	845.8	944.5	96.0	95.6
1996	867.7	964.0	70.2	50.6	916.0	1,026.7	94.7	93.9
1997	954.4	1,055.8	78.6	57.5	1,025.2	1,165.0	93.1	90.6
1998	953.9	1,115.7	80.3	64.2	1,048.6	1,301.1	91.0	85.7
1999	989.3	1,251.4	83.8	71.6	1,094.3	1,450.9	90.4	86.3
2000	1,093.2	1,475.3	91.1	80.9	1,188.3	1,639.9	92.0	90.0
2001	1,027.7	1,398.7	85.9	78.6	1,121.7	1,593.8	91.6	87.8
2002	1,003.0	1,430.2	84.2	81.3	1,099.2	1,648.0	91.3	86.8
2003	1,041.0	1,545.1	85.6	84.9	1,116.8	1,720.7	93.2	89.8
2004	1,180.2	1,798.9	93.7	94.2	1,222.9	1,910.8	96.5	94.1
2005	1,305.1	2,027.8	100.0	100.0	1,305.1	2,027.8	100.0	100.0
2006	1,471.0	2,240.3	109.0	106.1	1,422.1	2,151.2	103.4	104.1
2007	1,655.9	2,369.7	118.5	108.2	1,546.2	2,193.8	107.1	108.0
2008	1,831.1	2,538.9	124.8	104.7	1,629.3	2,123.5	112.4	119.6
Average annual growth rates								
80-08	6.93	8.01	5.63	6.71	5.63	6.71	1.23	1.22
80-89	6.69	8.08	5.11	7.30	5.11	7.30	1.51	0.72
89-00	7.31	8.67	7.24	8.78	7.24	8.78	0.06	-0.10
00-08	6.66	7.02	4.02	3.28	4.02	3.28	2.53	3.62

Source: Price indexes are from BEA NIPA table 4.2.4. Nominal imports and exports data are from BEA NIPA table 4.2.5, and the import and export volume indexes are from NIPA table 4.2.3. Chain-dollar export and import estimates are calculated by CSLS by adjusting the current-dollar import and export values for 2005 using the volume indexes.

Appendix Table 4b: Export and Import Volumes and Price Indexes, Canada, 1961-2008

	Exports of goods and services, chained 2002$	Imports of goods and services, chained 2002$	Exports of goods and services, Price Index (2002 = 100)	Imports of goods and services, Price Index (2002 = 100)
1961	41.5	42.1	17.6	17.9
1962	43.4	43.0	18.3	18.7
1963	47.3	43.7	18.5	19.2
1964	53.8	49.3	18.9	19.3
1965	56.2	55.9	19.2	19.4
1966	63.8	63.4	19.7	19.8
1967	70.6	66.9	20.0	20.1
1968	79.1	73.8	20.4	20.7
1969	85.5	83.4	20.9	21.3
1970	93.4	82.1	21.5	21.7
1971	97.8	87.5	21.6	22.3
1972	106.2	100.0	22.4	22.8
1973	116.8	114.5	25.6	24.5
1974	111.5	126.2	33.9	29.7
1975	102.3	122.3	38.1	34.4
1976	110.2	130.0	40.2	35.2
1977	117.1	129.5	43.7	39.9
1978	128.8	133.4	47.6	45.3
1979	133.5	142.7	56.3	51.6
1980	134.7	138.1	65.5	59.7
1981	137.1	141.7	70.8	66.7
1982	135.0	118.8	72.3	69.7
1983	143.0	130.7	73.2	69.9
1984	169.3	153.0	76.1	73.8
1985	177.4	165.8	77.4	76.0
1986	185.0	177.7	77.2	77.6
1987	190.5	187.2	78.7	76.6
1988	207.5	212.4	79.0	75.0
1989	209.5	224.9	80.7	75.0
1990	219.3	229.4	80.1	76.1
1991	223.2	235.1	77.2	74.9
1992	239.3	246.1	79.3	78.2
1993	265.2	264.2	82.8	83.1
1994	298.9	285.5	87.6	88.6
1995	324.2	301.9	93.3	91.6
1996	342.4	317.3	93.8	90.6
1997	370.9	362.5	94.0	91.4
1998	404.8	380.9	93.7	94.7
1999	448.0	410.6	94.7	94.6
2000	487.9	443.9	100.6	96.6
2001	473.5	421.2	101.9	99.5
2002	479.2	428.3	100.0	100.0
2003	468.4	446.0	98.8	93.5
2004	491.7	481.9	100.9	91.4
2005	501.0	516.3	103.7	90.7
2006	505.0	540.8	103.8	90.2
2007	510.3	572.1	104.7	88.3
2008	486.3	576.9	115.7	93.2
Average annual growth rates				
80-08	4.69	5.24	2.05	1.60
80-89	5.03	5.56	2.35	2.57
89-00	7.99	6.38	2.02	2.33
00-08	-0.04	3.33	1.76	-0.45

Source: Real export and import volumes are from Statistics Canada CANSIM Table 380-0017 (series v3860078 and v3860081). Export and import price indexes are from CANSIM Table 380-0056 (series v3860242 and v3860245).

Appendix Table 5a: Output and Income Measures, Billions of Current Dollars, United States, 1961-2008

	Gross domestic product	Gross domestic income	Gross national product	Gross national income	Net domestic product	Net domestic income	Net national product	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	545	545	548	549	487	487	490	491
1962	586	585	590	589	525	525	529	529
1963	618	619	622	623	554	555	559	560
1964	664	663	669	668	597	597	602	601
1965	719	718	724	723	648	647	654	652
1966	788	782	793	787	711	705	716	710
1967	832	828	838	833	750	745	755	750
1968	910	906	916	912	819	815	826	821
1969	984	982	991	988	885	882	891	889
1970	1,038	1,031	1,045	1,038	930	923	936	930
1971	1,127	1,116	1,134	1,123	1,009	998	1,017	1,006
1972	1,238	1,229	1,246	1,238	1,111	1,102	1,119	1,110
1973	1,382	1,374	1,395	1,387	1,242	1,234	1,254	1,246
1974	1,500	1,490	1,515	1,505	1,336	1,326	1,351	1,342
1975	1,638	1,621	1,651	1,634	1,447	1,431	1,460	1,444
1976	1,825	1,801	1,841	1,818	1,616	1,593	1,633	1,610
1977	2,030	2,009	2,050	2,029	1,798	1,777	1,819	1,797
1978	2,294	2,268	2,315	2,289	2,032	2,006	2,054	2,028
1979	2,562	2,515	2,594	2,547	2,263	2,216	2,295	2,248
1980	2,788	2,743	2,822	2,777	2,444	2,399	2,478	2,433
1981	3,127	3,090	3,160	3,123	2,734	2,697	2,766	2,730
1982	3,253	3,248	3,290	3,285	2,820	2,815	2,856	2,852
1983	3,535	3,485	3,572	3,522	3,084	3,034	3,121	3,071
1984	3,931	3,899	3,967	3,936	3,457	3,425	3,493	3,461
1985	4,218	4,175	4,244	4,202	3,712	3,670	3,739	3,696
1986	4,460	4,392	4,478	4,410	3,922	3,854	3,939	3,871
1987	4,736	4,704	4,754	4,721	4,165	4,132	4,183	4,150
1988	5,100	5,110	5,124	5,133	4,489	4,499	4,513	4,522
1989	5,482	5,426	5,508	5,452	4,831	4,775	4,857	4,801
1990	5,801	5,716	5,835	5,751	5,109	5,025	5,144	5,060
1991	5,992	5,912	6,022	5,942	5,268	5,188	5,298	5,218
1992	6,342	6,232	6,371	6,262	5,598	5,488	5,627	5,517
1993	6,667	6,532	6,699	6,563	5,889	5,754	5,921	5,785
1994	7,085	6,976	7,109	7,000	6,266	6,157	6,290	6,181
1995	7,415	7,362	7,444	7,392	6,545	6,493	6,575	6,522
1996	7,839	7,813	7,870	7,844	6,926	6,900	6,958	6,932
1997	8,332	8,346	8,356	8,370	7,369	7,383	7,392	7,406
1998	8,794	8,879	8,811	8,896	7,773	7,858	7,790	7,876
1999	9,354	9,425	9,381	9,452	8,259	8,330	8,287	8,358
2000	9,952	10,086	9,989	10,123	8,767	8,901	8,805	8,939
2001	10,286	10,390	10,338	10,441	9,030	9,133	9,082	9,185
2002	10,642	10,664	10,691	10,714	9,337	9,359	9,386	9,409
2003	11,142	11,126	11,211	11,194	9,788	9,772	9,857	9,840
2004	11,868	11,876	11,959	11,967	10,435	10,443	10,526	10,534
2005	12,638	12,718	12,736	12,815	11,097	11,177	11,194	11,274
2006	13,399	13,620	13,471	13,692	11,738	11,959	11,811	12,031
2007	14,078	14,093	14,193	14,208	12,318	12,332	12,433	12,448
2008	14,441	14,340	14,583	14,482	12,594	12,493	12,736	12,635
Average annual growth rates								
80-08	6.05	6.09	6.04	6.08	6.03	6.07	6.02	6.06
80-89	7.80	7.87	7.71	7.78	7.86	7.95	7.76	7.84
80-00	6.57	6.73	6.52	6.68	6.60	6.78	6.54	6.72
89-00	5.57	5.80	5.56	5.79	5.57	5.83	5.56	5.81
00-08	4.76	4.50	4.84	4.58	4.63	4.33	4.72	4.42

*Calculated by CSLS.

Source: Data for the United States are from Bureau of Economic Analysis NIPA table 1.7.5 with the exception of NNI, which was calculated by CSLS by subtracting consumption of fixed capital (Appendix Table 2) from GNI.

Appendix Table 5b: Output and Income Measures, Billions of Current Dollars, Canada, 1961-2008

	Gross domestic product	Gross domestic income	Gross national product	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	41	41	40	40	36	36	35	35
1962	45	45	44	44	39	39	39	39
1963	48	48	47	47	42	42	41	41
1964	53	53	52	52	46	46	45	45
1965	58	58	57	57	51	51	50	50
1966	65	65	64	64	57	57	56	56
1967	70	70	68	68	62	62	60	60
1968	76	76	75	75	67	67	66	66
1969	84	84	83	83	74	74	73	73
1970	90	90	89	89	80	80	79	79
1971	98	98	97	97	87	87	86	86
1972	110	110	108	108	98	98	96	96
1973	129	129	127	127	115	115	113	113
1974	154	154	152	152	137	137	135	135
1975	174	174	171	171	154	154	151	151
1976	200	200	196	196	178	178	174	174
1977	221	221	216	216	196	196	191	191
1978	245	245	239	239	217	217	211	211
1979	280	280	272	272	248	248	240	240
1980	314	314	306	306	277	277	269	269
1981	360	360	348	348	317	317	305	305
1982	380	380	367	367	333	333	320	320
1983	411	411	399	399	362	362	350	350
1984	450	450	435	435	396	396	382	382
1985	486	486	471	471	427	427	412	412
1986	513	513	495	495	450	450	432	432
1987	559	559	542	542	493	493	475	475
1988	613	613	593	593	543	543	523	523
1989	658	658	635	635	582	582	559	559
1990	680	680	655	655	598	598	573	573
1991	685	685	663	663	599	599	577	577
1992	700	700	675	675	611	611	586	586
1993	727	727	702	702	633	633	608	608
1994	771	771	743	743	671	671	643	643
1995	810	810	782	782	705	705	677	677
1996	837	837	809	809	726	726	698	698
1997	883	883	855	855	766	766	738	738
1998	915	915	885	885	792	792	762	762
1999	982	982	949	949	853	853	820	820
2000	1,077	1,077	1,049	1,049	939	939	911	911
2001	1,108	1,108	1,077	1,077	961	961	929	929
2002	1,153	1,153	1,124	1,124	997	997	968	968
2003	1,213	1,213	1,185	1,185	1,051	1,051	1,023	1,023
2004	1,291	1,291	1,265	1,265	1,123	1,123	1,097	1,097
2005	1,374	1,374	1,348	1,348	1,198	1,198	1,172	1,172
2006	1,449	1,449	1,435	1,435	1,264	1,264	1,249	1,249
2007	1,533	1,533	1,514	1,514	1,337	1,337	1,318	1,318
2008	1,600	1,600	1,584	1,584	1,393	1,393	1,377	1,377
Average annual growth rates								
80-08	5.98	5.98	6.05	6.05	5.93	5.93	6.01	6.01
80-89	8.55	8.55	8.46	8.46	8.59	8.59	8.49	8.49
80-00	6.35	6.35	6.35	6.35	6.29	6.29	6.30	6.30
89-00	4.58	4.58	4.66	4.66	4.45	4.45	4.54	4.54
00-08	5.08	5.08	5.30	5.30	5.05	5.05	5.30	5.30

*Calculated by CSLS.

Source: GDP and GDI are from Statistics Canada Table 380-0016 or 380-0017. (Canada estimates 'income-based GDP' and 'expenditure-based GDP,' which correspond to GDP and GDI, respectively. Statistics Canada reconciles the estimates to make them identical.)

GNP is from CANSIM Table 380-0015 (series v499724). For 1982-2008, GNI is from CANSIM Table 380-0062 (series v44182030). For earlier years, values are calculated as GNI = GDI + (GNP - GDP).

NNI, NDP, NDI and NNP are calculated by subtracting capital consumption allowances (Appendix Table 2) from the gross measures.

Appendix Table 6a: Output and Income Measures, Billions of Chained 2005 Dollars, United States, 1961-2008

	Gross domestic product	Gross domestic income*	Gross national product	Gross national income*	Net domestic product	Net domestic income*	Net national product	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	2,897	2,959	2,919	2,978	2,692	2,643	2,714	2,662
1962	3,072	3,140	3,097	3,161	2,863	2,815	2,888	2,837
1963	3,207	3,274	3,233	3,297	2,990	2,938	3,017	2,962
1964	3,392	3,461	3,420	3,487	3,169	3,115	3,197	3,141
1965	3,610	3,686	3,640	3,714	3,377	3,324	3,407	3,351
1966	3,845	3,928	3,873	3,953	3,600	3,546	3,628	3,572
1967	3,943	4,034	3,971	4,060	3,680	3,632	3,709	3,658
1968	4,133	4,230	4,164	4,258	3,857	3,810	3,889	3,838
1969	4,262	4,363	4,292	4,390	3,970	3,923	4,000	3,951
1970	4,270	4,367	4,299	4,394	3,960	3,911	3,990	3,938
1971	4,413	4,507	4,446	4,538	4,093	4,036	4,127	4,066
1972	4,648	4,741	4,683	4,773	4,318	4,254	4,354	4,287
1973	4,917	5,004	4,965	5,050	4,571	4,494	4,619	4,540
1974	4,890	4,923	4,944	4,974	4,519	4,386	4,574	4,436
1975	4,880	4,918	4,921	4,957	4,489	4,346	4,531	4,385
1976	5,141	5,182	5,191	5,230	4,743	4,591	4,793	4,639
1977	5,378	5,401	5,434	5,455	4,965	4,785	5,022	4,839
1978	5,678	5,699	5,733	5,752	5,248	5,049	5,305	5,103
1979	5,855	5,850	5,930	5,923	5,398	5,168	5,475	5,241
1980	5,839	5,760	5,913	5,830	5,348	5,049	5,425	5,119
1981	5,987	5,915	6,053	5,977	5,473	5,171	5,540	5,233
1982	5,871	5,824	5,939	5,889	5,319	5,048	5,389	5,113
1983	6,136	6,113	6,202	6,178	5,569	5,333	5,637	5,397
1984	6,577	6,567	6,640	6,628	5,993	5,775	6,057	5,836
1985	6,849	6,852	6,894	6,895	6,230	6,031	6,275	6,074
1986	7,087	7,085	7,117	7,113	6,434	6,230	6,464	6,258
1987	7,313	7,295	7,342	7,323	6,628	6,416	6,656	6,443
1988	7,614	7,595	7,650	7,629	6,899	6,685	6,936	6,720
1989	7,886	7,865	7,924	7,902	7,140	6,930	7,178	6,967
1990	8,034	7,996	8,082	8,044	7,254	7,043	7,302	7,091
1991	8,015	7,998	8,056	8,038	7,204	7,031	7,245	7,071
1992	8,287	8,266	8,326	8,304	7,455	7,296	7,494	7,334
1993	8,523	8,511	8,563	8,551	7,662	7,518	7,702	7,558
1994	8,871	8,861	8,901	8,891	7,976	7,836	8,006	7,866
1995	9,094	9,078	9,129	9,115	8,156	8,014	8,192	8,050
1996	9,434	9,427	9,471	9,465	8,448	8,329	8,485	8,368
1997	9,854	9,873	9,882	9,901	8,810	8,731	8,838	8,759
1998	10,284	10,350	10,304	10,370	9,169	9,149	9,189	9,169
1999	10,780	10,838	10,812	10,870	9,585	9,570	9,617	9,602
2000	11,226	11,249	11,269	11,292	9,946	9,911	9,989	9,953
2001	11,347	11,414	11,405	11,471	9,997	10,020	10,054	10,077
2002	11,553	11,641	11,607	11,695	10,153	10,213	10,207	10,267
2003	11,841	11,910	11,914	11,984	10,399	10,463	10,473	10,536
2004	12,264	12,311	12,359	12,406	10,776	10,825	10,870	10,919
2005	12,638	12,638	12,736	12,736	11,097	11,097	11,194	11,194
2006	12,976	12,961	13,046	13,031	11,378	11,354	11,448	11,425
2007	13,254	13,230	13,363	13,339	11,594	11,576	11,703	11,685
2008	13,312	13,157	13,443	13,286	11,597	11,474	11,728	11,603
Average annual growth rates								
80-08	2.99	2.99	2.98	2.99	2.80	2.98	2.79	2.97
80-89	3.40	3.52	3.31	3.44	3.26	3.58	3.16	3.48
80-00	3.32	3.40	3.28	3.36	3.15	3.43	3.10	3.38
82-89	4.31	4.38	4.21	4.29	4.29	4.63	4.18	4.52
89-00	3.26	3.31	3.25	3.30	3.06	3.31	3.05	3.30
00-08	2.15	1.98	2.23	2.05	1.94	1.85	2.03	1.94

*Calculated by CSLS.

Source: Data for the four product measures are from the Bureau of Economic Analysis NIPA table 1.7.6. Income measures are calculated by CSLS by deflating the nominal product measures in Appendix Table 5 with the gross domestic purchases deflator found in NIPA table 1.4.4.

Appendix Table 6b: Output and Income Measures, Billions of Chained 2002 Dollars, Canada, 1961-2008

	Gross domestic product	Gross domestic income*	Gross national product*	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	264	263	260	258	239	231	234	226
1962	283	281	278	276	256	247	251	242
1963	298	295	293	290	270	260	265	255
1964	317	315	312	309	288	278	282	272
1965	337	336	332	330	307	297	301	291
1966	360	359	354	353	328	318	322	312
1967	370	370	364	363	337	327	330	320
1968	388	387	382	381	353	343	347	337
1969	408	405	402	399	371	359	365	354
1970	420	419	414	412	381	371	375	364
1971	438	435	431	428	397	385	391	379
1972	462	460	455	454	420	409	414	403
1973	494	500	487	493	450	445	443	438
1974	512	529	504	522	467	470	459	462
1975	521	535	513	527	475	474	467	466
1976	548	566	538	556	499	502	489	492
1977	567	581	555	569	515	515	503	503
1978	590	597	575	583	535	530	521	515
1979	612	626	595	609	554	554	537	537
1980	625	642	608	624	564	566	547	548
1981	647	659	626	637	584	581	562	558
1982	629	637	607	615	564	559	543	537
1983	646	655	627	636	579	576	560	557
1984	683	690	662	668	613	608	592	586
1985	716	720	694	698	641	634	619	611
1986	733	733	709	708	655	643	630	618
1987	765	771	741	747	684	679	661	655
1988	803	814	777	788	720	721	694	694
1989	824	840	795	811	737	743	709	714
1990	825	837	796	806	733	735	703	705
1991	808	815	781	788	710	713	683	685
1992	815	819	786	789	713	714	684	684
1993	834	833	805	805	729	725	700	697
1994	874	872	843	840	766	759	734	727
1995	899	906	867	874	786	789	754	757
1996	913	926	882	894	795	803	764	772
1997	952	962	922	932	828	835	798	805
1998	991	986	958	953	863	854	830	821
1999	1,046	1,046	1,010	1,010	911	908	875	873
2000	1,101	1,120	1,072	1,091	958	977	930	948
2001	1,120	1,133	1,088	1,101	970	982	938	950
2002	1,153	1,153	1,124	1,124	997	998	968	969
2003	1,175	1,197	1,147	1,169	1,012	1,038	984	1,009
2004	1,211	1,254	1,187	1,228	1,046	1,091	1,022	1,065
2005	1,248	1,307	1,224	1,283	1,078	1,139	1,055	1,115
2006	1,283	1,347	1,271	1,333	1,111	1,175	1,098	1,161
2007	1,316	1,395	1,299	1,377	1,140	1,216	1,123	1,199
2008	1,321	1,423	1,308	1,409	1,141	1,238	1,128	1,224
Average annual growth rates								
80-08	2.71	2.89	2.77	2.95	2.55	2.84	2.62	2.91
80-89	3.11	3.04	3.02	2.95	3.02	3.07	2.93	2.98
80-00	2.87	2.83	2.87	2.83	2.69	2.77	2.69	2.78
82-89	3.93	4.02	3.94	4.02	3.89	4.15	3.90	4.17
89-00	2.67	2.65	2.75	2.73	2.41	2.52	2.49	2.61
00-08	2.31	3.03	2.52	3.25	2.20	3.00	2.45	3.25

*Calculated by CSLS.

Source: GDP is from Statistics Canada CANSIM Table 380-0017 (series v3860085). GNI data are official for 1982-2008 (from CANSIM Table 380-0062, series v44182031). GNI estimates for earlier years are computed by deflating the nominal series (Appendix Table 5) using the final domestic expenditure deflator.

GDI, NDI and NNI are calculated by deflating the nominal series (Appendix Table 5) by the final domestic expenditure deflator. GNP is calculated by deflating the nominal series using the GDP deflator. NDP and NNP are calculated by subtracting real capital consumption allowances (Appendix Table 2) from real GDP and GNP, respectively.

Appendix Table 7: Income and Output Measures for Canada and the US, Billions, 2008

Appendix Table 7a: Comparison of Product and Income Measures, Billions, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	13,312	14,441	1,321	1,600
Gross domestic income	13,157	14,340	1,423	1,600
Difference	156	101	-101	0
Gross national product	13,443	14,583	1,308	1,584
Gross national income	13,286	14,482	1,409	1,584
Difference	157	101	-101	0
Net domestic product	11,597	12,594	1,141	1,393
Net domestic income	11,474	12,493	1,238	1,393
Difference	123	101	-97	0
Net national product	11,728	12,736	1,128	1,377
Net national income	11,603	12,635	1,224	1,377
Difference	124	101	-96	0

Appendix Table 7b: Comparison of National and Domestic Measures, Billions, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	13,443	14,583	1,308	1,584
Gross domestic product	13,312	14,441	1,321	1,600
Difference	130	142	-13	-16
Gross national income	13,286	14,482	1,409	1,584
Gross domestic income	13,157	14,340	1,423	1,600
Difference	129	142	-14	-16
Net national product	11,728	12,736	1,128	1,377
Net domestic product	11,597	12,594	1,141	1,393
Difference	130	142	-13	-16
Net national income	11,603	12,635	1,224	1,377
Net domestic income	11,474	12,493	1,238	1,393
Difference	129	142	-14	-16

Appendix Table 7c: Comparison of Gross and Net Measures, Billions, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	13,312	14,441	1,321	1,600
Net domestic product	11,597	12,594	1,141	1,393
Difference	1,715	1,847	180	208
Gross domestic income	13,157	14,340	1,423	1,600
Net domestic income	11,474	12,493	1,238	1,393
Difference	1,683	1,847	185	208
Gross national product	13,443	14,583	1,308	1,584
Net national product	11,728	12,736	1,128	1,377
Difference	1,715	1,847	180	208
Gross national income	13,286	14,482	1,409	1,584
Net national income	11,603	12,635	1,224	1,377
Difference	1,683	1,847	185	208

Source: Tables 5a, 5b, 6a, 6b

Appendix Table 8: Growth of Income and output measures for Canada and the US, Growth Rate, 2000-2008

Appendix Table 8a: Comparison of Product and Income Measures, Average Annual Growth Rate, Per Cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	2.15	4.76	2.31	5.08
Gross domestic income	1.98	4.50	3.03	5.08
Difference	0.18	0.27	-0.72	0.00
Gross national product	2.23	4.84	2.52	5.30
Gross national income	2.05	4.58	3.25	5.30
Difference	0.18	0.27	-0.73	0.00
Net domestic product	1.94	4.63	2.20	5.05
Net domestic income	1.85	4.33	3.00	5.05
Difference	0.09	0.30	-0.80	0.00
Net national product	2.03	4.72	2.45	5.30
Net national income	1.94	4.42	3.25	5.30
Difference	0.09	0.30	-0.80	0.00

Appendix Table 8b: Comparison of National and Domestic Measures, Average Annual Growth Rate, Per Cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	2.23	4.84	2.52	5.30
Gross domestic product	2.15	4.76	2.31	5.08
Difference	0.08	0.08	0.21	0.22
Gross national income	2.05	4.58	3.25	5.30
Gross domestic income	1.98	4.50	3.03	5.08
Difference	0.08	0.08	0.22	0.22
Net national product	2.03	4.72	2.45	5.30
Net domestic product	1.94	4.63	2.20	5.05
Difference	0.09	0.09	0.24	0.25
Net national income	1.94	4.42	3.25	5.30
Net domestic income	1.85	4.33	3.00	5.05
Difference	0.09	0.09	0.24	0.25

Appendix Table 8c: Comparison of Gross and Net Measures, Average Annual Growth Rate, Per Cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	2.15	4.76	2.31	5.08
Net domestic product	1.94	4.63	2.20	5.05
Difference	0.22	0.13	0.11	0.03
Gross domestic income	1.98	4.50	3.03	5.08
Net domestic income	1.85	4.33	3.00	5.05
Difference	0.13	0.17	0.03	0.03
Gross national product	2.23	4.84	2.52	5.30
Net national product	2.03	4.72	2.45	5.30
Difference	0.20	0.12	0.08	0.00
Gross national income	2.05	4.58	3.25	5.30
Net national income	1.94	4.42	3.25	5.30
Difference	0.12	0.16	0.00	0.00

Source: Tables 5a, 5b, 6a, 6b.

Appendix Table 8: Growth of Income and output measures for Canada and the US, Growth Rate, 1980-2008

Appendix Table 8d: Comparison of Product and Income Measures, Average Annual Growth Rate, Per Cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	2.99	6.05	2.71	5.98
Gross domestic income	2.99	6.09	2.89	5.98
Difference	-0.01	-0.04	-0.18	0.00
Gross national product	2.98	6.04	2.77	6.05
Gross national income	2.99	6.08	2.95	6.05
Difference	-0.01	-0.03	-0.18	0.00
Net domestic product	2.80	6.03	2.55	5.93
Net domestic income	2.98	6.07	2.84	5.93
Difference	-0.17	-0.04	-0.29	0.00
Net national product	2.79	6.02	2.62	6.01
Net national income	2.97	6.06	2.91	6.01
Difference	-0.17	-0.04	-0.29	0.00

Appendix Table 8e: Comparison of National and Domestic Measures, Average Annual Growth Rate, Per Cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	2.98	6.04	2.77	6.05
Gross domestic product	2.99	6.05	2.71	5.98
Difference	-0.01	-0.01	0.06	0.07
Gross national income	2.99	6.08	2.95	6.05
Gross domestic income	2.99	6.09	2.89	5.98
Difference	-0.01	-0.01	0.07	0.07
Net national product	2.79	6.02	2.62	6.01
Net domestic product	2.80	6.03	2.55	5.93
Difference	-0.01	-0.01	0.07	0.08
Net national income	2.97	6.06	2.91	6.01
Net domestic income	2.98	6.07	2.84	5.93
Difference	-0.01	-0.01	0.07	0.08

Appendix Table 8f: Comparison of Gross and Net Measures, Average Annual Growth Rate, Per Cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	2.99	6.05	2.71	5.98
Net domestic product	2.80	6.03	2.55	5.93
Difference	0.18	0.02	0.16	0.05
Gross domestic income	2.99	6.09	2.89	5.98
Net domestic income	2.98	6.07	2.84	5.93
Difference	0.02	0.01	0.05	0.05
Gross national product	2.98	6.04	2.77	6.05
Net national product	2.79	6.02	2.62	6.01
Difference	0.18	0.02	0.15	0.04
Gross national income	2.99	6.08	2.95	6.05
Net national income	2.97	6.06	2.91	6.01
Difference	0.02	0.02	0.04	0.04

Source: Tables 5a, 5b, 6a, 6b.

Appendix Table 9a: Output and Income Per Capita Measures, Current Dollars, United States, 1961-2008

Year	Population, annual average of mid-quarter estimates, thousands	Gross domestic product GDP	Gross domestic income GDI	Gross national product GNP	Gross national income GNI	Net domestic product NDP	Net domestic income NDI	Net national product NNP	Net national income* NNI
1961	183,742	2,965	2,968	2,984	2,987	2,648	2,652	2,667	2,671
1962	186,590	3,139	3,137	3,160	3,159	2,814	2,813	2,836	2,834
1963	189,300	3,264	3,268	3,287	3,292	2,929	2,933	2,952	2,957
1964	191,927	3,458	3,454	3,484	3,479	3,112	3,108	3,138	3,133
1965	194,347	3,700	3,692	3,727	3,720	3,336	3,329	3,364	3,356
1966	196,599	4,007	3,975	4,033	4,001	3,618	3,586	3,643	3,612
1967	198,752	4,188	4,165	4,215	4,193	3,771	3,748	3,798	3,776
1968	200,745	4,532	4,511	4,563	4,541	4,082	4,060	4,112	4,091
1969	202,736	4,856	4,842	4,886	4,872	4,366	4,352	4,397	4,383
1970	205,089	5,063	5,029	5,094	5,060	4,535	4,501	4,566	4,532
1971	207,692	5,425	5,372	5,462	5,409	4,858	4,805	4,895	4,842
1972	209,924	5,897	5,854	5,937	5,895	5,291	5,249	5,332	5,289
1973	211,939	6,522	6,484	6,582	6,544	5,858	5,820	5,917	5,880
1974	213,898	7,010	6,964	7,083	7,037	6,245	6,199	6,317	6,272
1975	215,981	7,583	7,507	7,643	7,567	6,701	6,626	6,761	6,686
1976	218,086	8,366	8,259	8,443	8,336	7,412	7,304	7,489	7,381
1977	220,289	9,216	9,119	9,308	9,212	8,164	8,067	8,256	8,159
1978	222,629	10,303	10,186	10,400	10,283	9,129	9,012	9,226	9,109
1979	225,106	11,382	11,174	11,524	11,316	10,054	9,846	10,197	9,988
1980	227,726	12,243	12,045	12,393	12,194	10,733	10,534	10,882	10,683
1981	230,008	13,594	13,436	13,738	13,579	11,884	11,725	12,027	11,869
1982	232,218	14,009	13,989	14,166	14,146	12,142	12,122	12,300	12,279
1983	234,333	15,084	14,872	15,242	15,030	13,159	12,947	13,317	13,105
1984	236,394	16,629	16,495	16,782	16,648	14,622	14,489	14,775	14,642
1985	238,506	17,683	17,506	17,794	17,617	15,564	15,386	15,675	15,498
1986	240,683	18,531	18,249	18,604	18,322	16,294	16,012	16,367	16,085
1987	242,843	19,504	19,368	19,576	19,441	17,152	17,017	17,225	17,089
1988	245,061	20,813	20,852	20,908	20,947	18,320	18,358	18,415	18,454
1989	247,387	22,160	21,933	22,265	22,038	19,527	19,300	19,632	19,405
1990	250,181	23,185	22,849	23,323	22,987	20,422	20,086	20,560	20,224
1991	253,530	23,635	23,320	23,753	23,438	20,777	20,463	20,895	20,581
1992	256,922	24,686	24,258	24,799	24,371	21,789	21,361	21,902	21,474
1993	260,282	25,616	25,094	25,736	25,214	22,627	22,105	22,746	22,225
1994	263,455	26,893	26,480	26,984	26,572	23,784	23,371	23,875	23,462
1995	266,588	27,813	27,616	27,924	27,727	24,552	24,355	24,663	24,466
1996	269,714	29,062	28,966	29,179	29,083	25,679	25,583	25,796	25,700
1997	272,958	30,526	30,577	30,612	30,663	26,995	27,046	27,081	27,132
1998	276,154	31,843	32,152	31,905	32,214	28,147	28,456	28,210	28,519
1999	279,328	33,486	33,740	33,585	33,840	29,568	29,822	29,667	29,922
2000	282,418	35,237	35,711	35,370	35,845	31,043	31,517	31,177	31,651
2001	285,335	36,050	36,412	36,231	36,593	31,647	32,009	31,829	32,191
2002	288,133	36,935	37,012	37,106	37,182	32,406	32,483	32,577	32,653
2003	290,845	38,309	38,252	38,546	38,489	33,654	33,597	33,890	33,833
2004	293,502	40,435	40,462	40,746	40,772	35,553	35,580	35,864	35,891
2005	296,229	42,664	42,933	42,992	43,261	37,461	37,730	37,789	38,058
2006	299,052	44,805	45,542	45,047	45,784	39,251	39,989	39,494	40,231
2007	302,025	46,611	46,660	46,994	47,043	40,783	40,832	41,166	41,216
2008	304,831	47,375	47,044	47,841	47,509	41,316	40,984	41,781	41,450
Average annual growth rates									
80-08	1.05	4.95	4.99	4.94	4.98	4.93	4.97	4.92	4.96
80-89	0.92	6.81	6.89	6.73	6.80	6.88	6.96	6.78	6.86
80-00	1.08	5.43	5.58	5.38	5.54	5.45	5.63	5.40	5.58
89-00	1.21	4.31	4.53	4.30	4.52	4.30	4.56	4.29	4.55
00-08	0.96	3.77	3.51	3.85	3.58	3.64	3.34	3.73	3.43

*Calculated by CSLS.

Source: Population data are from Bureau of Economic Analysis NIPA Table 2.1.

Per capita measures calculated by CSLS using the population data above and the income and output estimates from Appendix Table 5.

Appendix Table 9b: Output and Income Per Capita Measures, Current Dollars, Canada, 1961-2008

Year	Population, annual average of mid-quarter estimates, millions	Gross domestic product GDP	Gross domestic income GDI	Gross national product GNP	Gross national income GNI	Net domestic product* NDP	Net domestic income* NDI	Net national product* NNP	Net national income* NNI
1961	18,224,500	2,259	2,259	2,219	2,219	1,984	1,984	1,944	1,944
1962	18,570,750	2,405	2,405	2,363	2,363	2,116	2,116	2,075	2,075
1963	18,919,000	2,535	2,535	2,490	2,490	2,233	2,233	2,188	2,188
1964	19,277,250	2,726	2,726	2,678	2,678	2,405	2,405	2,358	2,358
1965	19,633,500	2,951	2,951	2,900	2,900	2,608	2,608	2,556	2,556
1966	19,997,500	3,241	3,241	3,185	3,185	2,870	2,870	2,814	2,814
1967	20,363,750	3,423	3,423	3,362	3,362	3,026	3,026	2,965	2,965
1968	20,692,000	3,679	3,679	3,620	3,620	3,260	3,260	3,201	3,201
1969	20,994,250	3,993	3,993	3,938	3,938	3,541	3,541	3,486	3,486
1970	21,287,500	4,236	4,236	4,173	4,173	3,751	3,751	3,688	3,688
1971	21,747,319	4,526	4,526	4,459	4,459	4,009	4,009	3,942	3,942
1972	22,187,095	4,954	4,954	4,887	4,887	4,404	4,404	4,337	4,337
1973	22,453,742	5,743	5,743	5,662	5,662	5,111	5,111	5,030	5,030
1974	22,772,043	6,764	6,764	6,663	6,663	6,010	6,010	5,908	5,908
1975	23,103,010	7,515	7,515	7,400	7,400	6,663	6,663	6,549	6,549
1976	23,414,354	8,542	8,542	8,387	8,387	7,582	7,582	7,428	7,428
1977	23,693,935	9,326	9,326	9,128	9,128	8,275	8,275	8,077	8,077
1978	23,935,460	10,231	10,231	9,976	9,976	9,069	9,069	8,814	8,814
1979	24,170,164	11,567	11,567	11,251	11,251	10,240	10,240	9,924	9,924
1980	24,470,715	12,848	12,848	12,498	12,498	11,327	11,327	10,978	10,978
1981	24,784,554	14,544	14,544	14,055	14,055	12,809	12,809	12,319	12,319
1982	25,082,945	15,144	15,144	14,616	14,616	13,282	13,282	12,753	12,753
1983	25,335,951	16,237	16,237	15,754	15,754	14,278	14,278	13,795	13,795
1984	25,576,735	17,578	17,578	17,024	17,024	15,493	15,493	14,939	14,939
1985	25,813,200	18,816	18,816	18,232	18,232	16,555	16,555	15,971	15,971
1986	26,067,487	19,662	19,662	18,993	18,993	17,259	17,259	16,590	16,590
1987	26,397,870	21,174	21,174	20,518	20,518	18,664	18,664	18,009	18,009
1988	26,751,474	22,918	22,918	22,178	22,178	20,284	20,284	19,543	19,543
1989	27,214,902	24,168	24,168	23,340	23,340	21,378	21,378	20,549	20,549
1990	27,632,360	24,606	24,606	23,721	23,721	21,630	21,630	20,745	20,745
1991	27,987,111	24,489	24,489	23,672	23,672	21,419	21,419	20,603	20,603
1992	28,324,154	24,731	24,731	23,834	23,834	21,568	21,568	20,672	20,672
1993	28,651,462	25,380	25,380	24,502	24,502	22,098	22,098	21,220	21,220
1994	28,960,064	26,618	26,618	25,652	25,652	23,178	23,178	22,212	22,212
1995	29,263,007	27,695	27,695	26,719	26,719	24,106	24,106	23,130	23,130
1996	29,569,875	28,301	28,301	27,343	27,343	24,554	24,554	23,596	23,596
1997	29,867,572	29,555	29,555	28,627	28,627	25,652	25,652	24,724	24,724
1998	30,123,875	30,374	30,374	29,364	29,364	26,302	26,302	25,292	25,292
1999	30,367,051	32,352	32,352	31,258	31,258	28,104	28,104	27,010	27,010
2000	30,647,400	35,128	35,128	34,213	34,213	30,644	30,644	29,729	29,729
2001	30,970,939	35,777	35,777	34,765	34,765	31,013	31,013	30,001	30,001
2002	31,306,199	36,827	36,827	35,905	35,905	31,858	31,858	30,935	30,935
2003	31,599,552	38,392	38,392	37,487	37,487	33,271	33,271	32,367	32,367
2004	31,900,398	40,467	40,467	39,642	39,642	35,206	35,206	34,381	34,381
2005	32,204,674	42,660	42,660	41,860	41,860	37,187	37,187	36,388	36,388
2006	32,532,462	44,547	44,547	44,099	44,099	38,848	38,848	38,400	38,400
2007	32,881,904	46,620	46,620	46,031	46,031	40,668	40,668	40,079	40,079
2008	33,260,314	48,108	48,108	47,636	47,636	41,869	41,869	41,397	41,397
Average annual growth rates									
80-08	1.10	4.83	4.83	4.89	4.89	4.78	4.78	4.85	4.85
80-89	1.19	7.27	7.27	7.19	7.19	7.31	7.31	7.21	7.21
80-00	1.13	5.16	5.16	5.16	5.16	5.10	5.10	5.11	5.11
89-00	1.09	3.46	3.46	3.54	3.54	3.33	3.33	3.41	3.41
00-08	1.03	4.01	4.01	4.22	4.22	3.98	3.98	4.23	4.23

*Calculated by CSLS.

Source: Population data are from Statistics Canada CANSIM Table 051-0005 (series v1).

Per capita measures calculated by CSLS using the population data above and the income and output estimates from Appendix Table 5.

Appendix Table 10a: Output and Income Measures Per Capita, Chained 2005$, United States, 1961-2008

Year	Population, annual average of mid-quarter estimates, thousands	Gross domestic product GDP	Gross domestic income GDI	Gross national product GNP	Gross national income GNI	Net domestic product NDP	Net domestic income NDI	Net national product NNP	Net national income* NNI
1961	183,742	15,766	16,104	15,884	16,207	14,649	14,383	14,769	14,487
1962	186,590	16,466	16,827	16,597	16,942	15,346	15,086	15,478	15,204
1963	189,300	16,940	17,294	17,078	17,417	15,795	15,519	15,935	15,645
1964	191,927	17,675	18,032	17,821	18,167	16,509	16,230	16,658	16,363
1965	194,347	18,576	18,968	18,727	19,108	17,377	17,103	17,530	17,243
1966	196,599	19,559	19,979	19,701	20,109	18,312	18,039	18,455	18,168
1967	198,752	19,836	20,294	19,980	20,426	18,515	18,273	18,660	18,405
1968	200,745	20,590	21,072	20,743	21,213	19,215	18,978	19,371	19,119
1969	202,736	21,021	21,520	21,168	21,653	19,581	19,351	19,730	19,487
1970	205,089	20,820	21,291	20,964	21,423	19,309	19,071	19,455	19,202
1971	207,692	21,249	21,701	21,407	21,848	19,709	19,433	19,868	19,579
1972	209,924	22,140	22,583	22,308	22,738	20,571	20,263	20,741	20,419
1973	211,939	23,200	23,611	23,424	23,827	21,568	21,206	21,796	21,422
1974	213,898	22,861	23,016	23,114	23,254	21,127	20,503	21,385	20,741
1975	215,981	22,592	22,771	22,786	22,951	20,783	20,123	20,981	20,304
1976	218,086	23,575	23,763	23,803	23,982	21,746	21,051	21,979	21,271
1977	220,289	24,412	24,519	24,666	24,764	22,536	21,720	22,796	21,964
1978	222,629	25,503	25,597	25,752	25,837	23,573	22,679	23,827	22,920
1979	225,106	26,010	25,989	26,344	26,313	23,982	22,957	24,324	23,281
1980	227,726	25,640	25,292	25,967	25,602	23,486	22,171	23,821	22,481
1981	230,008	26,030	25,716	26,314	25,987	23,795	22,481	24,085	22,752
1982	232,218	25,282	25,080	25,576	25,361	22,906	21,738	23,205	22,019
1983	234,333	26,186	26,089	26,468	26,362	23,765	22,759	24,053	23,033
1984	236,394	27,823	27,782	28,088	28,038	25,353	24,429	25,623	24,686
1985	238,506	28,718	28,728	28,905	28,909	26,121	25,285	26,310	25,466
1986	240,683	29,443	29,439	29,568	29,555	26,734	25,884	26,858	26,000
1987	242,843	30,115	30,042	30,234	30,153	27,291	26,419	27,410	26,531
1988	245,061	31,069	30,990	31,218	31,132	28,153	27,278	28,302	27,420
1989	247,387	31,877	31,791	32,031	31,941	28,860	28,013	29,014	28,163
1990	250,181	32,112	31,962	32,304	32,152	28,993	28,153	29,186	28,343
1991	253,530	31,614	31,548	31,774	31,705	28,416	27,734	28,576	27,891
1992	256,922	32,255	32,175	32,408	32,322	29,016	28,399	29,170	28,546
1993	260,282	32,747	32,699	32,900	32,852	29,439	28,883	29,592	29,036
1994	263,455	33,671	33,633	33,784	33,747	30,275	29,744	30,388	29,858
1995	266,588	34,111	34,054	34,245	34,190	30,596	30,061	30,729	30,197
1996	269,714	34,977	34,952	35,115	35,093	31,320	30,882	31,459	31,024
1997	272,958	36,102	36,170	36,203	36,271	32,277	31,986	32,378	32,088
1998	276,154	37,238	37,479	37,313	37,553	33,201	33,129	33,275	33,203
1999	279,328	38,592	38,800	38,708	38,915	34,313	34,260	34,429	34,375
2000	282,418	39,750	39,832	39,901	39,983	35,218	35,092	35,370	35,243
2001	285,335	39,768	40,000	39,969	40,202	35,036	35,115	35,237	35,317
2002	288,133	40,096	40,401	40,283	40,587	35,238	35,447	35,425	35,633
2003	290,845	40,711	40,951	40,964	41,203	35,756	35,974	36,009	36,227
2004	293,502	41,784	41,945	42,107	42,268	36,714	36,881	37,036	37,203
2005	296,229	42,664	42,664	42,992	42,992	37,461	37,461	37,789	37,789
2006	299,052	43,391	43,340	43,625	43,574	38,046	37,968	38,280	38,203
2007	302,025	43,884	43,804	44,244	44,164	38,387	38,327	38,747	38,687
2008	304,831	43,671	43,160	44,099	43,585	38,044	37,640	38,472	38,064
Average annual growth rates									
80-08	1.05	1.92	1.93	1.91	1.92	1.74	1.91	1.73	1.90
80-89	0.92	2.45	2.57	2.36	2.49	2.32	2.63	2.22	2.54
80-00	1.08	2.22	2.30	2.17	2.25	2.05	2.32	2.00	2.27
89-00	1.21	2.03	2.07	2.02	2.06	1.83	2.07	1.82	2.06
00-08	0.96	1.18	1.01	1.26	1.08	0.97	0.88	1.06	0.97

*Calculated by CSLS.

Source: Population data are from Bureau of Economic Analysis NIPA Table 2.1.

Per capita measures calculated by CSLS using the population data above and the income and output estimates from Appendix Table 6.

Appendix Table 10b: Output and Income Measures, Chained 2002$, Canada, 1961-2008

Year	Population, annual average of mid-quarter estimates	Gross domestic product GDP	Gross domestic income* GDI	Gross national product* GNP	Gross national income GNI	Net domestic product* NDP	Net domestic income* NDI	Net national product* NNP	Net national income* NNI
1961	18,224,500	14,512	14,415	14,257	14,162	13,122	12,660	12,866	12,406
1962	18,570,750	15,238	15,137	14,973	14,875	13,793	13,319	13,529	13,056
1963	18,919,000	15,751	15,615	15,471	15,337	14,273	13,754	13,993	13,476
1964	19,277,250	16,459	16,335	16,172	16,050	14,937	14,415	14,651	14,130
1965	19,633,500	17,189	17,099	16,892	16,803	15,641	15,111	15,344	14,815
1966	19,997,500	17,998	17,967	17,686	17,656	16,404	15,909	16,092	15,597
1967	20,363,750	18,189	18,167	17,866	17,843	16,539	16,062	16,215	15,738
1968	20,692,000	18,774	18,700	18,475	18,402	17,051	16,568	16,751	16,270
1969	20,994,250	19,435	19,294	19,168	19,029	17,659	17,111	17,392	16,846
1970	21,287,500	19,749	19,660	19,455	19,368	17,914	17,407	17,621	17,115
1971	21,747,319	20,127	19,984	19,829	19,688	18,273	17,702	17,975	17,406
1972	22,187,095	20,802	20,748	20,523	20,469	18,938	18,443	18,659	18,165
1973	22,453,742	21,987	22,257	21,678	21,944	20,048	19,806	19,739	19,493
1974	22,772,043	22,480	23,250	22,143	22,901	20,508	20,656	20,171	20,308
1975	23,103,010	22,562	23,156	22,217	22,802	20,552	20,532	20,208	20,178
1976	23,414,354	23,419	24,169	22,996	23,733	21,291	21,455	20,868	21,018
1977	23,693,935	23,943	24,514	23,436	23,994	21,736	21,751	21,229	21,231
1978	23,935,460	24,639	24,959	24,026	24,339	22,362	22,125	21,750	21,504
1979	24,170,164	25,328	25,893	24,636	25,186	22,929	22,923	22,238	22,216
1980	24,470,715	25,558	26,216	24,863	25,503	23,052	23,113	22,357	22,400
1981	24,784,554	26,118	26,596	25,239	25,700	23,568	23,422	22,689	22,527
1982	25,082,945	25,069	25,399	24,195	24,523	22,504	22,275	21,630	21,389
1983	25,335,951	25,494	25,866	24,735	25,084	22,842	22,744	22,084	21,975
1984	25,576,735	26,722	26,980	25,880	26,130	23,979	23,781	23,136	22,930
1985	25,813,200	27,743	27,907	26,882	27,041	24,833	24,554	23,971	23,688
1986	26,067,487	28,137	28,119	27,180	27,162	25,121	24,682	24,164	23,725
1987	26,397,870	28,967	29,195	28,070	28,284	25,924	25,735	25,027	24,831
1988	26,751,474	30,006	30,436	29,037	29,441	26,915	26,937	25,945	25,954
1989	27,214,902	30,268	30,856	29,230	29,786	27,098	27,293	26,060	26,236
1990	27,632,360	29,868	30,275	28,794	29,183	26,529	26,613	25,456	25,524
1991	27,987,111	28,872	29,110	27,909	28,142	25,365	25,461	24,402	24,490
1992	28,324,154	28,778	28,900	27,735	27,852	25,179	25,204	24,136	24,156
1993	28,651,462	29,115	29,081	28,107	28,079	25,450	25,320	24,442	24,314
1994	28,960,064	30,189	30,103	29,092	29,007	26,454	26,212	25,358	25,119
1995	29,263,007	30,715	30,961	29,633	29,870	26,850	26,949	25,768	25,858
1996	29,569,875	30,888	31,315	29,843	30,247	26,869	27,169	25,823	26,108
1997	29,867,572	31,873	32,221	30,872	31,198	27,734	27,966	26,734	26,955
1998	30,123,875	32,896	32,730	31,803	31,646	28,643	28,343	27,549	27,254
1999	30,367,051	34,438	34,436	33,273	33,272	29,988	29,914	28,823	28,749
2000	30,647,400	35,909	36,544	34,974	35,584	31,273	31,879	30,338	30,928
2001	30,970,939	36,168	36,572	35,144	35,540	31,306	31,703	30,283	30,668
2002	31,306,199	36,827	36,836	35,905	35,906	31,858	31,865	30,935	30,943
2003	31,599,552	37,171	37,890	36,295	36,993	32,030	32,836	31,154	31,943
2004	31,900,398	37,969	39,298	37,196	38,495	32,800	34,189	32,026	33,388
2005	32,204,674	38,746	40,590	38,020	39,828	33,478	35,383	32,752	34,622
2006	32,532,462	39,450	41,400	39,054	40,980	34,151	36,104	33,754	35,687
2007	32,881,904	40,019	42,410	39,514	41,873	34,656	36,996	34,151	36,461
2008	33,260,314	39,728	42,772	39,338	42,360	34,305	37,225	33,915	36,805
Average annual growth rates									
80-08	1.10	1.59	1.76	1.65	1.83	1.43	1.72	1.50	1.79
80-89	1.19	1.90	1.83	1.81	1.74	1.81	1.86	1.72	1.77
80-00	1.13	1.71	1.67	1.72	1.68	1.54	1.62	1.54	1.63
89-00	1.09	1.57	1.55	1.64	1.63	1.31	1.42	1.39	1.51
00-08	1.03	1.27	1.99	1.48	2.20	1.16	1.96	1.40	2.20

*Calculated by CSLS.

Source: Population data are from Statistics Canada CANSIM Table 051-0005 (series v1).

Per capita measures calculated by CSLS using the population data above and the income and output estimates from Appendix Table 6.

Appendix Table 11: Income and Output Measures Per Capita for Canada and the US, 2008

Appendix Table 11a: Comparison of Product and Income Measures Per Capita, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	43,671	47,375	39,728	48,108
Gross domestic income	43,160	47,044	42,772	48,108
Difference	510	331	-3,044	0
Gross national product	44,099	47,841	39,338	47,636
Gross national income	43,585	47,509	42,360	47,636
Difference	514	331	-3,022	0
Net domestic product	38,044	41,316	34,305	41,869
Net domestic income	37,640	40,984	37,225	41,869
Difference	404	331	-2,920	0
Net national product	38,472	41,781	33,915	41,397
Net national income	38,064	41,450	36,805	41,397
Difference	408	331	-2,890	0

Appendix Table 11b: Comparison of National and Domestic Measures Per Capita, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	44,099	47,841	39,338	47,636
Gross domestic product	43,671	47,375	39,728	48,108
Difference	428	466	-390	-472
Gross national income	43,585	47,509	42,360	47,636
Gross domestic income	43,160	47,044	42,772	48,108
Difference	424	466	-412	-472
Net national product	38,472	41,781	33,915	41,397
Net domestic product	38,044	41,316	34,305	41,869
Difference	428	466	-390	-472
Net national income	38,064	41,450	36,805	41,397
Net domestic income	37,640	40,984	37,225	41,869
Difference	424	466	-420	-472

Appendix Table 11c: Comparison of Gross and Net Measures Per Capita, 2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	43,671	47,375	39,728	48,108
Net domestic product	38,044	41,316	34,305	41,869
Difference	5,626	6,059	5,423	6,239
Gross domestic income	43,160	47,044	42,772	48,108
Net domestic income	37,640	40,984	37,225	41,869
Difference	5,520	6,059	5,547	6,239
Gross national product	44,099	47,841	39,338	47,636
Net national product	38,472	41,781	33,915	41,397
Difference	5,626	6,059	5,423	6,239
Gross national income	43,585	47,509	42,360	47,636
Net national income	38,064	41,450	36,805	41,397
Difference	5,520	6,059	5,555	6,239

Source: Tables 9a, 9b, 10a, 10b

Appendix Table 12: Income and Output Measures Per Capita for Canada and the US, Average Annual Growth, 2000-2008

Appendix Table 12a: Comparison of Product and Income Measures Per Capita, Average Annual Growth, Per Cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	1.18	3.77	1.27	4.01
Gross domestic income	1.01	3.51	1.99	4.01
Difference	0.17	0.26	-0.72	0.00
Gross national product	1.26	3.85	1.48	4.22
Gross national income	1.08	3.58	2.20	4.22
Difference	0.17	0.26	-0.72	0.00
Net domestic product	0.97	3.64	1.16	3.98
Net domestic income	0.88	3.34	1.96	3.98
Difference	0.09	0.30	-0.79	0.00
Net national product	1.06	3.73	1.40	4.23
Net national income	0.97	3.43	2.20	4.23
Difference	0.09	0.30	-0.80	0.00

Appendix Table 12b: Comparison of National and Domestic Measures Per Capita, Average Annual Growth, Per Cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	1.26	3.85	1.48	4.22
Gross domestic product	1.18	3.77	1.27	4.01
Difference	0.08	0.08	0.21	0.22
Gross national income	1.08	3.58	2.20	4.22
Gross domestic income	1.01	3.51	1.99	4.01
Difference	0.08	0.08	0.22	0.22
Net national product	1.06	3.73	1.40	4.23
Net domestic product	0.97	3.64	1.16	3.98
Difference	0.09	0.09	0.24	0.25
Net national income	0.97	3.43	2.20	4.23
Net domestic income	0.88	3.34	1.96	3.98
Difference	0.09	0.09	0.24	0.25

Appendix Table 12c: Comparison of Gross and Net Measures Per Capita, Average Annual Growth, Per cent, 2000-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	1.18	3.77	1.27	4.01
Net domestic product	0.97	3.64	1.16	3.98
Difference	0.21	0.13	0.11	0.03
Gross domestic income	1.01	3.51	1.99	4.01
Net domestic income	0.88	3.34	1.96	3.98
Difference	0.13	0.17	0.03	0.03
Gross national product	1.26	3.85	1.48	4.22
Net national product	1.06	3.73	1.40	4.23
Difference	0.20	0.12	0.08	0.00
Gross national income	1.08	3.58	2.20	4.22
Net national income	0.97	3.43	2.20	4.23
Difference	0.12	0.16	0.00	0.00

Source: Tables 9a, 9b, 10a, 10b

Appendix Table 12: Income and Output Measures Per Capita for Canada and the US, Average Annual Growth, 1980-2008

Appendix Table 12d: Comparison of Product and Income Measures Per Capita, Average Annual Growth, Per Cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	1.92	4.95	1.59	4.83
Gross domestic income	1.93	4.99	1.76	4.83
Difference	-0.01	-0.03	-0.18	0.00
Gross national product	1.91	4.94	1.65	4.89
Gross national income	1.92	4.98	1.83	4.89
Difference	-0.01	-0.03	-0.18	0.00
Net domestic product	1.74	4.93	1.43	4.78
Net domestic income	1.91	4.97	1.72	4.78
Difference	-0.17	-0.04	-0.29	0.00
Net national product	1.73	4.92	1.50	4.85
Net national income	1.90	4.96	1.79	4.85
Difference	-0.17	-0.04	-0.29	0.00

Appendix Table 12e: Comparison of National and Domestic Measures Per Capita, Average Annual Growth, Per Cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross national product	1.91	4.94	1.65	4.89
Gross domestic product	1.92	4.95	1.59	4.83
Difference	-0.01	-0.01	0.06	0.07
Gross national income	1.92	4.98	1.83	4.89
Gross domestic income	1.93	4.99	1.76	4.83
Difference	-0.01	-0.01	0.07	0.07
Net national product	1.73	4.92	1.50	4.85
Net domestic product	1.74	4.93	1.43	4.78
Difference	-0.01	-0.01	0.07	0.07
Net national income	1.90	4.96	1.79	4.85
Net domestic income	1.91	4.97	1.72	4.78
Difference	-0.01	-0.01	0.07	0.07

Appendix Table 12f: Comparison of Gross and Net Measures Per Capita, Average Annual Growth, Per cent, 1980-2008

	US		Canada	
	Chained 2005$	Current dollars	Chained 2002$	Current dollars
Gross domestic product	1.92	4.95	1.59	4.83
Net domestic product	1.74	4.93	1.43	4.78
Difference	0.18	0.02	0.16	0.05
Gross domestic income	1.93	4.99	1.76	4.83
Net domestic income	1.91	4.97	1.72	4.78
Difference	0.02	0.01	0.05	0.05
Gross national product	1.91	4.94	1.65	4.89
Net national product	1.73	4.92	1.50	4.85
Difference	0.18	0.02	0.15	0.04
Gross national income	1.92	4.98	1.83	4.89
Net national income	1.90	4.96	1.79	4.85
Difference	0.02	0.02	0.04	0.04

Source: Tables 9a, 9b, 10a, 10b

Appendix Table 13: Purchasing Power Parity, Canada, 1961-2008

	Purchasing Power Parity CA$ per US$
1961	0.949
1962	0.942
1963	0.948
1964	0.957
1965	0.964
1966	0.978
1967	0.992
1968	0.981
1969	0.974
1970	0.971
1971	0.969
1972	0.984
1973	1.023
1974	1.080
1975	1.092
1976	1.131
1977	1.136
1978	1.132
1979	1.149
1980	1.159
1981	1.174
1982	1.200
1983	1.217
1984	1.212
1985	1.212
1986	1.222
1987	1.242
1988	1.254
1989	1.263
1990	1.255
1991	1.248
1992	1.235
1993	1.226
1994	1.214
1995	1.216
1996	1.213
1997	1.206
1998	1.188
1999	1.191
2000	1.232
2001	1.218
2002	1.229
2003	1.226
2004	1.230
2005	1.214
2006	1.205
2007	1.209
2008	1.231
Average a	
80-08	0.21
80-89	0.96
80-00	0.31
89-00	-0.23
00-08	-0.01

Source: OECD National Accounts, Main Aggregates, Table 4, series PPPGDP.
http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE4

Appendix Table 14: Nominal Canadian Income and Output Measures Per Capita in Current US Dollars at PPP, 1961-2008

	Gross domestic product	Gross domestic income	Gross national product	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	2,381	2,381	2,340	2,340	2,091	2,091	2,050	2,050
1962	2,554	2,554	2,510	2,510	2,247	2,247	2,203	2,203
1963	2,674	2,674	2,626	2,626	2,355	2,355	2,308	2,308
1964	2,848	2,848	2,798	2,798	2,513	2,513	2,463	2,463
1965	3,061	3,061	3,008	3,008	2,705	2,705	2,652	2,652
1966	3,315	3,315	3,258	3,258	2,935	2,935	2,878	2,878
1967	3,449	3,449	3,388	3,388	3,050	3,050	2,988	2,988
1968	3,752	3,752	3,692	3,692	3,324	3,324	3,264	3,264
1969	4,097	4,097	4,041	4,041	3,634	3,634	3,577	3,577
1970	4,364	4,364	4,299	4,299	3,864	3,864	3,799	3,799
1971	4,669	4,669	4,600	4,600	4,136	4,136	4,067	4,067
1972	5,033	5,033	4,966	4,966	4,474	4,474	4,407	4,407
1973	5,614	5,614	5,535	5,535	4,996	4,996	4,917	4,917
1974	6,262	6,262	6,168	6,168	5,563	5,563	5,469	5,469
1975	6,880	6,880	6,774	6,774	6,100	6,100	5,995	5,995
1976	7,549	7,549	7,412	7,412	6,701	6,701	6,565	6,565
1977	8,209	8,209	8,035	8,035	7,284	7,284	7,110	7,110
1978	9,040	9,040	8,815	8,815	8,013	8,013	7,788	7,788
1979	10,068	10,068	9,793	9,793	8,913	8,913	8,638	8,638
1980	11,086	11,086	10,785	10,785	9,774	9,774	9,473	9,473
1981	12,391	12,391	11,974	11,974	10,912	10,912	10,495	10,495
1982	12,618	12,618	12,178	12,178	11,066	11,066	10,626	10,626
1983	13,339	13,339	12,942	12,942	11,729	11,729	11,333	11,333
1984	14,507	14,507	14,050	14,050	12,787	12,787	12,329	12,329
1985	15,521	15,521	15,039	15,039	13,656	13,656	13,174	13,174
1986	16,094	16,094	15,546	15,546	14,127	14,127	13,579	13,579
1987	17,054	17,054	16,526	16,526	15,033	15,033	14,505	14,505
1988	18,276	18,276	17,686	17,686	16,175	16,175	15,585	15,585
1989	19,134	19,134	18,478	18,478	16,925	16,925	16,269	16,269
1990	19,611	19,611	18,906	18,906	17,239	17,239	16,534	16,534
1991	19,629	19,629	18,975	18,975	17,169	17,169	16,515	16,515
1992	20,030	20,030	19,304	19,304	17,469	17,469	16,743	16,743
1993	20,709	20,709	19,992	19,992	18,031	18,031	17,314	17,314
1994	21,922	21,922	21,126	21,126	19,089	19,089	18,293	18,293
1995	22,767	22,767	21,965	21,965	19,817	19,817	19,015	19,015
1996	23,333	23,333	22,544	22,544	20,244	20,244	19,454	19,454
1997	24,504	24,504	23,735	23,735	21,268	21,268	20,499	20,499
1998	25,577	25,577	24,727	24,727	22,148	22,148	21,298	21,298
1999	27,168	27,168	26,249	26,249	23,601	23,601	22,682	22,682
2000	28,521	28,521	27,778	27,778	24,880	24,880	24,137	24,137
2001	29,377	29,377	28,546	28,546	25,466	25,466	24,635	24,635
2002	29,957	29,957	29,207	29,207	25,914	25,914	25,164	25,164
2003	31,308	31,308	30,570	30,570	27,132	27,132	26,394	26,394
2004	32,887	32,887	32,217	32,217	28,612	28,612	27,941	27,941
2005	35,150	35,150	34,491	34,491	30,641	30,641	29,982	29,982
2006	36,953	36,953	36,582	36,582	32,225	32,225	31,854	31,854
2007	38,558	38,558	38,072	38,072	33,635	33,635	33,149	33,149
2008	39,093	39,093	38,709	38,709	34,023	34,023	33,639	33,639
Average annual growth rates								
80-08	4.60	4.60	4.67	4.67	4.56	4.56	4.63	4.63
80-89	6.25	6.25	6.17	6.17	6.29	6.29	6.19	6.19
80-00	4.84	4.84	4.84	4.84	4.78	4.78	4.79	4.79
89-00	3.70	3.70	3.78	3.78	3.56	3.56	3.65	3.65
00-08	4.02	4.02	4.24	4.24	3.99	3.99	4.24	4.24

Source: Appendix Tables 9 and 13

*Underlying measures were calculated by CSLS. See Appendix Table 5.

Appendix Table 15: Nominal Canadian Income and Output Measures Per Capita as a Proportion of United States Levels, Per Cent, 1961-2008

	Gross domestic product	Gross domestic income	Gross national product	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	80.3	80.2	78.4	78.3	79.0	78.9	76.8	76.7
1962	81.4	81.4	79.4	79.5	79.9	79.9	77.7	77.7
1963	81.9	81.8	79.9	79.8	80.4	80.3	78.2	78.0
1964	82.4	82.4	80.3	80.4	80.7	80.8	78.5	78.6
1965	82.7	82.9	80.7	80.9	81.1	81.3	78.9	79.0
1966	82.7	83.4	80.8	81.4	81.1	81.8	79.0	79.7
1967	82.4	82.8	80.4	80.8	80.9	81.4	78.7	79.1
1968	82.8	83.2	80.9	81.3	81.4	81.9	79.4	79.8
1969	84.4	84.6	82.7	82.9	83.2	83.5	81.4	81.6
1970	86.2	86.8	84.4	85.0	85.2	85.8	83.2	83.8
1971	86.1	86.9	84.2	85.0	85.1	86.1	83.1	84.0
1972	85.4	86.0	83.6	84.2	84.6	85.2	82.6	83.3
1973	86.1	86.6	84.1	84.6	85.3	85.8	83.1	83.6
1974	89.3	89.9	87.1	87.6	89.1	89.7	86.6	87.2
1975	90.7	91.6	88.6	89.5	91.0	92.1	88.7	89.7
1976	90.2	91.4	87.8	88.9	90.4	91.7	87.7	88.9
1977	89.1	90.0	86.3	87.2	89.2	90.3	86.1	87.1
1978	87.7	88.7	84.8	85.7	87.8	88.9	84.4	85.5
1979	88.5	90.1	85.0	86.5	88.6	90.5	84.7	86.5
1980	90.5	92.0	87.0	88.4	91.1	92.8	87.0	88.7
1981	91.1	92.2	87.2	88.2	91.8	93.1	87.3	88.4
1982	90.1	90.2	86.0	86.1	91.1	91.3	86.4	86.5
1983	88.4	89.7	84.9	86.1	89.1	90.6	85.1	86.5
1984	87.2	87.9	83.7	84.4	87.4	88.3	83.4	84.2
1985	87.8	88.7	84.5	85.4	87.7	88.8	84.0	85.0
1986	86.8	88.2	83.6	84.8	86.7	88.2	83.0	84.4
1987	87.4	88.1	84.4	85.0	87.6	88.3	84.2	84.9
1988	87.8	87.6	84.6	84.4	88.3	88.1	84.6	84.5
1989	86.3	87.2	83.0	83.8	86.7	87.7	82.9	83.8
1990	84.6	85.8	81.1	82.2	84.4	85.8	80.4	81.8
1991	83.1	84.2	79.9	81.0	82.6	83.9	79.0	80.2
1992	81.1	82.6	77.8	79.2	80.2	81.8	76.4	78.0
1993	80.8	82.5	77.7	79.3	79.7	81.6	76.1	77.9
1994	81.5	82.8	78.3	79.5	80.3	81.7	76.6	78.0
1995	81.9	82.4	78.7	79.2	80.7	81.4	77.1	77.7
1996	80.3	80.6	77.3	77.5	78.8	79.1	75.4	75.7
1997	80.3	80.1	77.5	77.4	78.8	78.6	75.7	75.6
1998	80.3	79.6	77.5	76.8	78.7	77.8	75.5	74.7
1999	81.1	80.5	78.2	77.6	79.8	79.1	76.5	75.8
2000	80.9	79.9	78.5	77.5	80.1	78.9	77.4	76.3
2001	81.5	80.7	78.8	78.0	80.5	79.6	77.4	76.5
2002	81.1	80.9	78.7	78.5	80.0	79.8	77.2	77.1
2003	81.7	81.8	79.3	79.4	80.6	80.8	77.9	78.0
2004	81.3	81.3	79.1	79.0	80.5	80.4	77.9	77.9
2005	82.4	81.9	80.2	79.7	81.8	81.2	79.3	78.8
2006	82.5	81.1	81.2	79.9	82.1	80.6	80.7	79.2
2007	82.7	82.6	81.0	80.9	82.5	82.4	80.5	80.4
2008	82.5	83.1	80.9	81.5	82.3	83.0	80.5	81.2
Average annual growth rates								
80-08	-0.33	-0.36	-0.26	-0.29	-0.36	-0.40	-0.28	-0.32
80-89	-0.53	-0.59	-0.53	-0.59	-0.55	-0.63	-0.54	-0.62
80-00	-0.56	-0.71	-0.51	-0.66	-0.64	-0.80	-0.58	-0.75
89-00	-0.59	-0.80	-0.50	-0.71	-0.71	-0.95	-0.62	-0.86
00-08	0.24	0.50	0.37	0.63	0.34	0.63	0.49	0.78

Source: Appendix Tables 9 and 14.

*Underlying measures were calculated by CSLS. See Appendix Table 5.

Appendix Table 16: Real Canadian Income and Output Measures Per Capita in 2002 US dollars at PPP, 1961-2008

	Gross domestic product	Gross domestic income*	Gross national product*	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	11,805	11,726	11,597	11,520	10,674	10,298	10,466	10,092
1962	12,395	12,313	12,180	12,100	11,220	10,834	11,005	10,621
1963	12,812	12,702	12,585	12,476	11,610	11,188	11,383	10,962
1964	13,389	13,288	13,155	13,056	12,151	11,726	11,917	11,494
1965	13,983	13,909	13,741	13,669	12,723	12,292	12,481	12,052
1966	14,640	14,615	14,387	14,362	13,344	12,941	13,090	12,688
1967	14,796	14,778	14,533	14,515	13,453	13,065	13,190	12,802
1968	15,272	15,212	15,028	14,969	13,870	13,478	13,626	13,235
1969	15,810	15,695	15,592	15,479	14,365	13,919	14,147	13,703
1970	16,064	15,993	15,826	15,755	14,572	14,160	14,333	13,922
1971	16,372	16,256	16,130	16,015	14,864	14,399	14,622	14,159
1972	16,922	16,877	16,695	16,651	15,405	15,003	15,178	14,776
1973	17,885	18,105	17,634	17,851	16,308	16,111	16,057	15,856
1974	18,286	18,912	18,012	18,629	16,682	16,803	16,408	16,519
1975	18,353	18,836	18,072	18,548	16,718	16,702	16,438	16,414
1976	19,050	19,660	18,706	19,305	17,319	17,452	16,975	17,097
1977	19,477	19,941	19,064	19,518	17,681	17,693	17,269	17,271
1978	20,042	20,303	19,544	19,798	18,191	17,997	17,692	17,493
1979	20,603	21,063	20,040	20,488	18,652	18,647	18,089	18,071
1980	20,790	21,325	20,225	20,745	18,752	18,801	18,187	18,221
1981	21,246	21,634	20,530	20,906	19,171	19,053	18,456	18,325
1982	20,393	20,661	19,681	19,948	18,306	18,120	17,595	17,399
1983	20,738	21,040	20,121	20,404	18,581	18,501	17,964	17,875
1984	21,737	21,947	21,052	21,255	19,505	19,345	18,820	18,653
1985	22,567	22,701	21,867	21,997	20,200	19,973	19,500	19,269
1986	22,888	22,873	22,109	22,095	20,435	20,078	19,656	19,299
1987	23,563	23,749	22,834	23,008	21,088	20,934	20,359	20,199
1988	24,408	24,758	23,620	23,949	21,894	21,912	21,105	21,112
1989	24,621	25,100	23,777	24,230	22,043	22,202	21,199	21,342
1990	24,296	24,627	23,422	23,739	21,580	21,648	20,707	20,763
1991	23,486	23,679	22,703	22,892	20,633	20,711	19,850	19,922
1992	23,410	23,508	22,561	22,656	20,482	20,502	19,633	19,650
1993	23,683	23,656	22,864	22,841	20,702	20,597	19,882	19,778
1994	24,557	24,487	23,665	23,595	21,519	21,322	20,628	20,433
1995	24,985	25,185	24,105	24,297	21,841	21,921	20,961	21,034
1996	25,126	25,473	24,275	24,604	21,857	22,100	21,006	21,238
1997	25,927	26,210	25,113	25,378	22,560	22,749	21,746	21,926
1998	26,760	26,624	25,870	25,742	23,299	23,055	22,410	22,170
1999	28,014	28,012	27,066	27,065	24,394	24,334	23,446	23,386
2000	29,210	29,727	28,449	28,946	25,439	25,932	24,678	25,158
2001	29,421	29,750	28,588	28,910	25,466	25,789	24,634	24,947
2002	29,957	29,964	29,207	29,208	25,914	25,921	25,164	25,171
2003	30,237	30,822	29,524	30,092	26,055	26,711	25,342	25,984
2004	30,886	31,967	30,257	31,314	26,681	27,811	26,052	27,159
2005	31,518	33,018	30,927	32,398	27,233	28,782	26,642	28,163
2006	32,091	33,677	31,768	33,335	27,780	29,369	27,458	29,030
2007	32,554	34,499	32,143	34,062	28,191	30,094	27,780	29,659
2008	32,317	34,793	31,999	34,457	27,905	30,280	27,588	29,939
Average annual growth rates								
80-08	1.59	1.76	1.65	1.83	1.43	1.72	1.50	1.79
80-89	1.90	1.83	1.81	1.74	1.81	1.86	1.72	1.77
80-00	1.71	1.67	1.72	1.68	1.54	1.62	1.54	1.63
89-00	1.57	1.55	1.64	1.63	1.31	1.42	1.39	1.51
00-08	1.27	1.99	1.48	2.20	1.16	1.96	1.40	2.20

Source: Appendix Tables 10 and 13.
Note: Based on CSLS rebasing of United States measures to a 2002 base year.
*Underlying measures for Canada were calculated by CSLS. See Appendix Table 6.

Appendix Table 17: Real Canadian Income and Output Measures Per Capita as a Proportion of United States Levels, Per Cent, 1961-2008

	Gross domestic product	Gross domestic income*	Gross national product*	Gross national income	Net domestic product*	Net domestic income*	Net national product*	Net national income*
	GDP	GDI	GNP	GNI	NDP	NDI	NNP	NNI
1961	81.3	79.6	79.3	77.7	79.2	78.3	77.1	76.2
1962	81.7	80.0	79.7	78.1	79.5	78.6	77.3	76.4
1963	82.1	80.3	80.0	78.4	79.9	78.9	77.7	76.6
1964	82.2	80.6	80.1	78.6	80.0	79.0	77.8	76.8
1965	81.7	80.2	79.7	78.2	79.6	78.6	77.4	76.5
1966	81.3	80.0	79.3	78.1	79.2	78.5	77.1	76.4
1967	81.0	79.6	79.0	77.7	79.0	78.2	76.9	76.1
1968	80.5	79.0	78.7	77.2	78.5	77.7	76.5	75.7
1969	81.6	79.8	80.0	78.2	79.8	78.7	78.0	76.9
1970	83.8	82.2	82.0	80.4	82.1	81.2	80.1	79.3
1971	83.6	81.9	81.8	80.2	82.0	81.1	80.0	79.1
1972	83.0	81.7	81.2	80.1	81.4	81.0	79.6	79.2
1973	83.7	83.9	81.7	81.9	82.2	83.1	80.1	81.0
1974	86.8	89.9	84.6	87.6	85.9	89.6	83.4	87.1
1975	88.2	90.5	86.1	88.4	87.5	90.8	85.2	88.4
1976	87.7	90.5	85.3	88.1	86.6	90.7	84.0	87.9
1977	86.6	89.0	83.9	86.2	85.3	89.1	82.4	86.0
1978	85.3	86.8	82.4	83.8	83.9	86.8	80.7	83.5
1979	86.0	88.7	82.6	85.2	84.6	88.8	80.9	84.9
1980	88.0	92.2	84.6	88.6	86.8	92.8	83.0	88.7
1981	88.6	92.0	84.7	88.0	87.6	92.7	83.3	88.1
1982	87.6	90.1	83.5	86.0	86.9	91.2	82.5	86.4
1983	86.0	88.2	82.5	84.7	85.0	88.9	81.2	84.9
1984	84.8	86.4	81.4	82.9	83.7	86.6	79.9	82.7
1985	85.3	86.4	82.1	83.2	84.1	86.4	80.6	82.8
1986	84.4	85.0	81.2	81.8	83.1	84.8	79.6	81.2
1987	84.9	86.5	82.0	83.5	84.0	86.7	80.8	83.3
1988	85.3	87.4	82.1	84.1	84.6	87.9	81.1	84.2
1989	83.8	86.4	80.6	83.0	83.1	86.7	79.5	82.9
1990	82.1	84.3	78.7	80.8	80.9	84.1	77.1	80.1
1991	80.6	82.1	77.6	79.0	79.0	81.7	75.5	78.1
1992	78.8	79.9	75.6	76.7	76.8	79.0	73.2	75.3
1993	78.5	79.1	75.4	76.1	76.5	78.0	73.1	74.5
1994	79.2	79.6	76.0	76.5	77.3	78.4	73.8	74.9
1995	79.5	80.9	76.4	77.7	77.6	79.8	74.2	76.2
1996	78.0	79.7	75.1	76.7	75.9	78.3	72.6	74.9
1997	78.0	79.3	75.3	76.5	76.0	77.8	73.0	74.7
1998	78.0	77.7	75.3	75.0	76.3	76.1	73.2	73.0
1999	78.8	79.0	75.9	76.1	77.3	77.7	74.1	74.4
2000	79.8	81.6	77.4	79.2	78.5	80.8	75.9	78.1
2001	80.3	81.4	77.6	78.7	79.0	80.3	76.0	77.3
2002	81.1	81.1	78.7	78.7	80.0	80.0	77.2	77.3
2003	80.6	82.3	78.2	79.9	79.2	81.2	76.5	78.5
2004	80.2	83.4	78.0	81.0	79.0	82.5	76.5	79.9
2005	80.2	84.7	78.1	82.4	79.0	84.0	76.7	81.5
2006	80.3	85.0	79.1	83.7	79.4	84.6	78.0	83.1
2007	80.5	86.1	78.9	84.4	79.9	85.9	78.0	83.9
2008	80.3	88.2	78.8	86.5	79.8	88.0	78.0	86.0
Average annual growth rates								
80-08	-0.33	-0.16	-0.25	-0.09	-0.30	-0.19	-0.22	-0.11
80-89	-0.54	-0.73	-0.53	-0.73	-0.49	-0.75	-0.49	-0.75
80-00	-0.49	-0.61	-0.44	-0.56	-0.50	-0.69	-0.45	-0.63
89-00	-0.45	-0.51	-0.37	-0.42	-0.51	-0.63	-0.42	-0.54
00-08	0.09	0.97	0.22	1.11	0.19	1.07	0.34	1.22

Source: Appendix Tables 9, 10 and 16.
Note: Based on CSLS rebasing of United States measures to a 2002 base year.
*Underlying measures for Canada were calculated by CSLS. See Appendix Table 6.

Can Sectoral Reallocations of Labour Explain Canada's Absymal Productivity Performance?

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ABSTRACT

This report presents a framework for decomposing aggregate productivity growth into within-sector effects and sectoral reallocation effects. This framework is used to analyze productivity growth in 12 Canadian industries for the 1961-2007 period and for several sub-periods. The results do not support the common view that Canada's weak post-2000 productivity performance is attributable to a reallocation of labour toward mining, oil and gas, a sector with low productivity growth. Rather, it was the fall in labour productivity growth in manufacturing that accounted for all of the slowdown in business sector productivity growth after 2000.

PRODUCTIVITY GROWTH HAS BEEN slow in Canada since 2000, both from an historical perspective and relative to that in the United States. Growth of business sector output per hour has averaged 0.8 per cent per year between 2000 and 2009, compared to 1.5 per cent in the 1973-2000 period (and 3.3 per cent in the 1945-1973 period) and 2.3 per cent in the United States.

Aggregate labour productivity growth is determined by both productivity growth within a sector and the reallocation of the share of hours worked between sectors. An understanding of the dynamics of this growth requires insight into the contributions of these two effects. This article develops an analytical framework to estimate these effects at the aggregate and sectoral levels and applies it to the Canadian economy for the 1961-2007 period and a number of sub-periods.

One hypothesis that has been put forward to explain Canada's poor productivity performance has been the reallocation of labour to less productive activities, with downward effects on aggregate productivity. Based on the analytical framework developed in this article, I investigate this hypothesis and find no evidence to support it.

The article is divided into three parts. The first part develops the analytical framework to decompose aggregate productivity growth into within-sector effects and reallocation effects for the business sector and 12 industries or sectors. The second section presents and discusses the results of the decomposition. The third and final section discusses whether the results shed light

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on the reasons for the slower aggregate productivity growth the Canadian economy has been experiencing since 2000.

The Analytical Framework

To begin we note that at any given point in time,

$$P \equiv \frac{Q}{H} = \frac{\Sigma Q_i}{H} = \frac{\Sigma H_i P_i}{H} = \Sigma P_i h_i \qquad (1)$$

where

P = Aggregate labour productivity level
P_i = Labour productivity level in sector i
H = Aggregate hours worked
H_i = Hours worked in sector i
h_i = Share of hours worked in sector i
Q = Aggregate real output
Q_i = Real output of sector i

Equation (1) says that aggregate labour productivity P is equal to the weighted average of labour productivity in each of the sectors that make up the economy. The weight for each sector is its share of the total number of hours worked in the economy.

Because we are interested in how shifts in hours worked across sectors affect aggregate labour productivity growth, we must move beyond a single point in time. Equation (2) expresses the absolute change in aggregate labour productivity from period 0 to period 1, $\Delta P = P^1 - P^0$, where superscripts denote the period.

$$\Delta P = \Sigma h_i^0 \Delta P_i + \Sigma P_i^0 \Delta h_i + \Sigma \Delta h_i \Delta P_i \qquad (2)$$

In equation (2) h_i^0 and P_i^0 are respectively the share of total hours worked in sector i and the level of labour productivity in sector i (expressed in dollars) in period 0.

In order to obtain economically meaningful sectoral contributions to aggregate productivity growth, we adjust the second term of equation (2) by subtracting the average level of labour productivity $\bar{P}^0$ from the level of labour productivity in each sector in period 0, P_i^0. In the third term, we subtract the average change in labour productivity $\Delta\bar{P}$ from the change in labour productivity in each sector, ΔP_i. The first adjustment ensures that an increase in the hours share in a sector with a below-average labour productivity level makes a negative contribution to aggregate labour productivity growth.[2] The second adjustment also ensures that an increase in the hours share in a sector with below-average absolute growth in labour productivity makes a negative contribution to aggregate labour productivity growth. The result of these adjustments is equation (3):

$$\Delta P = \Sigma h_i^0 \Delta P_i + \Sigma (P_i^0 - \bar{P}^0)\Delta h_i + \Sigma \Delta h_i (\Delta P_i - \Delta\bar{P}) \qquad (3)$$

We are able to subtract $\bar{P}^0$ and $\Delta\bar{P}$ from equation (2) because the terms $\Delta\bar{P}\Delta h_i$ and $\bar{P}^0 \Delta h_i$ each sum to zero across all sectors, since $\bar{P}^0$ and $\Delta\bar{P}$ are constant and all changes in hours share Δh_i sum to zero across sectors.

The three terms in equation (3) represent respectively the within-sector, reallocation level and reallocation growth effects. The within-sector effect captures the change in labour productivity within a sector. The reallocation level effect indicates whether changes in hours share have favoured sectors with above- or below-average labour productivity levels. The reallocation growth effect is the sum of the product of the absolute change in the share of hours worked and the absolute change in the labour productivity level for each of the i sectors relative to the

2 It is this adjustment for the average productivity level that differentiates our decomposition formula from that of Tang and Wang (2004).

average change across all sectors. It measures whether an economy is subject to a phenomenon akin to Baumol's cost disease, *i.e.* the tendency of labour to move towards sectors with relatively small absolute increases in labour productivity. A negative reallocation growth effect at the aggregate level means that labour is moving to sectors with relatively smaller absolute labour productivity increases.

There are some limitations to this analysis. First, the analysis assumes that differences in technological, institutional, and market structures across sectors lead to differences in average levels of labour productivity, even if marginal products are the same. It also assumes that when a sector loses or gains labour, the changes in output per hour are equal to the sector's average output per hour worked. Second, these results are sensitive to the level of disaggregation. For instance, we use 12 sectors. If within a sector, resources shift from one subsector to another, and these subsectors have different levels of labour productivity, then the measured impact of the reallocation effect on aggregate labour productivity growth would be different.

The Results

The within-sector effect, the reallocation level effect, the reallocation growth effect (also known as the Baumol effect or the interaction effect), the total reallocation effect (the sum of the productivity level and growth effects) and the total sector contribution related to aggregate (business sector) labour productivity growth for 12 sectors are presented for the 1961-2007 period and six cyclically neutral (peak-to-peak) sub-periods (1961-1973, 1973-2000, 1973-1981, 1981-1989, 1989-2000 and 2000-2007). Table 1 provides estimates of the total contributions to aggregate labour productivity growth from these effects in both absolute and relative terms for the seven periods. Table 2 provides a sectoral decomposition of these effects for the 2000-2007 period. Appendix Tables 1-3 provide more detailed estimates of the sectoral contributions to aggregate labour productivity growth from the different effects for the 1961-2007, 1961-1973, and 1973-2000 sub-periods. The focus of the discussion in this section will be on Table 1 and Table 2.

For the business sector as a whole, the average annual rate of labour productivity growth in the 2000-2007 period was 1.10 per cent per year (Table 1). This is below the growth rate experienced in all earlier periods under analysis. Of this growth rate, 1.13 percentage points or 102.3 per cent was due to the within-sector effect, that is, productivity growth within the 12 sectors; 0.12 percentage points or 10.6 per cent was due to the reallocation level effect, and -0.14 percentage points or 12.8 per cent was due to the reallocation growth effect. The total reallocation effect is the sum of the reallocation level and growth effects and was -0.03 percentage points or -2.3 per cent.

The total reallocation effect can be positive, that is a boost or fillip to aggregate productivity growth (1961-1973 and 1973-1981) or negative, that is a drag on productivity growth (1961-1973, 1973-2000, 1981-1989, 1989-2000, and 2000-2007). Its importance relative to the aggregate labour productivity growth depends on the absolute size of the effect (in percentage points) as well as the absolute level of aggregate labour productivity growth (the greater the productivity growth, the smaller the relative importance and vice versa, ceteris paribus). The positive contribution of the total reallocation effect, in both absolute and relative terms, was greatest in positive terms in 1961-73 and 1973-1981 and the negative contribution was largest in 1981-1989 and 1989-2000.

Table 2 provides the sectoral decomposition of the contributions of the reallocation effects to aggregate labour productivity growth in the 2000-2007 period. There were offsetting devel-

Table 1

Decomposition of Aggregate Labour Productivity Growth into Within-Sector and Reallocation Effects, 1961-2007

	Average Annual Growth Rate	Contribution to Labour Productivity Growth								Churn Measure			
		Within-Sector Effect[1]		Reallocation Level Effect[2]		Reallocation Growth Effect[3]		Total Reallocation Effect		Share of Hours Worked		Reallocation Level Effect	
	per cent	points	per cent	points	per cent	points	per cent	points	per cent	total	average annual	total	average annual
1961-2007	2.01	2.13	105.9	0.28	13.9	-0.40	-19.76	-0.12	-5.91	51.7	1.1	0.31	0.01
1961-1973	3.44	3.08	89.7	0.48	14.1	-0.13	-3.80	0.35	10.30	17.6	1.5	0.66	0.05
1973-2000	1.62	1.83	113.0	0.06	3.8	-0.27	-16.74	-0.21	-12.97	32.0	1.2	0.21	0.01
1973-1981	1.71	1.37	80.3	0.56	32.5	-0.22	-12.82	0.34	19.73	14.4	1.8	0.74	0.09
1981-1989	1.31	1.53	117.1	-0.13	-10.0	-0.09	-7.12	-0.22	-17.15	7.8	1.0	0.25	0.03
1989-2000	1.79	2.03	113.3	-0.10	-5.6	-0.14	-7.69	-0.24	-13.32	13.2	1.2	0.31	0.03
2000-2007	1.10	1.13	102.3	0.12	10.6	-0.14	-12.82	-0.03	-2.27	9.6	1.4	0.71	0.10

Source: Tables 4-4f. CSLS calculations based on Statistics Canada's Canadian Productivity Accounts KLEMS database.

Notes: The aggregate is the business sector. The business sector covers the whole economy less public administration, non-profit institutions and the rental value of owner-occupied dwellings. GDP for the business sector is calculated as the sum of the GDP of the constituent sectors.

Labour productivity is real GDP per hour worked. Real GDP is calculated from Statistics Canada, Canadian Productivity Accounts KLEMS Database, CANSIM Table 383-0021. Current-dollar GDP estimates for 2002 were extended forward to 2007 and backward to 1961 using the growth rates of the corresponding real GDP series from the same table.

The churn measure is the sum of the absolute values changes in share of total hours worked or the sum of the absolute values of the reallocation effect. The average annual churn is the total churn measure divided by the number of years in the period.

1. The contribution of labour productivity growth within the sector to aggregate labour productivity growth.

2. The contribution of changes in the share of hours worked between sectors to aggregate labour productivity growth.

3. The reallocation growth effect is the sum of the product of the absolute change in the share of hours worked and the absolute change in the labour productivity level for each of the i sectors. It measures whether an economy is subject to Baumol's cost disease, i.e. the tendency of factors of production to move into sectors with relatively small absolute increases in productivity.

opments within this period. In terms of the productivity level reallocation effect, there were significant positive effects experienced by the mining and oil and gas extraction sector (0.26 percentage points per year) and finance, insurance, real estate and renting and leasing (0.08 points) because of the above average labour productivity level and increasing hours share of these sectors. Significant negative level reallocation effects occurred in manufacturing (-0.15 points) because of the sector's above average productivity level and falling hours share and in other services (except public administration) (-0.09 points) because of this sector's below average productivity level and increasing hours share.

In terms of the productivity growth reallocation effect, all sectors had minimal effects except mining and oil and gas extraction (-0.09 points), due to the very large fall in labour productivity in this sector and the increase in the hours share.

Because of the small size of the sectoral productivity growth reallocation effects, the total reallocation effect was close to the productivity level reallocation effect for all sectors, except for mining and oil and gas extraction.

It is interesting to note that gross reallocation effects (sum of the absolute values of the sectoral productivity level effect), which we also call the churn measure, has been greater on an average

Table 2: Decomposition of Aggregate Labour Productivity Growth by Sector and Within-Sector and Reallocation Effects, 2000-2007

	Within-Sector Effect	Reallocation Effect			Total Effect	Within-Sector Effect	Reallocation Effect			Total Effect
		Level	Growth	Total			Level	Growth	Total	
	(percentage points)					(per cent)				
Business Sector	1.10	-	-	-	1.10	100.0	-	-	-	100.0
Agricult., Forest., Fish. and Hunt.	0.12	0.04	-0.02	0.02	0.14	10.5	3.66	-1.52	2.14	12.6
Mining and Oil and Gas Extract.	-0.24	0.26	-0.09	0.17	-0.06	-21.4	24.03	-8.50	15.53	-5.9
Utilities	-0.01	0.02	0.00	0.02	0.01	-1.2	2.24	-0.14	2.10	0.9
Construction	0.11	-0.03	0.00	-0.03	0.08	9.8	-2.83	0.40	-2.44	7.4
Manufacturing	0.27	-0.15	-0.01	-0.16	0.11	24.4	-13.37	-1.12	-14.49	9.9
Wholesale Trade	0.26	0.00	0.00	0.00	0.26	23.4	0.21	-0.37	-0.16	23.3
Retail Trade	0.23	-0.01	0.00	-0.01	0.23	21.2	-0.73	0.08	-0.65	20.6
Transportation and Warehousing	0.03	0.00	0.00	0.00	0.03	2.8	0.02	0.01	0.03	2.8
Information and Cultural Ind.	0.14	-0.01	-0.01	-0.02	0.13	12.9	-0.89	-0.57	-1.46	11.4
FIRE	0.11	0.08	0.00	0.08	0.19	9.6	7.36	0.19	7.54	17.1
Prof., Scient. and Tech. Services	0.03	-0.01	0.00	-0.02	0.01	2.3	-1.27	-0.38	-1.65	0.6
Other Services (exc. Pub. Admin.)	0.09	-0.09	-0.01	-0.10	-0.01	8.1	-7.87	-0.90	-8.77	-0.7

Source: CSLS calculation based on data from Statistics Canada. See Table 4f for more details.

annual basis in the most recent period (0.10) than in the six earlier periods (Table 1).

Table 2 provides estimates of the absolute and relative importance by sector of the within-sector effect and the total effect for the 2000-2007 period. Given the 4.17 per cent average annual fall in output per hour in the mining and oil and gas extraction sector between 2000 and 2007 (Appendix Table 3), this sector's within sector effect contributed -0.24 percentage points per year to aggregate labour productivity growth. The above average productivity level of the sector combined with the increased hours share resulted in a 0.26 point productivity level effect. The below average productivity growth of the sector, again combined with the rising hours share, resulted in a -0.09 point productivity growth reallocation effect for a total reallocation effect of 0.17 points. This offset much of the sector's large negative within sector effect to result in a -0.06 point net contribution to aggregate productivity growth.

Three sectors made large within-sector contributions to aggregate labour productivity growth in the 2000-2007 period: manufacturing (0.27 points), wholesale trade (0.26 points), and retail trade (0.23 points). The absolute increases in constant dollar output per hour were the same for the three sectors, but those of the retail and wholesale trade sectors were due to the rapid productivity growth of these two sectors (3.30 per cent and 3.64 per cent per year respectively), while that of manufacturing reflected mainly its high productivity level (productivity growth in this sector was only 1.11 per cent). The overall contribution of the two trade sectors to aggregate productivity growth, in both absolute and relative terms, was close to the within sector contribution due to small reallocation effects. In contrast, the overall contribution of manufacturing to aggregate productivity growth was only 0.09 points because of this sector's negative reallocation effect (-0.16), primarily due to a large negative productivity level effect arising

Table 3

A Comparison of Sectoral Contribution in 1973-2000 and 2000-2007 period Divided into Within-Sector and Reallocation Effects

	Labour Productivity		Contribution to Aggregate Labour Productivity Growth								
	1973-2000	2000-2007	1973-2000			2000-2007			Difference Between 1973-2000 and 2000-2007		
			Within-Sector Effect	Real-location Effect	Total Effect	Within-Sector Effect	Real-location Effect	Total Effect	Within-Sector Effect	Real-location Effect	Total Effect
	(compound annual growth rate)		(percentage points)								
	A	B	C	D	E	F	G	H	I = F - C	J = G - D	K = H - E
Business Sector[1]	1.62	1.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Agriculture, Forestry, Fishing and Hunting	2.68	3.28	0.16	0.06	0.21	0.12	0.02	0.14	-0.04	-0.03	-0.07
Mining and Oil and Gas Extraction	-0.29	-4.17	-0.03	-0.02	-0.04	-0.24	0.17	-0.06	-0.21	0.19	-0.02
Utilities	0.93	-0.43	0.03	0.00	0.04	-0.01	0.02	0.01	-0.05	0.02	-0.03
Construction	1.43	1.61	0.12	0.01	0.14	0.11	-0.03	0.08	-0.01	-0.04	-0.06
Manufacturing	2.89	1.11	0.89	-0.13	0.76	0.27	-0.16	0.11	-0.62	-0.02	-0.65
Wholesale Trade	2.94	3.64	0.15	0.00	0.15	0.26	0.00	0.26	0.11	0.00	0.11
Retail Trade	2.08	3.30	0.13	0.00	0.13	0.23	-0.01	0.23	0.10	-0.01	0.09
Transportation and Warehousing	1.55	0.52	0.09	0.00	0.09	0.03	0.00	0.03	-0.06	0.00	-0.06
Information and Cultural Industries	3.42	3.21	0.08	0.01	0.10	0.14	-0.02	0.13	0.06	-0.03	0.03
Finance, Insurance, Real Estate and Renting and Leasing1	1.52	0.75	0.17	0.07	0.24	0.11	0.08	0.19	-0.07	0.02	-0.05
Professional, Scientific and Technical Services	0.82	0.43	0.02	-0.04	-0.01	0.03	-0.02	0.01	0.00	0.02	0.02
Other Services (except Public Administration)2	0.07	0.71	0.01	-0.18	-0.17	0.09	-0.10	-0.01	0.08	0.08	0.16
Sum Total	-	-	1.83	-0.21	1.62	1.13	-0.03	1.10	-0.71	0.19	-0.52

from the very large fall in the sector's hours share (3.32 points). It is interesting to note that the two trade sectors accounted for 0.49 points or 44 per cent of aggregate labour productivity growth in 2000-2007, but accounted for only 19.9 per cent of total hours worked.

Perspectives on the post-2000 productivity slowdown

It is also very insightful to examine the changes in the contributions by sector to aggregate productivity growth between 1973-2000 and 2000-2007 (Table 3). Between these two periods, labour productivity growth decreased 0.52 percentage points, from 1.62 per cent per year in 1973-2000 to 1.10 per cent in 2000-2007 (Table 1). All the post-2000 slowdown can be accounted for by the manufacturing sector, which made a -0.65 percentage points contribution to the -0.52 points falloff in aggregate productivity growth between periods. This situation arose from the 1.8 percentage-point fall in annual labour productivity growth in

manufacturing between 1973-2000 and 2000-2007 (from 2.9 per cent to 1.1 per cent).

Across all sectors, the slowdown for within-sector productivity growth between 1973-2000 and 2000-2007 (-0.71 points) was larger than the total slowdown including both within-sector and reallocation effects (-0.52 points). In other words, sectoral shifts were not directly responsible for the falloff in labour productivity growth. Indeed, these sectoral reallocations boosted productivity between periods. This is because the negative impact of the sector reallocations (both productivity level and growth effects) was smaller in 2000-2007 (-0.03 points) than in 1973-2000 (-0.21 points), making a 0.19 point positive contribution to the difference in productivity growth between the two periods (Appendix Table 2).

The reason for this can be largely found in the mining and oil and gas extraction sector. In 1973-2000, this magnitude of the reallocation level effect in this sector was very small (-0.02 points). In 2000-2007, the size of this effect rose to 0.17 points because of the movement of workers to this high productivity level sector, resulting in a 0.19 point change between period.

Conclusion

It was the fall in labour productivity growth in manufacturing that accounted for all of the slowdown in business sector productivity growth in 2000-2007 in Canada relative to the 1973-2000 period. Despite the large decline in labour productivity in the mining and oil and gas extraction sector, this sector contributed little to the slowdown because of positive reallocation level effects. The rising employment share in a very high labour productivity level sector offset the falling productivity level in the sector. It is the falling productivity growth rate in manufacturing, not sectoral reallocations, that largely explains why labour productivity growth in Canada has been so weak after 2000 relative to the last quarter of the 20th century.

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Appendix Tables

Appendix Table 1
Decomposition of Aggregate Labour Productivity Growth by Sector into Within-Sector and Reallocation Effects, 1961-2007

	Labour Productivity				Sector Minus Business Sector Productivity		Share of Total Hours Worked		
	1961 Level	2007 Level	Compound Annual Growth Rate	Absolute Change	1961 Level	1961-2007 Absolute Change	1961	2007	Absolute Change
	(constant 2002 dollars per hour worked)		(per cent)	(constant 2002 dollars per hour worked)			(per cent)		(percentage points)
	A	B	C	D = B-A	E = A - 15.32	F = D - 23.01	G	H	I = H-G
Business Sector[1]	15.32	38.33	2.01	23.01	N/A	N/A	100.0	100.0	N/A
Agriculture, Forestry, Fishing and Hunting	6.73	32.95	3.51	26.22	-8.59	3.20	16.86	3.31	-13.55
Mining and Oil and Gas Extraction	95.76	119.20	0.48	23.44	80.44	0.42	1.58	2.01	0.42
Utilities	56.90	145.96	2.07	89.06	41.58	66.04	0.69	0.83	0.14
Construction	19.29	33.77	1.22	14.48	3.97	-8.54	9.49	9.28	-0.21
Manufacturing	13.42	50.69	2.93	37.27	-1.90	14.25	26.28	14.96	-11.33
Wholesale Trade	11.43	41.05	2.82	29.62	-3.89	6.61	4.82	7.12	2.31
Retail Trade	6.89	23.28	2.68	16.38	-8.43	-6.63	11.88	12.80	0.92
Transportation and Warehousing	12.14	34.57	2.30	22.44	-3.18	-0.58	7.12	6.34	-0.78
Information and Cultural Industries	11.92	63.24	3.70	51.32	-3.41	28.31	1.94	2.73	0.79
Finance, Insurance, Real Estate and Renting and Leasing1	44.78	71.82	1.03	27.04	29.46	4.03	4.28	8.03	3.74
Professional, Scientific and Technical Services	21.69	30.00	0.71	8.31	6.37	-14.71	1.72	7.76	6.04
Other Services (except Public Administration)2	16.22	20.19	0.48	3.97	0.90	-19.04	13.33	24.83	11.50
Sum Total							100.0	100.0	0.00
								Total Churn Measure:	51.7
								Average Annual Churn:	1.12

Source: Calculated by CSLS from Statistics Canada, Canadian Productivity Accounts KLEMS Database, CANSIM Table 383-0021.

Notes: The churn measure is the sum of the absolute values changes in share of total hours worked or the sum of the absolute values of the real-location effect. The average annual churn is the total churn measure divided by the number of years in the period.

In column [E] the business sector average labour productivity over the period is subtracted from the sector's period average labour productivity in order to obtain reallocation effects that can be interpreted inuititvely. In the absence of this adjustment, a sector that experiences an increase in labour share always experiences a positive reallocation effect. This is misleading, because the reallocation effect should be negative if, for example, a below-average productivity sector experiences an increase in labour share.

Appendix Table 2
Decomposition of Aggregate Labour Productivity Growth by Sector into Within-Sector and Reallocation Effects, 1973-2000

	Labour Productivity				Sector Minus Business Sector Productivity		Share of Total Hours Worked		
	1973 Level	2000 Level	Compound Annual Growth Rate	Absolute Change	1973 Level	1973-2000 Absolute Change	1973	2000	Absolute Change
	(constant 2002 dollars per hour worked)		(per cent)	(constant 2002 dollars per hour worked)			(per cent)		(percentage points)
	A	B	C	D = B-A	E = A - 22.98	F = D - 12.52	G	H	I = H-G
Business Sector[1]	22.98	35.51	1.62	12.52	N/A	N/A	100.0	100.0	N/A
Agriculture, Forestry, Fishing and Hunting	12.88	26.28	2.68	13.40	-10.10	0.87	9.08	4.43	-4.65
Mining and Oil and Gas Extraction	173.66	160.66	-0.29	-13.00	150.68	-25.52	1.55	1.46	-0.09
Utilities	117.17	150.40	0.93	33.23	94.19	20.71	0.74	0.77	0.03
Construction	20.61	30.20	1.43	9.59	-2.37	-2.94	9.84	7.78	-2.06
Manufacturing	21.75	46.91	2.89	25.15	-1.23	12.63	27.40	18.28	-9.12
Wholesale Trade	14.60	31.96	2.94	17.35	-8.38	4.83	6.62	7.29	0.67
Retail Trade	10.64	18.54	2.08	7.90	-12.34	-4.62	12.74	12.68	-0.05
Transportation and Warehousing	21.99	33.34	1.55	11.35	-0.99	-1.17	6.15	6.36	0.22
Information and Cultural Industries	20.42	50.67	3.42	30.25	-2.56	17.73	2.16	2.90	0.74
Finance, Insurance, Real Estate and Renting and Leasing1	45.33	68.16	1.52	22.83	22.35	10.31	5.81	7.39	1.58
Professional, Scientific and Technical Services	23.37	29.10	0.82	5.73	0.39	-6.80	2.94	7.20	4.26
Other Services (except Public Administration)2	18.86	19.22	0.07	0.36	-4.12	-12.17	14.98	23.46	8.48
Sum Total							100.0	100.0	0.00
								Total Churn Measure:	32.0
								Average Annual Churn:	1.18

Source: Calculated by CSLS from Statistics Canada, Canadian Productivity Accounts KLEMS Database, CANSIM Table 383-0021.

Notes: The churn measure is the sum of the absolute values changes in share of total hours worked or the sum of the absolute values of the reallocation effect. The average annual churn is the total churn measure divided by the number of years in the period.

In column [E] the business sector average labour productivity over the period is subtracted from the sector's period average labour productivity in order to obtain reallocation effects that can be interpreted inuititvely. In the absence of this adjustment, a sector that experiences an increase in labour share always experiences a positive reallocation effect. This is misleading, because the reallocation effect should be negative if, for example, a below-average productivity sector experiences an increase in labour share.

Appendix Table 3
Decomposition of Aggregate Labour Productivity Growth by Sector into Within-Sector and Reallocation Effects, 2000-2007

	Labour Productivity				Sector Minus Business Sector Productivity		Share of Total Hours Worked		
	2000 Level	2007 Level	Compound Annual Growth Rate	Absolute Change	2000 Level	2000-2007 Absolute Change	2000	2007	Absolute Change
	(constant 2002 dollars per hour worked)		(per cent)	(constant 2002 dollars per hour worked)			(per cent)		(percentage points)
	A	B	C	D = B-A	E = A - 35.51	F = D - 2.83	G	H	I = H-G
Business Sector[1]	35.51	38.33	1.10	2.83	N/A	N/A	100.0	100.0	N/A
Agriculture, Forestry, Fishing and Hunting	26.28	32.95	3.28	6.67	-9.23	3.84	4.43	3.31	-1.12
Mining and Oil and Gas Extraction	160.66	119.20	-4.17	-41.46	125.16	-44.29	1.46	2.01	0.54
Utilities	150.40	145.96	-0.43	-4.44	114.90	-7.27	0.77	0.83	0.06
Construction	30.20	33.77	1.61	3.57	-5.31	0.74	7.78	9.28	1.51
Manufacturing	46.91	50.69	1.11	3.78	11.40	0.95	18.28	14.96	-3.32
Wholesale Trade	31.96	41.05	3.64	9.09	-3.55	6.26	7.29	7.12	-0.17
Retail Trade	18.54	23.28	3.30	4.73	-16.96	1.90	12.68	12.80	0.12
Transportation and Warehousing	33.34	34.57	0.52	1.24	-2.17	-1.59	6.36	6.34	-0.02
Information and Cultural Industries	50.67	63.24	3.21	12.56	15.17	9.74	2.90	2.73	-0.17
Finance, Insurance, Real Estate and Renting and Leasing1	68.16	71.82	0.75	3.66	32.66	0.83	7.39	8.03	0.64
Professional, Scientific and Technical Services	29.10	30.00	0.43	0.89	-6.40	-1.93	7.20	7.76	0.56
Other Services (except Public Administration)2	19.22	20.19	0.71	0.97	-16.29	-1.85	23.46	24.83	1.37
Sum Total							100.0	100.0	0.00
								Total Churn Measure:	9.6
								Average Annual Churn:	1.37

Source: Calculated by CSLS from Statistics Canada, Canadian Productivity Accounts KLEMS Database, CANSIM Table 383-0021.

Notes: The churn measure is the sum of the absolute values changes in share of total hours worked or the sum of the absolute values of the reallocation effect. The average annual churn is the total churn measure divided by the number of years in the period.

In column [E] the business sector average labour productivity over the period is subtracted from the sector's period average labour productivity in order to obtain reallocation effects that can be interpreted inuititvely. In the absence of this adjustment, a sector that experiences an increase in labour share always experiences a positive reallocation effect. This is misleading, because the reallocation effect should be negative if, for example, a below-average productivity sector experiences an increase in labour share.

Productivity Growth in Canadian and U.S. Regulated Industries

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ABSTRACT

This article compares the productivity growth of a set of Canadian and U.S. regulated industries. Using data from Statistics Canada's KLEMS database and the U.S. Bureau of Economic Analysis, the article examines productivity growth in transportation services (which includes air, rail, and other transportation services), broadcasting and telecommunications, cultural industries (which include publishing and information services, and motion pictures and sound recording), and financial services (which includes financial intermediation and insurance) over the period from 1977 to 2006. These industries provide the foundational networks on which other industries rely. In 1977, they were quite heavily regulated in Canada. They experienced deregulation after 1977, but still faced various types of regulation in 2006. Deregulation also occurred in the United States, but regulation has generally been less restrictive in that country over the period.

THE EVIDENCE SHOWS THAT many of the Canadian industries that underwent deregulation experienced faster labour productivity growth and multifactor productivity growth than did the aggregate Canadian business sector and had similar or higher productivity growth than did their counterparts in the United States over the 1977-2006 period. These industries include rail transportation, motion pictures and sound recording, financial intermediation and insurance carriers. The broadcasting and telecommunications industry had similar productivity growth in the two countries before 2001, and after 2001 it had much slower productivity growth in Canada. The airline industry and the publishing and information services industries had slower productivity growth in Canada than in the United States over the 1977-to-2006 period.

Recent research for OECD countries suggests that productivity growth is boosted by reforms that promote better corporate governance and competition (Nicoletti and Scarpetta, 2003). Regulation is seen to create barriers to entry, reduce the incentives to innovate and invest, all of which lead to slower technological progress and slower productivity growth (Crafts, 2006; Conway and Nicoletti, 2007).

Similarly, in a series of cross country case studies, the McKinsey Institute identified regulation and a lack of competition as factors behind low productivity growth in many countries (Kellison, 2004). Many of the McKinsey studies focused on restrictions on foreign invest-

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ment, traditional utility type regulation, and urban planning restrictions that reduced retail and wholesale competition.

Since a number of studies have found that regulation and barriers to competition hinder productivity growth (though they may have beneficial effects in other areas), the focus of this article is the productivity performance of the 'regulated' infrastructure sector in Canada.

The industries that are examined encompass transportation services, including rail and air; broadcasting and telecommunications; and financial services, including financial intermediation and insurance. These industries provide the foundational networks on which other industries rely. They are also industries that have traditionally faced regulation in terms of the pricing of products, the supply of industry outputs, and restrictions on foreign ownership. In recent years, they have undergone varying degrees of deregulation and experienced increases in competition.

Productivity is important but it is just one of many indicators that analysts use to judge the performance of an economy. Productivity is a measure of the efficiency with which resources are turned into output. Growth in labour productivity is closely associated with growth in GDP per capita and with increases in real wages (Baldwin and Gu, 2007c). Other aspects of an economy—the safety of the products produced, the volatility of the economic system, and the fairness of the distribution of income—require other indicators if one is to fully assess the many factors, in addition to productivity, that together affect an economy's overall health.[2]

Canada has sector-specific legislation and/or policies on foreign investment in telecommunications, broadcasting, cultural industries, and transportation services. The financial services sector is subject to ownership restrictions, but not specific foreign-ownership restrictions. According to the Organisation for Economic Co-operation and Development (OECD), Canada has the second greatest restrictions on foreign direct investment in the OECD countries (Maher and Shaffer, 2005). The regulations are generally more restrictive in Canada than in the United States in non-manufacturing industries, including air transportation and telecommunications (Conway and Nicoletti, 2006).

These sectors were quite heavily regulated in Canada at the beginning of the period of study (1977), experienced deregulation at different times during the period, but still faced various types of regulation at the end (2006). Deregulation also occurred in the United States, but regulation has generally been less restrictive there over the period.

Regulation is expected to affect the *level* of an industry's productivity. That is, heavily regulated industries are likely to be behind less regulated industries in other countries in terms of the level of their productivity, everything else being equal. Deregulation is posited to give the regulated industries a boost, that is, their productivity *growth* is expected to increase the relative productivity level towards that of their less regulated counterparts as they partially or fully "catch up" to them. During periods of deregulation productivity growth rates are expected to be particularly robust - both relative to other industries in the same country and relative to the same industries in other countries that have already experienced more deregulation.

This article investigates this hypothesis by asking whether productivity growth in the Canadian regulated industries has been especially robust relative to other Canadian industries and to their U.S. counterparts.[3]

2 Gray (1987), for example, demonstrates that environmental regulations in the United States negatively affected productivity growth, though presumably benefiting the environment.

Table 1
The Share of Regulated Industries in Business Sector Nominal GDP in Canada, 1977 and 2006

	1977	2006	Absolute Change
Air transportation	0.7	0.4	-0.3
Rail transportation	1.5	0.6	-0.9
Other transportation	3.6	3.8	0.3
Publishing, data processing and information services	0.8	1.3	0.5
Motion picture and sound recording industries	0.1	0.3	0.2
Broadcasting and telecommunications	2.8	2.8	0.0
Financial intermediation	2.7	4.0	1.3
Insurance carriers and related activities	1.6	1.6	0.0
Total regulated industries	13.9	14.9	1.0

Source: Statistics Canada, KLEMS database and CANSIM table 383-0021.
Note: Figures for 'total regulated industries' are simply the sum of the figures for the eight specific industries.

The paper is organized as follows. The second section outlines the data used for the international comparison. Section three examines labour productivity growth in regulated industries in Canada while section four compares labour productivity growth in Canadian and U.S. regulated industries. Section five examines multifactor productivity growth and capital deepening in the regulated industries in both countries. Section six concludes.

The Data

This article examines the growth in output and labour productivity in regulated industries in Canada and in the United States over the 1977-2006 period. The industry definitions for the regulated industries are based on the 1997 North American Industry Classification System (NAICS). The industries that will be examined are transportation services industries (rail, air, and other transportation services including truck, transit and ground passenger transportation and pipeline transportation); two cultural industries (publishing, data processing and information services; and motion pictures and sound recording industries); broadcasting and telecommunications; and two financial services industries (financial intermediation including monetary authorities and credit intermediation, and insurance carriers).[4] All of these industries, with the possible exception of the cultural sector, play a foundational network role for industries in the rest of the economy.[5]

Regulated industries accounted for 14.9 per cent of business sector nominal GDP in 2006 (Table 1). This was up from 13.9 per cent in 1977. The share of air transportation and rail transportation in business sector GDP declined over the period. The share of the two cultural industries, financial intermediation, and other transportation increased, while the share of broadcasting and telecommunications and insurance carriers was unchanged over the period.

Canadian Data

The data for Canada are taken from the Canadian KLEMS database. This database provides time series data for multifactor productivity, output and inputs including capital, labour, energy, materials and purchased services for industries on a NAICS basis back to 1961 (Baldwin, Gu and Yan, 2007). For the purpose of this article, we use GDP as the measure of output and hours worked and net capital stock as measures of labour and capital. This is consistent with the data used for the U.S. industries. The

3 Additional studies of the impact of regulation might try to capture whether turning points in productivity growth could be identified with specific regulatory events and whether other factors in the underlying technology also favoured the regulated sector in Canada that might have had a greater stimulating effect on them than on their counterpart U.S. industries. But these issues were beyond the scope of this study.

4 The insurance carriers for the United States include related activities that make up a small portion of the insurance industry.

5 Another important regulated industry is the utilities industry (i.e. electricity generation and distribution). Utilities are not addressed in this study.

data for the Canadian business sector are taken from CANSIM Table 383-0021.

U.S. Data

The data for the regulated industries in the United States are obtained from the U.S. Bureau of Economic Analysis (BEA). For the output measure, BEA publishes chain-type volume indexes for value added. For the labour measure, BEA publishes data on persons engaged in production that include paid workers and self-employed workers for the 1998-2006 period; it also publishes data on full-time and part-time paid workers for the period prior to 1998. The two measures are linked to form a time series of persons engaged in production for the 1977-2006 period. This is appropriate, as there is very little self-employment in these industries and the trend between persons engaged in production and the number of full-time and part-time workers is very similar for the industries examined over the 1998-to-2006 period. Finally, the number of persons engaged in production in an industry is multiplied by hours worked per person engaged in production in the same industry from the EU KLEMS database to obtain the number of hours worked (Timmer, O'Mahony and van Ark, 2007). The data on GDP and hours worked for the U.S. business sector are obtained from the Bureau of Labor Statistics.

The investment data by industry are obtained from the BEA (Lally, 2004). The data are based on NAICS and contain investment for 47 asset categories. The capital stock of each asset category for U.S. industries is then estimated using the perpetual inventory method by assuming a geometric depreciation pattern. To ensure the measures of capital stock in the United States are comparable with those in Canada, we have used the depreciation rates that are used in the Canadian KLEMS database (for details, see Baldwin *et al*., 2008).

Labour Productivity Trends in Regulated Industries in Canada

In this section, we examine the output and productivity growth of the regulated industries over the 1977-to-2006 period. We begin by discussing the regulatory framework in each industry.

Structural Reforms and Deregulation in Regulated Industries in Canada

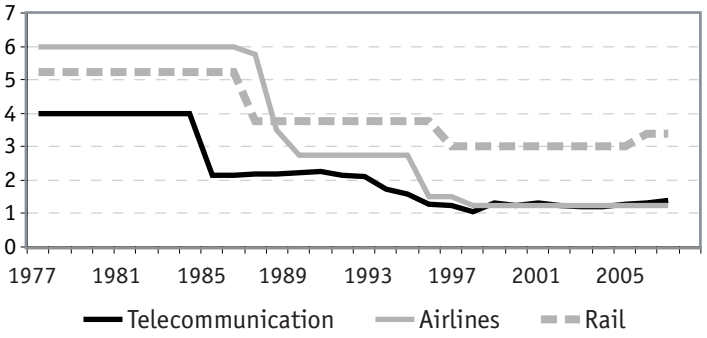
Throughout the period since the 1970s, there has been a trend toward deregulation within Canadian regulated industries. A number of structural reforms were implemented in the late 1980s across a range of the regulated industries (Conway and Nicoletti, 2006). The OECD publishes regulation indicators in energy, transport and communications that measure restrictions to competition. These indicators capture factors such as barriers to entry, state ownership and market structures in the industry, although they do not reflect restrictions to foreign ownership.[6] For example, in telecommunications, the indicator is based on the market share of new entrants to gauge the extent to which regulators succeeded in promoting competition (Conway and Nicoletti, 2006). Chart 1 illustrates these indicators for air transportation, telecommunications and rail transportation over the 1977-2006 period. Restrictions to competition are based on a 0 to 6 scale where 6 signifies that there are heavy restrictions to competition in the industry and 0 indicates no restrictions.

Both the airline and the rail industries were largely deregulated in 1988 with the emergence of the *Canada Transportation Act*. This Act entitled all licensed domestic air carriers to operate freely in southern Canada, and this right was then extended throughout the country in 1996. However, there are restrictions on foreign ownership in the airline industry, and

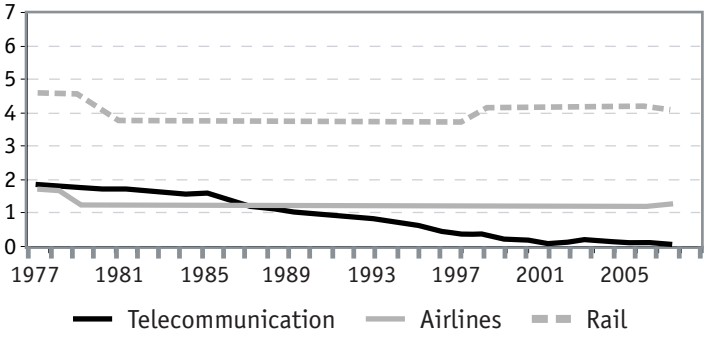
6 For further explanation of these indicators, see Conway and Nicoletti (2006).

Chart 1
Regulation Index by Industry in Canada
(based on a scale from 0-6, from the least to the most restrictions to competition)

Canada



United States



Source: Conway and Nicoletti (2006).

there remain controls preventing foreign carriers from competing on domestic routes. Under the *Canada Transportation Act*, ownership and control of voting interests held in a Canadian air carrier by non-Canadians may not exceed 25 per cent.

The telecommunications industry consists of wired or wireline and wireless telecommunications carriers as well as satellite telecommunications, while the broadcasting industry comprises radio and television broadcasting, as well as pay and specialty television. With the introduction of technological advances, both telecommunications and broadcasting have experienced dramatic changes in the last decade. Changes in the telecommunications services sector include the liberalization of the terminal equipment market (1980 to 1982), the launch of cellular service (1985), facilities-based long distance (1992), and fixed satellite services (2000). Changes to the broadcasting industry include the introduction of pay TV and specialty services (1983) and the launch of digital networks (2002).

According to the OECD, Canada started early, relative to most OECD countries, in implementing competitive reforms to its telecommunications policy and regulatory regime. The *Telecommunications Act* of 1993 installed a more flexible regulatory framework to foster competition. Canada has had open-market entry in all telecommunications services since the end of 1998 (although a licence is required for wireless operators and international service providers), and its telecommunications industry is considered to be one of the most pro-competitive in OECD countries (Maher and Shaffer, 2005). However, Canada is one of six OECD countries that have restrictions on foreign ownership in public telecommunications operators.

The rules regarding foreign ownership require majority ownership and control of Canadian broadcasting entities by Canadians; however, at least 40 per cent of television content is not produced in Canada. Broadcast program distribution was opened to competition in 1997, which allows cable firms to face competition from direct-broadcast satellites. Since then, cable operators have been able to change their basic cable rates without seeking approval from the Canadian Radio-Television and Telecommunications Commission.

In cultural industries, policies generally prohibit the acquisition of an existing Canadian-owned business and they prohibit or set conditions for the establishment of new businesses, particularly in most types of publishing. Canada has sought to restrict access to U.S. press, television and radio with cultural

trade restrictions, although this policy is not unique to Canada. Although restrictions exist, in many cases, foreign-owned companies dominate the culture industries in terms of sales.

The financial intermediation industry consists of activities related to the central bank and depository institutions such as commercial banks and credit unions. This industry has experienced many changes in its regulatory regime since the early 1980s, particularly because of changes made to the *Bank Act*, which is subject to review every five years. In 1987, amendments were made to federal legislation to permit Canadian banks to invest in corporate security dealers. In 1999, federal legislation allowed foreign banks to establish specialized, commercially focused branches in Canada, although foreign-bank branches were restricted in accepting deposits of at least $150,000. Previously, they were required to establish separate Canadian subsidiaries. Following this change, many foreign-bank subsidiaries converted into foreign-bank branches. In 2001, reforms were made to the *Bank Act* to encourage increased competition and accountability, such as allowing banks to own finance companies.

The insurance carriers industry consists of the markets for life insurance and pensions, health and accident insurance and property and casualty (P&C) insurance. Both federal and provincial levels of government regulate the insurance industry. Over 90 per cent of firms in the life and health insurance sector and over two thirds of firms in the P&C sector are regulated by the Government of Canada under the *Insurance Companies Act*. All insurers are subject to market conduct regulation by the province in which they carry on business. In 2001, federal legislation allowed insurers to set up holding companies and gain access to Canada's national payments system.

Table 2
Labour Productivity Growth in Regulated Industries in Canada
(average annual rate of change)

	1961-1977	1977-1990	1990-2006	1977-2006
Air transportation	4.6	3.1	0.8	1.8
Rail transportation	7.0	5.7	6.9	6.3
Other transportation	2.6	1.1	0.3	0.7
Publishing, data processing and information services	2.4	0.4	1.2	0.9
Motion picture and sound recording industries	-1.1	1.8	2.4	2.1
Broadcasting and telecommunications	6.3	5.1	3.9	4.5
Financial intermediation	1.5	2.2	3.0	2.6
Insurance carriers and related activities	2.5	5.6	2.7	4.0
Total regulated industries	4.2	3.0	2.0	2.4
Business sector	3.5	1.1	1.7	1.4

Source: Statistics Canada, KLEMS database and CANSIM table 383-0021.

Output and Labour Productivity Growth in Regulated Industries in Canada

Table 2 presents estimates of labour productivity (output per hour) growth in regulated industries and the business sector in Canada over 1977-2006. Business sector labour productivity growth was 1.4 per cent per year. Labour productivity growth was higher in seven of the nine regulated industries. The exceptions were publishing and information services, and other transportation services. Over the 1977-2006 period, labour productivity growth was strongest in rail transportation (6.3 per cent per year), broadcasting and telecommunications (4.5 per cent) and financial intermediation (4.0 per cent).

The deregulation was associated with increased productivity growth in the regulated industries in Canada. During the period 1961 to 1977, the labour productivity growth of the total regulated industries was 0.7 percentage point faster than that of the total business sector. During the period 1977 to 1990 when the industries were being deregu-

Table 3
Real GDP Growth in Regulated industries in Canada
(average annual rate of change)

	1961-1977	1977-1990	1990-2006	1977-2006
Air transportation	10.1	6.6	-0.5	2.6
Rail transportation	5.1	1.5	4.2	3.0
Other transportation	4.4	4.1	3.4	3.7
Publishing, data processing and information services	4.5	4.9	4.3	4.6
Motion picture and sound recording industries	-0.9	6.2	5.3	5.7
Broadcasting and telecommunications	9.9	6.8	5.0	5.8
Financial intermediation	7.4	4.7	4.1	4.4
Insurance carriers and related activities	3.7	5.8	2.1	3.8
Total regulated industries	6.2	4.9	3.7	4.2
Business sector	5.2	3.3	3.2	3.2

Source: Statistics Canada, KLEMS database and CANSIM table 383-0021.

Table 4
Hours Worked Growth in Regulated Industries in Canada
(average annual rate of change)

	1961-1977	1977-1990	1990-2006	1977-2006
Air transportation	5.2	3.4	-1.3	0.8
Rail transportation	-1.8	-4.0	-2.5	-3.2
Other transportation	1.7	3.0	3.0	3.0
Publishing, data processing and information services	2.1	4.5	3.0	3.7
Motion picture and sound recording industries	0.2	4.4	2.8	3.5
Broadcasting and telecommunications	3.3	1.7	1.0	1.3
Financial intermediation	5.7	2.5	1.1	1.8
Insurance carriers and related activities	1.2	0.2	-0.6	-0.2
Total regulated industries	1.9	1.9	1.7	1.8
Business sector	1.7	2.2	1.4	1.8

Source: Statistics Canada, KLEMS database and CANSIM table 383-0021.

lated, the productivity growth difference favouring the total regulated industries almost tripled. Over that period, the productivity growth in the total regulated industries was 1.9 percentage point higher than in the total business sector.

The strong productivity performance in the industries that have been deregulated supports the empirical evidence from the OECD, European Union and the United Kingdom that deregulation is associated with higher productivity growth, possibly through the reduction in barriers to entry, and increases in incentives to innovation and adoption of advanced technologies (Copenhagen Economics, 2007; European Commission, 2004).

As noted above, publishing and information services and other transportation industries have had slower productivity growth than the business sector. The Canadian publishing industry experienced less deregulation than most of the other industries studied here.[7] The slower productivity growth in other transportation occurred during a time when Canada experienced a recession in the early 1990s and a surge in oil prices.

Tables 3 and 4 present estimates of growth in real gross domestic product (GDP) and hours worked in regulated industries and the business sector in Canada over the 1977-2006 period. Output growth was higher than the business sector average of 3.2 per cent per year in all regulated industries except air and rail transportation. Growth in hours worked in the two cultural industries was higher than all other regulated industries and the business sector.

The rest of this section presents a more detailed examination of output and labour productivity growth in the regulated industries over the 1977-2006 period. The airline industry experienced strong output, hours, and labour productivity growth in the 1977-1990 period. Since then it has performed well below average on all three variables. The industry was greatly affected by the recession of early 1990s. Following this recession, output growth rebounded, outpacing the business sector until 1998. Thereafter, the trends

7 These industries may also be subject to greater measurement problems when it comes to the price data that are used to generate output growth from revenue data.

reversed as the industry experienced a number of disruptions, including 9/11 and surges in oil prices.

GDP in the rail industry, consisting of freight and passenger railways, grew at less than one half the rate of business sector output (1.5 per cent versus 3.3 per cent per year) in the 1977-1990 period. However, since the privatization of Canadian National Railways (CN) in 1995, and further deregulation in 1996, the industry's output growth has doubled. Moreover, in 1998, CN purchased U.S. rail company Illinois Central Corp., which allowed the Canadian railway to connect its Canadian lines to a line running from Chicago to New Orleans. This has led CN to increase its customer base and gain significant economies of scale. Labour productivity growth in the rail industry has been the highest of any regulated industry since 1977.

Other transportation services, which include truck, transit and ground passenger transportation and pipeline transportation, had higher growth in output and hours worked than the business sector in 1977-2006 period. But its labour productivity growth was below that of the business sector (0.7 pr cent versus 1.4 per cent per year).

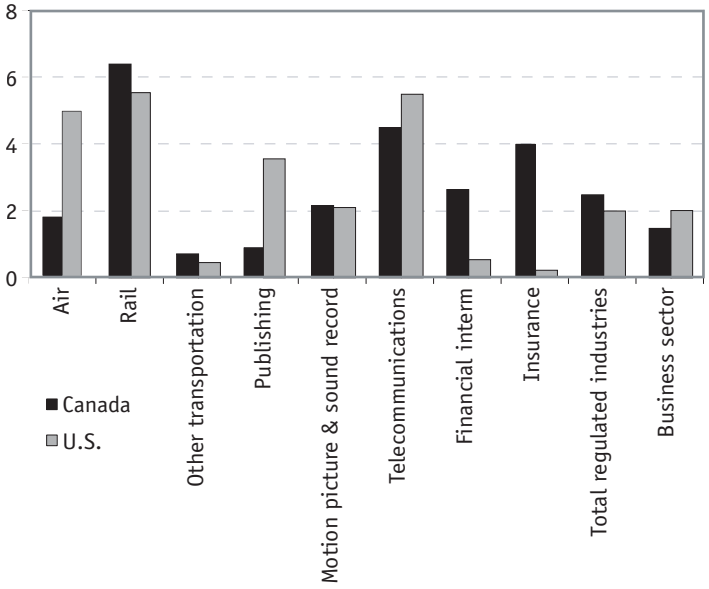
The broadcasting and telecommunications industry's performance has proven to be quite robust in terms of output and productivity growth over the 1977-2006 period. Hours worked grew by 1.3 per cent per year over the period while output grew much faster, so most of the output growth translated into productivity growth.

The wireless telecommunications component has been growing quickly, particularly since the launch of cellular service. The number of wireless phones has been increasing rapidly. The number of mobile communication subscribers in 2003 was more than 10 times the number of subscribers in 1993. Moreover, the rate of Internet subscriptions in Canada is one of the highest in the world, with 56 subscribers per 100 households in 2003. In broadcasting, the FM-radio segment is one of the most profitable in broadcasting. Much of the growth in television broadcasting over the last decade can be attributed to the rapid rise of pay and specialty television.

The publishing, data processing and information services industry consists of the publishers of newspapers, periodicals, books, databases and software, data processing services, and information services such as news syndicates, libraries and archives. Its GDP accounted for 0.8 per cent of the business sector's GDP in 1977. This ratio jumped to 1.3 per cent in 2006 because of above average output growth (Table 1). However, labour productivity growth in this industry over the 1977-2006 period was below that of the business sector (0.9 per cent versus 1.4 per cent per year).

The motion picture and sound recording industries include motion picture and video production, distribution and exhibition, and record production, integrated record production, music publishers and sound recording studios. The sector is small, but it has expanded rapidly, from 0.1 per cent of nominal business sector GDP in 1997 to 0.3 per cent in 2006. Since 1997, there have been increases in service production for Hollywood films in the motion picture industry. The creation of the Canadian Film or Video Tax Credit in 1994, the Canadian Television Fund in 1996 and the expansion of the broadcasting industry generated the need for more Canadian programming. Moreover, many new and large movie theatres have been built in recent years. On the other hand, the Canadian film market is fragmented into the markets for French-language and English-language Canadian productions. The industry in Quebec is largely subsidized, and there are barriers to entry in the French-language market in

Chart 2
Labour Productivity Growth in Canadian and U.S. regulated industries, 1977-2006
(average annual rate of change)



Source: Canada KLEMS and CANSIM Table 383-0021, Bureau of Economic Analysis.

the form of laws stipulating that distributors interested in distributing films in Quebec must be based in the province, along with mandatory translation of foreign films. In terms of the sound-recording industries, according to the International Federation of the Phonographic Industry, Canada ranked sixth in terms of recorded-music sales in 2003. Labour productivity in motion pictures and sound-recording industry grew more quickly than that of the business sector over the 1977-2006 period (2.1 per cent per year versus 1.4 per cent).

Labour productivity grew much more quickly in financial intermediation and insurance carriers than in the business sector over the 1977-2006 period. While domestic banks and trust companies dominate the industry, the real value of services produced by foreign bank subsidiaries and branches has been growing quickly (Hinchley, 2006). This has contributed to the industry's output growth.

Canada–U.S. Comparison of Labour Productivity Growth in Regulated Industries

In this section, we compare output and labour productivity growth in Canadian and U.S. regulated industries over time. In the 1970s, the regulated sector in Canada was, in general, more heavily regulated than in the United States (Conway and Nicoletti, 2006). Since the 1970s, there has been deregulation and open-market entry in both Canada and the United States, but at a faster pace in Canada. By the early 2000s, the gap between the severity of regulation in Canada as compared to the United States had been considerably reduced; the possible exception would be that of the cultural industries in Canada. The book publishing, distribution and retail sectors, the periodical publishing and newspaper sectors, and the film distribution sectors all have policy measures that generally prohibit the acquisition of an existing Canadian-owned business and prohibit or set conditions for the establishment of new businesses. In the United States, there are no rules preventing foreign ownership in the publishing industry, with the exception of newspapers (Price, 2001).

Over the 1977-2006 period, labour productivity growth in the business sector was slower in Canada (1.4 per cent per year) than in the United States (2.0 per cent) as shown in Chart 2. However, six of nine regulated industries in Canada had higher (or comparable) labour productivity growth than their U.S. counterparts. The three exceptions were air transportation, publishing and information services, and broadcasting and telecommunications. Overall, labour productivity growth in the regulated industries was higher in Canada than in the United States: 2.4 per cent per year versus 2.0 per cent.

The regulated industries in Canada that had a higher or comparable productivity growth relative to the United States are those industries which experienced deregulation. The slow pro-

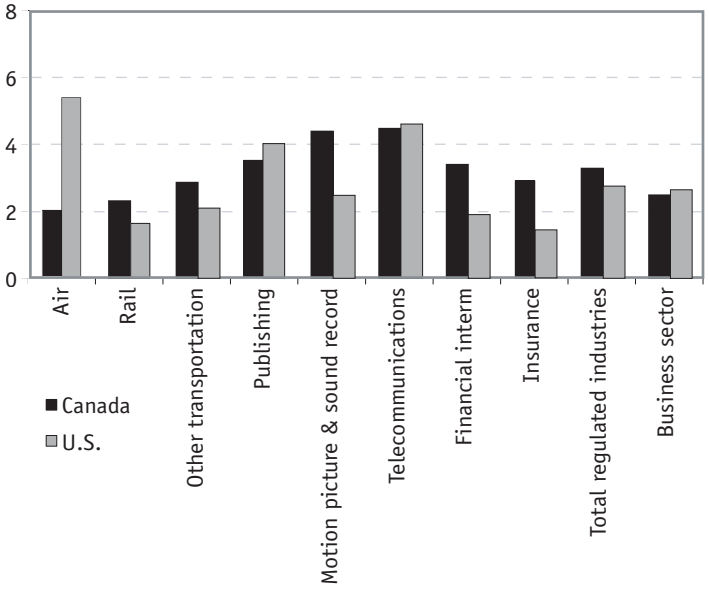
ductivity growth in Canadian publishing and information services, which experienced less deregulation, stands in contrast to those industries where there was more deregulation.

Chart 3 presents the real GDP growth in regulated industries in Canada and the United States over the 1977-2006 period. Output growth in Canada was higher or comparable to that in the United States in six of the nine regulated industries. Again the exceptions are air transportation, publishing and information services, and telecommunications and broadcasting. Air transportation in Canada had much slower output growth than in the United States over the 1977-to-2006 period, which was due to slow growth in Canadian air transportation after the early 1990s.

In the rest of the section, we provide a Canada-U.S. comparison of labour productivity growth in individual industries over time, as shown in Charts 4 to 7. These charts show trends in the ratio of labour productivity in Canada to that in the United States (1977=100 for both countries). An index above 100 implies that the relative Canada–United States productivity level has increased relative to the base period. A decrease in the relative index implies that productivity growth in Canada has been slower than productivity growth in the United States. The slope of each line at a given year indicates the relative growth rates of labour productivity in the two countries.

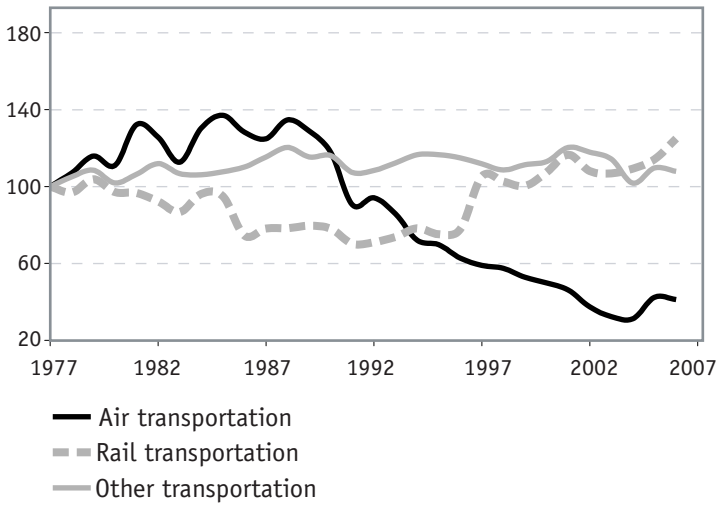
From 1977 to 1990, labour productivity growth was higher in Canada than in the United States in air transportation (Chart 4). After 1990, this situation reversed, with the United States leading in terms of labour productivity growth. Productivity growth has been particularly poor in the Canadian air transportation industry after 1990. On the other hand, the rail industry in Canada did not perform in the same manner as air transportation. There was a downward trend in the relative Canada–United States

Chart 3
Real GDP growth in Canadian and U.S. Regulated Industries, 1977-2006
(average annual rate of change)



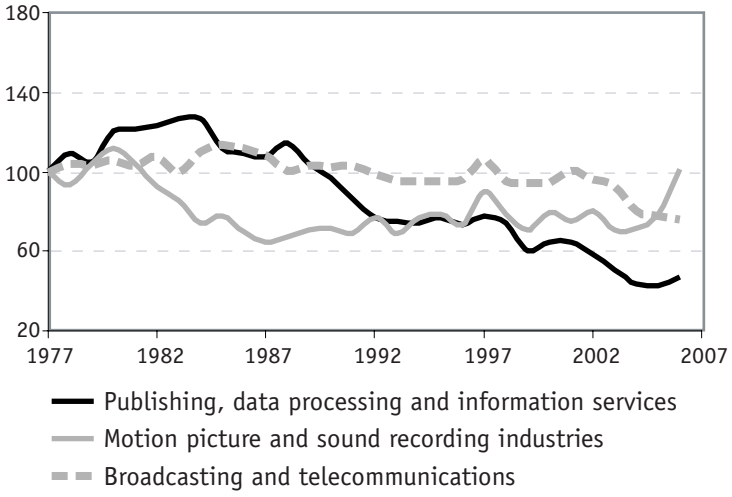
Source: Canada KLEMS and CANSIM Table 383-0021, Bureau of Economic Analysis.

Chart 4
Relative Canada/United States Labour Productivity in Transportation, 1977-2006
Index (1977=100)



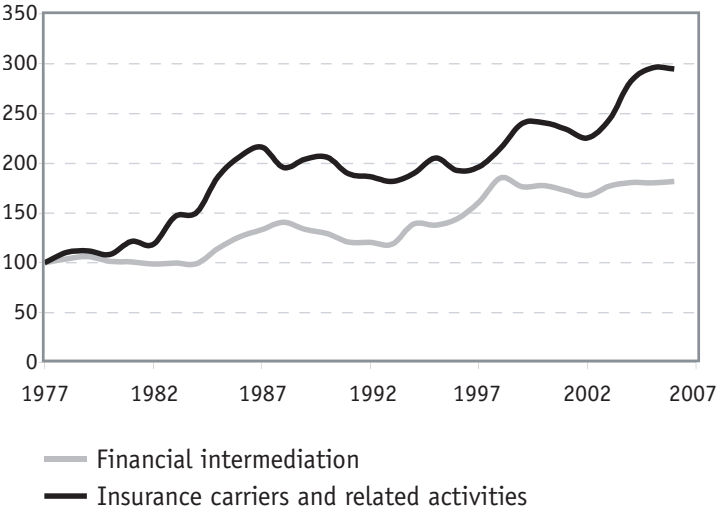
Source: Canada KLEMS, Bureau of Economic Analysis.

Chart 5
Relative Canada/United States Labour Productivity in Information and Cultural Industries, 1977-2006
Index (1977=100)



Source: Canada KLEMS, Bureau of Economic Analysis.

Chart 6
Relative Canada/United States Labour Productivity in Financial Services, 1977-2006
Index (1977=100)



Source: Canada KLEMS, Bureau of Economic Analysis.

labour productivity ratio until 1990. Thereafter, the ratio increased, with the rail transportation industry in Canada growing more quickly than in the United States. The other transportation services had slightly higher labour productivity growth in Canada than in the United States throughout the period.

Labour productivity growth in broadcasting and telecommunications was similar in the two countries before 2001, and after 2001 it was slower in Canada (Chart 5). In the publishing, data processing and information services industry, Canada outperformed the United States until the mid-1980s, as shown in Chart 5. Since then, labour productivity in the United States grew faster than in Canada. For the motion picture and sound recording industries, labour productivity growth was slower in Canada until the mid-1980s. Thereafter, labour productivity growth was similar in the two countries for most of the period.

Labour productivity growth in financial intermediation and insurance carriers was higher in Canada than in the United States in the 1977-2006 period (Chart 6). The ratio of Canadian to U.S. labour productivity showed a steady increase over the period for the two financial services industries. Alternative output measures using other data sources have shown that productivity growth of Canadian banks has been higher than that of American banks in recent years (Allen and Engert, 2007).

The overall labour productivity growth in the regulated industries was higher in Canada than in the United States over the period 1977 to 2006 (Chart 7). But there was some decline in Canada's relative productivity in the regulated industries after 2000, which was mostly due to the relatively slower productivity growth in the Canadian broadcasting and telecommunications services.

Canada–U.S. Comparison of Investment and Multifactor Productivity Growth in Regulated Industries

Labour productivity growth can be broken into two main components: gains that originate from changes in capital intensity (the amount of capital per hour worked); and growth in multifactor productivity (MFP), which is generally everything that cannot be accounted for by capital intensity growth. Growth in MFP is often associated with technological change, organizational change or economies of scale. In this section, we examine the sources of labour productivity growth in the regulated sector in Canada and the United States, and compare them in both countries over time. We will use a standard growth accounting technique:

$$\Delta \ln(LP_t) = \Delta \ln(MFP_t) + \bar{S}_K \Delta \ln\left(\frac{K_t}{L_t}\right),$$

where Δ denotes the change between periods *t-1* and *t*. *LP* is labour productivity defined as real gross domestic product (GDP) per hour worked, *K/L* is capital stock per hour worked, and $\bar{S}_K$ is the average share of capital income in nominal GDP in the periods *t-1* and *t*.

The equation shows the two main sources of labour productivity growth. The first term is MFP growth, which increases labour productivity growth on a point-for-point basis. The second term on the right-hand side is the contribution of capital deepening (or capital deepening effect), whereby more capital services make workers more productive.[8]

Table 5 presents labour productivity growth, the capital deepening effect and MFP growth in regulated industries in Canada and the United States over the 1977-2006 period. For the business sector, labour productivity growth and MFP growth were slower in Canada than in the

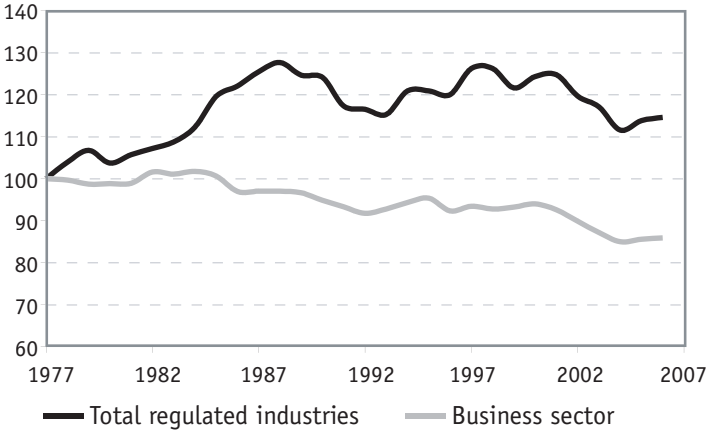
Table 5
Sources of Labour Productivity Growth in Regulated Industries in Canada and the United States, 1977-2006 (average annual rate of change)

	Canada			United States		
	LP	K/L	MFP	LP	K/L	MFP
Air transportation	1.8	0.9	0.9	5.0	0.6	4.3
Rail transportation	6.3	1.1	5.2	5.5	0.9	4.6
Other transportation	0.7	-0.1	0.7	0.4	-0.4	0.8
Publishing, data processing and information services	0.9	2.1	-1.3	3.5	1.3	2.2
Motion picture and sound recording industries	2.1	0.6	1.5	2.1	1.0	1.0
Broadcasting and telecommunications	4.5	1.3	3.1	5.4	2.4	3.0
Financial intermediation	2.6	2.8	-0.2	0.5	2.6	-2.0
Insurance carriers and related activities	4.0	3.8	0.2	0.2	1.8	-1.6
Total regulated industries	2.4	0.9	1.5	2.0	1.1	0.9
Business sector	1.4	0.5	1.0	2.0	0.7	1.2

Notes: LP denotes Labour productivity; K/L denotes contribution of capital intensity to labour productivity growth; MFP denotes multifactor productivity.

Sources: Statistics Canada, KLEMS database and CANSIM table 383-0021; Bureau of Economic Analysis.

Chart 7
Relative Canada/United States Labour Productivity in Regulated Industries and the Business Sector, 1977-2006
Index (1977=100)



Source: Canada KLEMS, Bureau of Economic Analysis.

8 For details on the growth accounting framework, see Jorgensen, Ho and Stiroh (2005) and Baldwin and Gu (2007a).

United States. The capital deepening effect was also smaller in Canada. However, for many of the Canadian regulated industries that underwent deregulation, labour productivity growth and MFP growth in Canada were higher or quite comparable with those in the United States. In addition, the investment and the capital deepening effect in those industries in Canada were also higher than in the United States or comparable to those of similar U.S. industries. Those industries include rail transportation, other transportation, motion pictures and sound recording, and financial services. For rail transportation, other transportation services, and motion pictures and sound recording, labour productivity growth and MFP growth were similar in Canada and in the United States. For the two financial services industries, labour productivity grew faster in Canada than in the United States. MFP showed little change in Canada but experienced a large decline in the United States.

The broadcasting and telecommunications industry experienced similar productivity growth in the two countries before 2001. After 2001, it had much slower productivity growth in Canada. Most of this slower labour productivity in the Canadian broadcasting and telecommunications industry was due to slower MFP growth in that industry after 2001. Baldwin and Gu (2009) found that the slower productivity growth in that industry was an important contributor to Canada's slower business sector labour productivity growth after 2000.

The publishing and information services and air transportation industries in Canada had slower labour productivity growth and MFP growth than in the United States in 1997-2006. But the capital deepening effect was similar in the two countries. This suggests that the slower labour productivity growth in Canada was due to slower MFP growth, and there was no deficiency in relative investment in those Canadian industries. The publishing and information services and air transportation industries in Canada experienced slower technological progress and slower improvement in production efficiency than did those in the United States.

The slower MFP growth and labour productivity growth in the publishing and information services industries in Canada occurred in a sector that experienced the least deregulation of the industries examined here. Productivity growth in air transportation slowed down during the period when Canada experienced a recession in the early 1990s, the effects of 9/11 and a number of other negative shocks associated with fuel price increases.

The contributions of capital deepening and MFP growth to labour productivity growth differ across industries. But the main contributor to labour productivity growth is the same in most industries between Canada and the United States. For the financial services sector, capital deepening is more important than MFP growth for labour productivity growth. For rail transportation, and broadcasting and telecommunications, MFP growth and technological progress are more important for labour productivity growth. For the cultural industries and air transportation, the capital deepening effect and multifactor productivity growth are both important for growth in labour productivity.

Conclusion

This article has examined productivity growth in nine Canadian regulated industries and compared the results with those in comparable U.S. industries. The evidence shows that many of the Canadian industries that underwent deregulation and opened market entry to competition experienced faster labour productivity growth and multifactor productivity (MFP) growth than the business sector over the 1977-2006 period. While the business sector had slower productivity growth in Canada than in the United States, most Canadian regulated industries had similar

or higher productivity growth relative to their counterparts in the United States.

In Canada, the growth in labour productivity in regulated industries ranged from an annual average rate of 1.8 per cent in air transportation, to 4.5 per cent in broadcasting and telecommunications and 6.3 per cent in rail between 1997 and 2006. The overall growth in labour productivity in the regulated industries was 2.4 per cent per year, higher than the business sector average (1.4 per cent). Between 1977 and 2006, growth in labour productivity in the business sector as a whole was slower in Canada than in the United States, 1.4 per cent versus 2.0 per cent per year.

In contrast to the situation in the business sector, most regulated industries in Canada had higher, or comparable, growth in labour productivity than their American counterparts. These include rail transportation, other transportation, motion pictures and sound recording, financial intermediation, and insurance. For example, the 2.6 per cent average annual rate of labour productivity growth in financial intermediation in Canada was much higher than the 0.5 per cent in the United States. Labour productivity growth in insurance was 4.0 per cent in Canada but zero in the United States. Labour productivity growth in motion pictures and sound recording was about the same in the two countries.

The broadcasting and telecommunications industry had similar productivity growth in the two countries before 2001. After 2001 the industry had much slower productivity growth in Canada.

On the other hand, labour productivity increased 5.0 per cent per year in air transportation in the United States over the 1977-2006 period, well above the 1.8 per cent rate in Canada. Productivity growth in publishing and information services was 3.5 per cent in the United States, compared to 0.9 per cent in Canada.

Overall, labour productivity growth in the regulated industries in 1997-2006 was higher in Canada than in the United States, 2.4 per cent per year versus 2.0 per cent.

On balance, the evidence for Canada is consistent with the empirical evidence from the European Union, the United Kingdom and other OECD countries that suggest that deregulation is associated with higher productivity growth. This comes from reduced barriers to entry, increased competition, and increased incentives to innovation and adoption of advanced technologies such as information technologies.

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International Comparisons of Industry-based Productivity Levels in the Financial and Business Service Sectors

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ABSTRACT

This article attempts to explain the relatively poor productivity growth in four major EU countries (Germany, France, United Kingdom, and Netherlands) relative to the United States. Our study is carried out from a sectoral perspective, focussing on the financial and business services sectors. Instead of examining only sectoral productivity growth rates, we also examine sectoral productivity level gaps. Our results imply that the productivity differential in the business services sector is a major factor behind the US lead in productivity.

THIS ARTICLE AIMS AT CONTRIBUTING to the explanations underlying the relatively poor productivity performance of European countries. Over the last decade, the United States has displayed productivity growth rates that are substantially above those observed in continental Europe. Van Ark et al. (2008) find for example that in the United States productivity growth increased from 1.2 per cent per year between 1973 and 1995 to 2.3 per cent per year in the 1995-2006 period. Over the same period, annual productivity growth in Europe declined from 2.4 per cent between 1973 and 1995 to 1.5 per cent during the second period.

Numerous authors have discussed the underlying reasons for this differential. In that regard, information and communication technologies (ICT) seem to have been of outstanding importance for the evolution of productivity over the last two decades (Oliner and Sichel, 2002). In particular, Jorgenson *et al.* (2007a) claim that in the late 1990s, the productivity differential in favour of the United States originated in ICT *producing* industries. This changed after the dot-com crash in 2000. Since then, the industries intensively *using* ICT capital have accounted for the differences in productivity growth and levels between the United States and the European economies.

A second factor put forward to explain the divergence in productivity dynamics between the two regions is total factor productivity. TFP growth seems to have been substantially higher in the United States. As most authors assert, this seems to hinge principally on more favourable institutional settings in the form of labour and product market regulations (Van Ark *et al.*, 2008).

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The two aforementioned factors are thought to have played an important role for the difference in productivity dynamics in the services sectors. Moreover, a number of authors believe that it is precisely the services sectors that are responsible for the bulk of the productivity gap between the European and Anglo-Saxon economies. Regarding manufacturing, one finds that in some European countries this sector is equally or even more productive than in the United States (Inklaar *et al.*, 2006). The Common European market is thought to have played a key role in that respect.[2] As the services sectors tend to gain economic weight in developed economies, it has become essential to understand the factors underlying these evolutions. The sectoral approach we adopt here is further justified by the heterogeneity of productivity performance atthe sectoral level, implying important limitations for the analysis of aggregate data (Jorgenson *et al.*, 2007b).

Following the above, this article focuses on the financial[3] and business services sector[4] of a set of five developed countries (France, Germany, the Netherlands, the United Kingdom, and the United States). The novelty of our analysis resides in the fact that we concentrate on both sectoral productivity level gaps and growth rates. Although there is an abundant body of literature that analyses sectoral productivity growth rates, only very few papers treat sectoral productivity level gaps (Inklaar *et al.*, 2006). Level gap evaluations allow a direct comparison of equivalent sectors in different countries. In addition, they provide valuable information on how to understand and interpret growth dynamics i.e. they permit detection of possible convergence or catching–up effects (Inklaar *et al.*, 2006). These effects may be all the more significant in branches such as the financial sector where technological spill-overs are very important and markets can be regarded as highly integrated. Our analysis is made possible by a new data set providing for internationally comparable industry level data and made available by the EU KLEMS project (Timmer *et al.*, 2007).

We concentrate particularly on the financial and business services sectors for a number of reasons. First, and most importantly, the two sectors are relatively important in size and account, on average in the five countries, for 6 per cent and 20 per cent respectively of total value added (see Chart 1a and b). Moreover, as can be seen from the charts, both sectors and especially business services display an increasing share in value added over the 1992-2006 period. The growing importance of market services can be explained by a number of interacting factors. Higher per capita income leads to an increasing demand for services. In addition, there is an increasing marketization of traditional household activities and many manufacturing firms

2 This underlines the importance of a number of measures aimed at creating a single market for services within the EU, notably the Services Directive and the Lisbon agenda. The Services Directive is an initiative of the European Commission aimed at creating a single market for services within the EU, similar to the single market for goods already existing. The Lisbon Strategy aims to make the EU 'the most dynamic and competitive knowledge-based economy in the world.' The agenda stresses the need to increase private and public spending on research (research and development expenditures should attain 3 per cent of GDP), while creating more jobs (raising the employment rate to 80 per cent), especially high-skilled ones. The agenda also underlines the need to open up protected sectors, to improve the climate for businesses, to reform labour markets, and to promote environmentally sustainable growth. So far it seems as if the Agenda is not living up to its ambitions as stated by the European Commission (2004) and Aghion *et al*. (2004) for example.

3 NACE Sub-sectors 65-67 including financial intermediation, central banking, Insurance and Pension funding and Activities auxiliary to financial intermediation.

4 NACE Sub-sectors 71-74 including renting of machinery and equipment, computer and related activities, research and development and other business activities (management, legal and accounting services etc.) We exclude real estate activities as the output of this industry reflects mostly imputed rents whose computation can vary substantially across countries.

Chart 1a
Share of Financial Services in Total Value Added

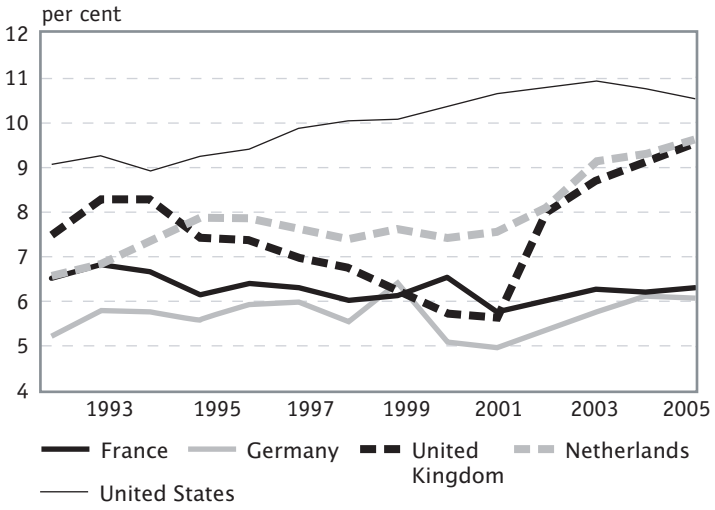
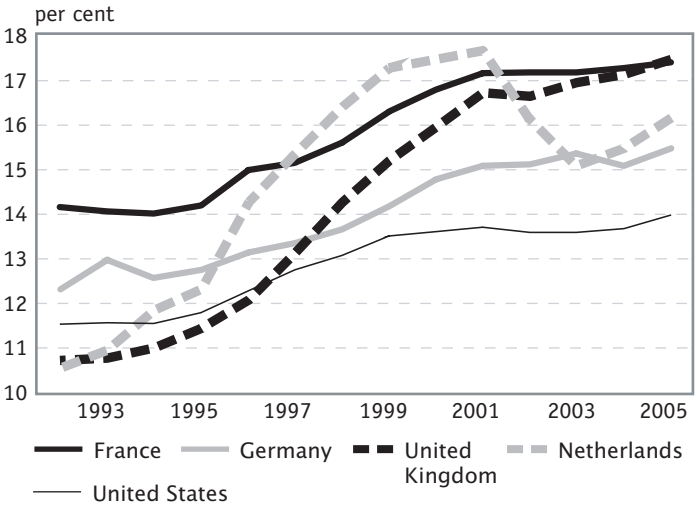


Chart 1b
Share of Business Services in Total Value Added



out-source more and more business services, trade and transport activities (Schettkat and Yocarini, 2005).

In addition to their importance in terms of value added, the two sectors also cater to other sectors in the economy by providing essential services. This means that productivity levels in those two sectors should have repercussions on the performance of other sectors in the economy. One need only think of the consequences that the functioning of the financial sector can have on investment decisions, or of the way legal or accounting services will influence the performance of companies in other industries. The impact of financial systems on growth has been well established empirically (see for example Levine, 2005 and de Serres *et al.*, 2006). Numerous studies based on macro or sectoral data find that financial development[5] has a significant impact on growth, either directly via productivity, or indirectly via its effect on the build-up of physical and knowledge capital (Pelgrin *et al.*, 2002).

In order to illustrate the importance of the two sectors, we now briefly present aggregate productivity growth and both sectors' contribution to it for the five countries. Our measure of productivity growth is here limited to the market economy, which means that health and education services, public administration and defence are excluded. We also exclude real estate activities (see footnote 3) and calculate our measure of productivity as value added over hours worked.

As presented in Chart 2, productivity growth has been the highest in the United States over the 1992-2005 period. Moreover, as mentioned above, productivity growth accelerated in the United States, while slowing down in most European countries. Between 1997 and 2005, it averaged 2.4 per cent per year in the United States (versus 1.5 per cent over the 1992-1997 period), but only 1.1 per cent in the United Kingdom (1.9 per cent over the preceding period) and 1.6 per cent in Germany (after 2.1 per cent over the preceding period). In France, productivity growth remained stable (1.5 per cent over the 1997-2005 period, after 1.4 per cent initially). The Netherlands was the only

5 Financial development is in most studies measured as the size of financial intermediation or of external finance relative to GDP.

one of the four European countries in which productivity growth increased substantially (2.0 per cent over the 1997-2005 period, after 1.0 per cent over the preceding period). In summary, productivity growth accelerated substantially in the United States and the Netherlands after 1997, remained stable in France, and decreased in the United Kingdom and Germany.

The contribution of the financial sector to overall productivity growth over the 1992-2005 period is highest in the United Kingdom (Chart 3a). When looking at sub-periods, this remains true as the financial sector's contribution in the United Kingdom over the second sub-period is 0.5 percentage points per year, after 0.4 percentage points in the first sub-period.

However, the increase of the sector's contribution is largest in the United States where the contribution doubles from the first to the second sub-period reaching 0.4 percentage points. The contribution of the financial sector also increased, albeit to a lesser extent, in France and the Netherlands, and became negative during the second sub-period in Germany. Consequently, the sector's contribution increased in all countries except Germany and doubled in the United States.

For the business services sector the contribution to overall productivity in the 1992-2007 period was the largest in the United Kingdom, followed by the United States (Chart 3b). This diagnosis changes, when looking at sub-periods. For the 1997-2005 period, the sector's contribution in the United States was of 0.7 percentage points per year compared to -0.1 points in the first sub-period. The sector contributed 0.6 percentage points to productivity growth in the United Kingdom in 1997-2005 (after 0.5 points initially). In France (0.0 points after -0.1 points) and the Netherlands (0.1 points after 0.0 points) the sector's contributions increased only slightly, whereas it was negative in both periods in Germany (-0.2 points). Again, it is the United States that experienced the largest increase in the sector's contribution between sub-periods, attaining also the highest contribution in the second sub-period.

Chart 2
Aggregate Productivity Growth, 1992 - 2005

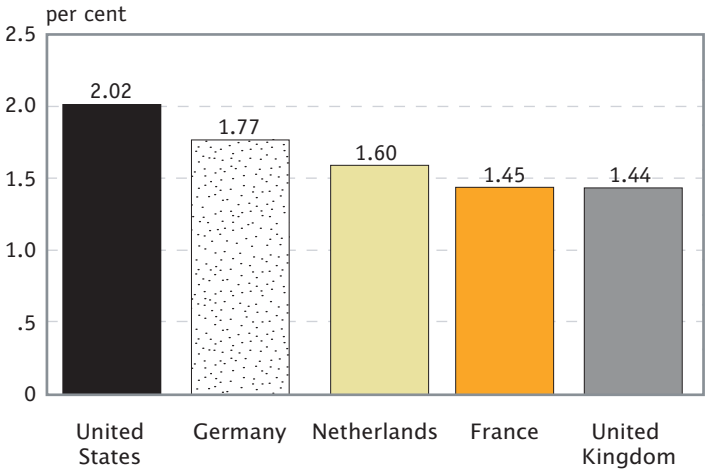
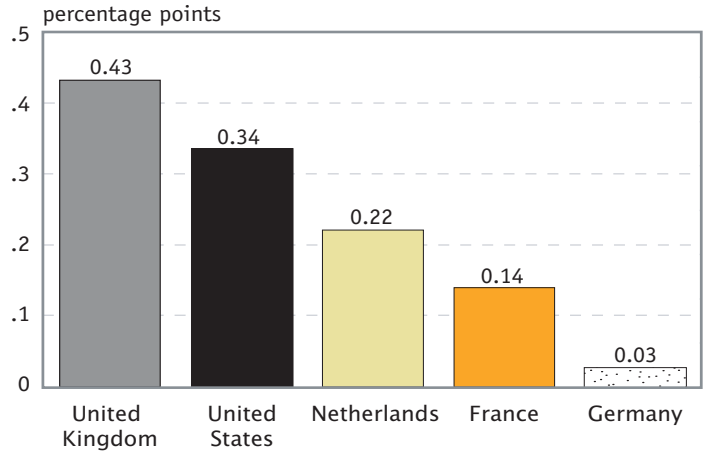
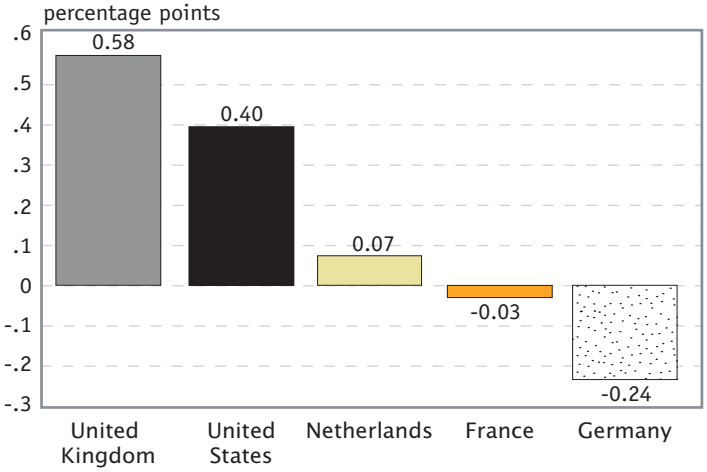


Chart 3a
Contribution of the Financial Sector to Overall Productivity Growth



An important caveat in the analysis of the contributions of the financial sector and business services to aggregate productivity growth is that the measurement of output in these sectors can be problematic. The measurement of output is in general much more difficult for services than in goods producing industries. (Grilliches, 1994,

Chart 3b
Contribution of the Business Services Sector to Overall Productivity Growth



for instance classified an important part of the services sector as 'unmeasurable'.) Most measurement problems hinge on the fact that services are intangible and often depend on the actions of consumers as well as producers. The measurement of nominal output in market services is generally straightforward, as it is mostly a matter of accurately registering total revenue. The main difficulty remains, however, the measurement of output volumes since the latter demands accurate price measurements that have to be adjusted for changes in the quality of services output (Van Ark *et al.*, 2008).

The measurement of banking output is even more challenging: only a part of banks' activities such as fees and commissions earnings can be measured directly. A large part of the sector's output, consisting essentially of the interest rate spread between loans and deposits, is indirectly accounted for (and referred to as financial intermediation services indirectly measured or FISIM).[6] In light of these measurement issues, the results presented further on should be interpreted cautiously.

The remainder of this article is organised as follows: the next section will briefly outline the methodology used to construct productivity growth rates and levels for the sectors of interest. A third section then presents our results for productivity levels, growth rates and input growth contributions. The fourth and last part will offer brief concluding remarks.

Methodology

Growth accounting

The analysis of productivity provided in this article is based on the standard growth accounting methodology as developed by Kuznets, Leontief and Jorgenson. We decompose productivity growth into the contributions of inputs. In order to obtain these contributions, we apply the methodology developed by Jorgenson *et al.* (2005), summarized in Inklaar and Timmer (2007). We define productivity as value added per hour worked. For each industry, value added growth is computed according to a neoclassical production function, using labour (L), ICT capital (K^{ICT}) and non-ICT capital (K^{N}). Total Factor productivity (A) is represented as a Hicks-neutral augmentation of aggregate inputs. We have for each industry a production function defined as:

$$VA_t = A\, f\left(L_t, K_t^N, K_t^{ICT}\right) \qquad (1)$$

Under the assumption of complete use of production factors, competitive factor markets and constant returns to scale (which implies $\bar{v}^L + \bar{v}^N + \bar{v}^{ICT} = 1$), gross value added can be defined as the weighted growth rate of inputs and total factor productivity (here calculated as a residual):

6 The interested reader can find more details on measurement issues in the financial sector in Williams *et al.* (2009) for the United Kingdom, Fixler and Zieschang (1999) for the United States and Inklaar *et al.* (2008) for European Union member countries.

$$\ln\frac{VA_t}{VA_{t-1}} = \bar{v}^L \ln\frac{L_t}{L_{t-1}} + \bar{v}^N \ln\frac{K_t^N}{K_{t-1}^N} + \bar{v}^{ICT} \ln\frac{K_t^{ICT}}{K_{t-1}^{ICT}} + \ln\frac{A_t}{A_{t-1}} \quad (2)$$

where $\bar{v}^j$ is the two-period average share of input type i in nominal value added. Capital services are defined as the aggregate of the individual capital stocks weighted by the asset's compensation share in total capital compensation:

$$\ln\frac{K_t}{K_{t-1}} = \sum_j \bar{v}_j^K \ln\frac{K_{j,t}}{K_{j,t-1}} \quad (3)$$

where $\bar{v}_j^K$ denotes the two-period average share of asset type j in total nominal capital compensation. For our analysis we distinguish between two types of capital: ICT capital (communication equipment, computing equipment, and software) and Non-ICT capital (transport, other machinery and equipment, and non-residential structures).

The change in labour composition is defined as the difference between the growth of labour inputs and the growth of total hours worked:

$$\ln\frac{q_t^L}{q_{t-1}^L} = \sum_h \bar{v}_h^L \ln\frac{L_{h,t}}{L_{h,t-1}} - \ln\left(\sum_h L_{h,t} \Big/ \sum_h L_{h,t-1}\right) = \ln\frac{L_t}{L_{t-1}} - \ln\frac{H_t}{H_{t-1}} \quad (4)$$

where L_t is the labour input index, aggregated over the h labour types using labour compensation shares and H_t is total hours worked summed over the different labour types.

In order to obtain labour productivity growth, we use value added per hour worked (va = VA/H). Capital input is also expressed in terms of hours worked (k = K/H) and TFP growth is simply deduced as a residual:

$$\ln\frac{va_t}{va_{t-1}} = \bar{v}^L \ln\frac{q_t^L}{q_{t-1}^L} + \bar{v}^N \ln\frac{k_t^N}{k_{t-1}^N} + \bar{v}^{ICT} \ln\frac{k_t^{ICT}}{k_{t-1}^{ICT}} + \ln\frac{A_t}{A_{t-1}} \quad (5)$$

Level gaps accounting

In order to compare productivity levels across countries, we use a methodology proposed by Inklaar and Timmer (2007). We assume that the production function is identical between countries.[7] Consequently, equation (5) can be used with time subscripts replaced with country subscripts (the United States is the reference country).

$$\ln\left(\frac{va_C}{va_{USA}}\right) = \bar{v}_L \ln\left(\frac{q_C}{q_{USA}}\right) + \bar{v}_{ICT} \ln\left(\frac{k_C^{ICT}}{k_{USA}^{ICT}}\right) + \bar{v}_N \ln\left(\frac{k_C^N}{k_{USA}^N}\right) + \ln\left(\frac{A_C}{A_{USA}}\right) \quad (6)$$

Until recently, comparisons of productivity levels by industry have been hampered by the lack of a comprehensive dataset for Purchasing Power Parities (PPPs) for industry outputs and inputs. Indeed, any reasonable comparison of industry performance in different countries needs a comprehensive set of industry-specific PPPs, as they are required to transform national output and input measures into internationally comparable quantity indexes. For the purposes of this study we use a new dataset made available by the EU-KLEMS project. This dataset provides industry PPPs for the year 1997 and covers 45 industries at the 2-digit level. The gross output PPPs have been made transitive by applying the EKS procedure and are available for

7 This assumption entails that the technological frontier is the same for all sample countries and that production sets differ across countries only because of differences in factor endowments. This hypothesis is in line with standard neoclassical trade theory and goes hand in hand with the hypothesis of constant returns to scale.

Table 1
PPPs/Exchange Rate for Financial Services, 1997

	France	Germany	Netherlands	United Kingdom	United States
PPP II	1.23	1.14	1.01	1.07	1
PPP GO	1.02	1.06	0.82	0.82	1
PPP VA	0.9	1.01	0.71	0.64	1

Table 2
PPPs/Exchange Rate for Business Services, 1997

	France	Germany	Netherlands	United Kingdom	United States
PPP II	1.17	1.19	1.14	1.18	1
PPP GO	1.85	1.40	1.40	1.30	1
PPP VA	1.85	1.39	1.41	1.30	1

all OECD countries.[8] The sample of countries we will here concentrate on consists of France, Germany, the Netherlands, the United Kingdom and the United States, the latter being the sample's reference country.

Based on the EU-KLEMS dataset for gross output PPPs we construct, in a first step, PPPs for value added. The latter are based on the relation between gross output and value added as defined in national input output tables (Gross Output – Intermediate Consumption = Value Added). Analytically this gives the following expression, used also in a number of other articles on the subject (e.g. Inklaar *et al.*, 2006; Rao *et al.*, 2004).

$$\ln\left(\frac{P_C^{GO}}{P_{USA}^{GO}}\right) = \overline{w}\ln\left(\frac{P_C^{VA}}{P_{USA}^{VA}}\right) + (1-\overline{w})\ln\left(\frac{P_C^{II}}{P_{USA}^{II}}\right) \quad (7)$$

Where P_C^{GO} and P_{USA}^{GO} are the relative price levels of gross output in country C and the USA respectively, P_C^{VA} and P_{USA}^{VA} the relative price levels of value added, P_C^{II} and P_{USA}^{II} the relative price levels for intermediate inputs and $\overline{w}$ the share of value added in gross output averaged between the country in question and the reference country, in our case the United States.

Based on this expression, it is necessary to calculate PPPs for intermediate inputs. The methodology we follow is outlined in great detail in Inklaar and Timmer (2007). For the computation of intermediate input PPPs, we assume that the price of a good is independent of its use. Thus, we calculate intermediate input PPPs for the two industries in question, by aggregating gross output PPPs of the delivering industries weighted by their importance in the industry's total intermediate inputs. In addition, PPPs for intermediate inputs should reflect the costs of purchasing intermediate deliveries, and should hence be based on purchasers' prices. As the PPPs for gross output in our data set are based on basic prices, we have to adjust the gross output PPPs for transport and trade margins and net taxes. Data on margins and net taxes are only available for commodities and not by industry. In order to obtain information on pricing behaviour in a particular industry, we aggregate margins for commodities by their weight in the industry's output. Note that our analysis is based on pair wise comparisons of countries vis-à-vis the United States so all ratios are bilateral. Table 1 shows the intermediate input and the resulting value added PPPs relative to the market exchange rate. For instance, when comparing Germany's intermediate input PPP in finance with the one for the United States (normalized to 1), one can see that inputs in Germany are more expensive than in the United States.

As it can be seen from the Tables 1 and 2, intermediate consumption is more expensive in the four European countries than in the United States. But whether value added will be more or less 'expensive' than in the reference country depends not only on relative prices for intermediate inputs and outputs,

8 For a thorough description of the dataset, see (Timmer et al., 2007).

but also on the weight intermediate inputs and value added have in gross output. The latter differs not only by country, but also by industry. Indeed, the share of value added in gross output is on average 5 percentage points higher in finance than in business services.

Compared to the United States, value added is less 'expensive' in finance in all sample countries except Germany. Hence, when applying the PPP for value added to the measure of value added as given in national input output tables, the resulting quantity will be bigger than the initial value for France, the UK and the Netherlands, but will be smaller for Germany.

In contrast, the usual measures of value added in the business sector given in national input output tables will be divided by the PPPs derived above. Hence, quantity indices of value added in the business sector will be smaller than the initial unadjusted values found in national input output tables.

The computation of PPPs for capital inputs are based on the method proposed by Jorgenson and Nishimizu (1978). The PPPs for capital services are based on PPPs for investment provided by Eurostat and the OECD. These PPPs for investment are adjusted by the ratio of user costs of capital between countries (which depends on capital's rate of return, depreciation rates and investment price changes). For our analysis we use capital input PPPs as calculated by Inklaar and Timmer (2007).

The PPPs for labour input are based on the methodology proposed by Jorgenson and Grilliches (1967), which involves aggregating relative wages across different labour types using labour compensation shares for each labour type as weights. For this purpose we distinguish between three labour categories: high-skilled (university graduates), medium-skilled (roughly higher education below degree), and low-skilled (no formal qualifications). The resulting quantity indices for inputs and outputs and the subsequent productivity levels are presented in the next section of the article.

Table 3
Sources of the Gap in Labour Productivity in the Financial Services Sector
(value added per hour worked, gap measured as percentage productivity differential relative to the US)

	France	Germany	Netherlands	United Kingdom
1997				
Productivity differential	12.4	-8.8	23.0	7.8
Contributions from				
Labour Composition	3.0	-3.1	-0.7	-4.0
ICT Capital	-1.3	-0.8	0.4	-1.6
Non-ICT Capital	-8.2	6.2	13.0	-11.7
TFP	18.8	-11.1	10.4	25.1
2005				
Productivity differential	15.2	-32.9	23.0	16.6
Contributions from				
Labour Composition	6.4	-2.4	3.2	-2.4
ICT Capital	4.9	-7.5	0.7	0.2
Non-ICT Capital	-1.4	4.7	3.3	-11.6
TFP	5.2	-27.7	15.7	30.3

Results for level and growth accounting

Finance

Productivity levels – differentials and input contributions

Table 3 shows the productivity differential and the input contributions to it for the financial sector in the sample countries vis-à-vis the United States in 1997 and 2005.

In 1997, we find that the productivity level in the financial sector in the Netherlands is 23.0 per cent higher than in the United States. This difference is due to the positive contributions of non-ICT capital (13.0 points), TFP (10.4 points) and ICT capital (0.4 points) and to the negative contribution of labour composition (-0.7 points).

More generally, productivity levels in the financial sector in 1997 in the four European

countries except for Germany are higher than in the United States. This is the case although the contribution of labour composition is negative in three of the countries (the exception is France). The contribution of labour composition is negative because the share of hours worked by the highly skilled in total hours worked is at least two times higher in the United States (40 per cent) than in the other countries.[9] Also, it should be underlined, that ICT capital's contribution to labour productivity is higher in the United States than in the European countries, except in the Netherlands, a fact confirmed by numerous other studies (Inklaar *et al.*, 2005).

Germany is the only country among the four European countries with a lower level of labour productivity in the financial sector than the United States. This is due to a negative contribution of TFP in 1997, while TFP's contribution is highly positive in the other three countries. Although the underlying explanations behind Germany's negative TFP performance are beyond the scope of this analysis, an important reason might be the financial sector's high degree of fragmentation. Indeed, Germany's banking landscape is shaped by many small and often state-run banks (*Sparkassen*, *Landesbanken*) hampering the diffusion of positive externalities and the realization of returns to scale due to agglomeration or size effects. For a sample of German and Italian banks, Fiorentino *et al.* (2009) find that the privatized banks indeed experienced a significant increase in productivity.

The second part of Table 3 shows the productivity differential and the input contributions to it for the financial sector in the sample countries vis-à-vis the United States in 2005. Between 1997 and 2005, France and the United Kingdom increased their lead on the United States and the Netherlands-US gap remained unchanged. In the Netherlands, all components contributed positively to the productivity differential, but TFP's contribution was by far the most significant. TFP growth and to a lesser extent ICT capital were the principal drivers behind the increase in the UK's productivity differential vis-à-vis the United States (here the differential in favour of the United Kingdom actually doubled).

In 2005, Germany continued to be the only one of the four countries with a lower level of labour productivity in the financial sector than the United States. Between 1997 and 2005 the negative differential vis-à-vis the United States more than tripled from 8.8 percentage points to 32.9 points, with lower TFP the single most important driver of this development. In Germany, negative contributions come from all inputs except non-ICT capital accumulation. A classical explanation for the negative contribution of ICT capital would be an institutional framework that does not allow firms the organisational flexibility needed to benefit fully from ICT capital (Gust and Marquez, 2003). The negative effects induced by the composition of Germany's labour force could also hamper productivity growth in the German financial sector, as a certain level of qualification is needed to reap the full benefits of ICT diffusion. The highly negative TFP contribution could also reflect the structure of the German banking sector (see preceding paragraph). The latter has changed very little, whereas the liberalization of financial markets advanced considerably in the other sample countries. Given this first set of results, the financial sector does not seem to account for the EU's negative productivity differential vis-à-vis the United States, but might contribute to it in the case of Germany.

9 Cette and Bourles (2007) find that observed productivity measures can be biased. Using a model that takes into account diminishing returns to hours worked, they show that 'structural' estimates of hourly productivity growth for several European countries are 10-15 percentage point below observed measures. These estimates assign some role to labor market institutions in explaining Europe's productivity performance.

Productivity growth and input contributions

Over the first sub-period (1992-1997), Table 4 shows that ICT capital contributed heavily to labour productivity growth in the financial sector for all five countries. In contrast, the non-ICT capital contribution was less significant and even negative in the Netherlands. The most significant factor behind productivity growth in Germany and the United Kingdom was TFP growth, probably going hand in hand with financial market liberalization. Surprisingly, TFP growth was negative in the United States.

Over the second sub-period (1997-2005), labour productivity growth in the financial sector was very strong in all countries except Germany, where it was negative. Labour productivity growth accelerated relative to 1992-97 in all countries except the United Kingdom, where the rate of productivity growth remains still high (3.9 per cent per year) and Germany, where it fell 4.3 percentage points. In all countries, the principal driver of labour productivity growth was ICT capital accumulation, as was largely the case during the preceding period. Note that labour composition's contribution was smallest in the United States. In fact, absolute labour input growth (measured by total hours worked) increased the most in the United States. But, at the same time, the share of hours worked by the low-skilled increased only in the United States, while decreasing in the four European countries.

In summary, we observe that in 1992-1997 the labour productivity growth differential in the financial sector vis-à-vis the United States was positive for three of the four European countries (France was the exception) and that in 1997-2005 it was positive for two countries (the exceptions were Germany, where growth was negative, and the Netherlands, where growth was the same as in the United States). In both periods, the main drivers of labour productivity growth generally were ICT capital and TFP growth to some extent, the latter reflecting most probably structural features of the respective economies. In addition, TFP contributions exhibited in the majority of countries a downward trend between periods. Irrespective of the underlying growth drivers, it is, however, not the financial sector that accounts for the aggregate labour productivity growth differential in favour of the United States. Moreover, observed growth patterns and drivers of the financial sector are similar across countries. This could be due to the fact that financial markets are quite homogeneous and integrated. One way to corroborate this intuition is to look at intermediate consumption (Inklaar and Timmer, 2007). Intermediate service consumptions are usually higher in the United States than in other countries. Yet, looking at the different types of intermediate consumption (material, energy, and services), we find that the structures in the financial sectors are quasi-identical across countries. This implies that the degree to which services are

Table 4
Sources of Labour Productivity Growth in Financial Services
(value added per hour worked, percentage growth and contributions)

	France	Germany	Nether-lands	United Kingdom	United States
1992-1997					
Productivity	0.0	3.0	2.2	4.9	2.0
Contributions from					
Labour Composition	0.5	0.5	0.4	0.3	0.2
ICT Capital	0.5	0.9	1.5	1.2	1.6
Non-ICT Capital	0.0	0.5	-0.1	0.5	0.7
TFP	-1.0	1.2	0.4	2.9	-0.4
1997-2005					
Productivity	3.0	-1.3	2.7	3.9	2.7
Contributions from					
Labour Composition	1.2	0.6	1.5	0.8	0.4
ICT Capital	1.2	0.8	1.9	1.8	1.8
Non-ICT Capital	0.4	0.1	-0.7	0.1	0.3
TFP	0.2	-2.8	0.0	1.2	0.1

Table 5
Labour Productivity Growth and TFP Contributions in Financial Services, 1992-1997 and 1997-2005
(value added per hour worked, in per cent and percentage points)

	France	Germany	Nether-lands	United Kingdom	United States
1992-1997					
Labour productivity	0.0	3.0	2.2	4.9	2.0
TFP	-1.0	1.2	0.4	2.9	-0.4
1997-2005					
Labour productivity	3.0	-1.3	2.7	3.9	2.7
TFP	0.2	-2.8	0.0	1.2	0.1

Table 6
Sources of the Gap in Labour Productivity in Business Services
(value added per hour worked, gap measured as percentage productivity differential relative to the US)

	France	Germany	Netherlands	United Kingdom
1997				
Productivity differential	-14.1	2.7	-16.4	-30.3
Contributions from				
Labour Composition	-2.8	-9.1	7.6	-8.2
ICT Capital	0.8	1.7	-1.4	-1.6
Non-ICT Capital	8.1	26.6	2.2	-3.6
TFP	-20.1	-16.6	-24.8	-16.9
2005				
Productivity differential	-28.4	-21.4	-24.3	-32.6
Contributions from				
Labour Composition	-3.9	-9.5	9.7	-10.8
ICT Capital	1.7	-7.3	-7.6	-7.1
Non-ICT Capital	8.0	20.6	0.4	-3.2
TFP	-34.2	-25.2	-26.8	-11.4

outsourced is similar across the financial sectors of the five countries.

The financial sector's productivity performance in the light of the current turmoil

As seen above, TFP growth, along with ICT capital, is an important driver of labour productivity growth in the financial sector. TFP growth is calculated as a residual. Hence, it captures intangible assets such as organizational efficiency and technological progress. It can also reflect more or less favourable institutional settings in the form of product and labour market regulations. Last but not least, TFP growth may simply be 'a measure of our ignorance' as Abramovitz put it. In that spirit and in light of the current financial turmoil, TFP growth, or at least parts of it, could as well be related to evolutions in the financial sector that have little to do with the sectors' fundamentals. In particular, TFP growth may be influenced by over-evaluations of assets prices, which inflated value added artificially and which will prove transitory, or indeed may have already proven transitory with the economic crisis.

In Table 5 we compare annual average productivity growth and TFP's contribution to it over the two sub-periods (1992-1997 and 1997-2005). In comparison to the first sub-period, the second one was relatively turbulent as a major crises, the dot-com bubble, took place. In addition, measures applied to the financial sector might have been biased by the build-up to what would become the financial crisis of 2007. When interpreting TFP growth as a factor capturing evolutions that are not reflected by the variations of explicit production factors, one would therefore assume that TFP growth would have been more important during the second sub-period. This is, however, not the case. TFP growth's contribution to productivity growth decreased between the two sub-periods in all countries except the United States and France. These results suggest that there is little reason to believe that our measures of productivity growth were more fragile to excessive developments in the financial sector in the second sub-period. That said, the general fragility related to TFP measures for financial sectors applies to our computations, implying that our results have to be interpreted cautiously.

Business Services

Productivity levels – differentials and input contributions

Regarding labour productivity levels in business services, our results are found in Table 6. In 1997, the productivity level for all countries except Germany were well below that in United States (per cent gaps ranged from -14.1 per cent in France to -30.3 pent cent in the United Kingdom). In Germany, the labour productivity level in business services was 2.7 per cent higher than in the United States. The contribution of labour composition to the gap differed significantly across countries: it was negative in all countries except in Netherlands. The contribution of ICT capital to the gap was small in all four countries, being slightly positive in Germany and France and slightly negative in the United Kingdom and the Netherlands. In addition, TFP's contribution is highly negative in all countries. Non-ICT capital is particularly significant in Germany, being the single factor explaining the positive productivity differential vis-à-vis the United States.

In 2005, labour productivity differentials in business services for all four European countries were highly negative in comparison to the United States, with the gap increasing in all four countries. A greater negative contribution to the gap from TFP was the most important reason behind this evolution in France and Germany, reflecting probably less pro-growth institutional settings and differences in organisational efficiency. However, when interpreting these results, one should bear in mind that the business services sector is very heterogeneous, covering various domains of economic activity (legal, accounting, design and translation activities, management and advertising, scientific and market research). ICT capital's contribution to the labour productivity gap in 2005 was negative in all countries except France. Non-ICT capital's contribution was negative only in the United Kingdom. Labour composition effects remain negative in all countries except the Netherlands.

Productivity growth and input contributions

In 1992-1997, labour productivity growth in business services was negative in all countries except the United Kingdom. Over this period, labour composition's contribution to labour productivity growth was small, but positive in all countries except the Netherlands where it was zero. This was related to the increase in the share of hours worked by the highly skilled. Both ICT and non-ICT capital contribute positively to labour productivity growth (except in the Netherlands where non-ICT capital made a negative contribution). Last but not least, TFP was an important growth driver of labour productivity in business services, but in the negative sense in all countries except the United Kingdom. Coupled with the fact that the sector is quite labour intensive, this underlines the importance of structural features such as the regulations on product and labour markets. In addition, TFP growth can be negatively affected by financing conditions, as found by Estevao and Severo (2010), since financial shocks can distort the allocation of factors across firms within an industry.

In 1997-2005, labour productivity growth in the business services sector varied significantly across countries, ranging from 3.1 per cent per year in the United States and 3.0 per cent in the United Kingdom to -1.8 per cent in Germany. This is in line with changes in the productivity differentials between 1997 and 2005 as found in Table 6, which showed an increase in the US advantage. In Germany and France, labour productivity growth was identical, and negative, in both sub-periods, underlying the need of structural reforms in the market services, in line with the Lisbon Strategy. More generally, the contribution of labour composition to labour productivity growth was positive in all countries in 1997-2005, since the share of hours worked by the highly skilled increased substantially in all countries. The contribution of ICT

Table 7
Business Services, Productivity Growth and Input Contributions
(value added per hour worked, percentage growth and contributions)

	France	Germany	Nether-lands	United Kingdom	United States
1992-1997					
Productivity	-0.1	-1.8	-0.3	3.3	-0.8
Contributions from					
Labour Composition	0.5	0.5	0.0	0.3	0.2
ICT Capital	0.5	1.0	0.3	1.1	1.2
Non-ICT Capital	0.9	1.1	-0.5	0.2	0.4
TFP	-2.0	-4.4	-0.1	1.7	-2.6
1997-2005					
Productivity	-0.1	-1.8	0.8	3.0	3.1
Contributions from					
Labour Composition	0.7	0.3	0.6	0.1	0.4
ICT Capital	0.5	1.4	0.7	1.5	1.9
Non-ICT Capital	0.3	0.5	0.4	0.7	0.5
TFP	-1.6	-4.0	-0.9	0.7	0.3

capital was somewhat greater in most countries than in 1992-1997. It is important to note that the contribution of ICT capital was particularly important in the United States (around three times the contribution of ICT Capital in France). In addition, in all countries except the United States and the United Kingdom TFP growth was negative. This may suggest an absence of hampering institutional settings in these two countries.

The key development in business services between the 1992-1997 and 1997-2005 periods was the massive 3.9 percentage-point acceleration of labour productivity in the United States (from -0.8 per cent per year to 3.1 per cent per year). There was no change in labour productivity growth in France and Germany between periods, while labour productivity growth picked up in the Netherlands and fell in the United Kingdom, albeit from a high growth rate. The importance of ICT capital and TFP growth for the business services sector should be underlined. The interpretation of the latter should however, be undertaken with caution.

Over the period under consideration productivity levels and growth rates in the European countries of our sample lag very much behind those in the United States. There can be no doubt that, given the sector's importance and size, it accounts for a large part of the productivity differential between the United States and the European countries (see also the introduction for the computations of the sectors' contribution to the productivity growth rate of the overall market economy). Moreover, given the productivity level gaps, we can exclude possible catching-up effects as an underlying reason for the diverging growth dynamics across the sample countries. Subsequently, possible explanations for the increasing US productivity lead in business services include greater ICT capital accumulation and positive effects of a higher percentage of skilled workers on average, both related to more favourable institutional settings. Given these results, the swift implementation for the Services Directive could prove to be an important step towards narrowing the productivity differential in business services vis-à-vis the United States.

Conclusion

This article employs a sectoral approach to productivity level gaps and growth rates. The first part of our exercise consisted of computing productivity levels for the years 1997 and 2005 for the financial and business services sectors of five advanced economies (France, Germany, the Netherlands, the United Kingdom and the United States). We found that productivity levels in the sample countries' financial sectors are very similar and that the European countries do not seem to lag behind the United States.

Indeed, our measures imply that productivity levels (value added per hour worked) in the European financial sectors are actually higher than in the United States. This situation may be explained by lower regulatory barriers to competition in the banking sector: all the European

countries of our sample were less regulated than the United States in 2003, and a regulatory environment that is conductive to competition has a significant positive impact on sectoral output and potential growth (de Serres *et al.*, 2006). This is true for all countries but Germany where productivity levels are substantially lower. We believe that one important factor behind Germany's poor performance is the high degree of fragmentation of its financial system, the small size of its institutions impeding on their returns to scale.

Nevertheless, our results should be interpreted with caution. We have calculated TFP as a residual and the classical explanation for TFP is that it reflects primarily more or less favourable institutional settings. The distinction between prices and volumes being an uneasy undertaking for the financial sector (see the introduction for a discussion of measurement issues of output in finance), a different reading would be that TFP simply reflects errors in our computations or the omission of one or several explanatory variables (intangible assets being one possibility). Bearing in mind these constraints, our results still support the view that it is not the financial sector(s) that is responsible for Europe's negative productivity differential vis-à-vis the United States.

In terms of labour growth rates in the financial sector, the principal drivers are ICT capital and TFP growth. This is the case for all five countries and in both sub-periods. In addition, when examining the two sub-periods, we observe that productivity growth accelerated somewhat in the second period (1997-2005) in line with increasing contributions of ICT capital.

Regarding business services, productivity level gaps vary significantly. But one should bear in mind that this sector is very heterogeneous in its composition and covers various domains of economic activity (legal, accounting, design and translation activities, management and advertising, scientific and market research). Market structure varies across countries, and this heterogeneity between European economies is for instance underlined by the OECD's PMR indicator (Conway and Nicoletti, 2006). Labour productivity levels in the business services sectors of European countries are generally substantially below the US level. This is not the case in Germany where productivity was well above the other countries in 1992-1997; however, this proved to be transitory as in 2005, the productivity level in the German business services sector converged to the level of other European countries and was below that of the United States. Given this sector's importance in total value added, we believe that the business services sector accounts for a large part of the EU's negative productivity differential vis-à-vis the USA. This conclusion seems to be broadly in line with the findings of numerous other authors such as Van Ark *et al.* (2008).

Labour productivity growth rates for the business services sector vary significantly across countries, implying different trends in TFP growth. The contribution of ICT capital is important in all countries. However, it must be borne in mind that the positive effects of ICT capital accumulation will also depend on intangible factors such as organizational efficiency or educational levels and life-long learning (Brynjolfsson and Hitt, 2003). Also, in contrast with to the financial sector, labour productivity growth in business services did not accelerate during the second sub-period (1997-2005) except in the Netherlands and the United States. This implies that the observed labour productivity growth patterns cannot be explained by catch-up effects. Nonetheless, given the sector's importance for the national economies, our results imply that the sectors' poor performance contributed to the EU's negative productivity differential vis-à-vis the United States.

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