IC Insights
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Industry Canada Industrie Canada

# IC Insights

*Information and analysis from across Industry Canada*
Summer 2013



## Inside this issue .....



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# Recent Developments of Interest to Industry Canada

**China forecast to become the world's largest economy by 2017**

- According to International Monetary Fund (IMF) forecasts, China is set to become the world's largest economy by 2017, overtaking the U.S.
- In 2017, China's economy will represent 18 percent of the world's gross domestic product (GDP), up from a share of 14 percent in 2011 and 2 percent in 1980.
- Canada's economy represents less than 2 percent of world GDP, and is ranked as the world's 13th largest economy. Canada is forecast to maintain this ranking until 2017, when Indonesia is projected to move up to 13th.

**Quantum Valley**

- Researchers at the Institute for Quantum Computing (IQC) at the University of Waterloo are making great strides in developing world-leading technologies in quantum information processing.
- While a fully-functional general-use quantum computer may still be years away, IQC's research into quantum mechanical effects has enabled it to accomplish tasks in cryptography that were deemed impossible using classical communication technologies.
- IQC's breakthroughs in quantum technologies are being developed for the market within an innovation eco-system in the Waterloo region that includes incubators and accelerators, such as Communitech, as well as a Quantum Valley Investments, a $100 million venture capital fund.
- This eco-system has become known as "Quantum Valley" in recognition of its potential for generating enormous economic activity, reminiscent of Silicon Valley in California.

**Canada's participation in Global Value Chains (GVCs)**

- A relatively new OECD-WTO database – Trade in Value-Added – provides interesting insights into countries GVC participation by measuring foreign inputs/value added included in a country's exports (upstream links) or measuring the domestic inputs/value added of the county contained in the exports of other countries (downstream links).
- While the OECD-WTO data tends to rank Canada low in GVC participation – fourth lowest, ahead of only South Africa, New Zealand and Brazil – many of the G7 economies are found in the lower end. Canada's mining sector and transport equipment industries show the highest participation in GVCs.
- The OECD-WTO trade data also shows that services, such as logistics, design, and transportation, are far more important to global commerce than they appear in traditional calculations of exports and imports. In Canada, services value added represents nearly 40 percent of total exports.
- Interpreting national GVC participation is difficult, as different industry compositions make direct comparisons challenging, and trade-related indicators provide incomplete measurement.

**North America is to lead a shift in global energy balance**

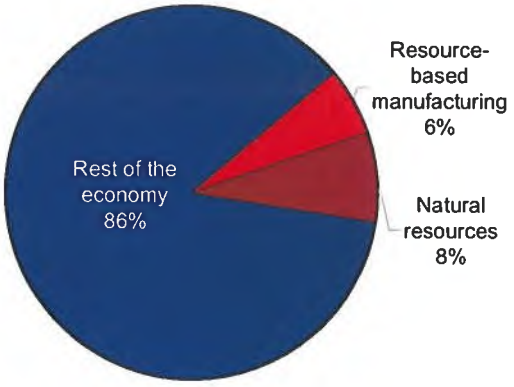
- The World Energy Outlook 2012 by the International Energy Agency projects that the U.S. will become the world's largest oil producer by about 2020. As well, embedded in its forecasts are the impacts of new fuel-efficiency measures in transport.
- The result is a continued fall in U.S. oil imports, to the extent that North America is forecasted to become a net oil exporter around 2030.

# Resource-Based Manufacturing in Canada

## Introduction

The resource sector is a vital contributor to the Canadian economy. The natural resource sector's (agriculture, forestry, fishing, and hunting and mining and oil and gas extraction) real GDP amounted to about $87 billion in 2012, and it employed nearly 700,000 workers. Including resource-based manufacturing[1] in natural resources, the sector represented 14 percent of Canada's economy in 2009 (Figure 1).

**Figure 1: Economic composition of Canada's natural resource industries (2009)**




Resource-based manufacturing comprises four key sub-sectors in Canada:

- Food processing
- Wood processing
- Petroleum and chemicals processing
- Mineral and metal processing

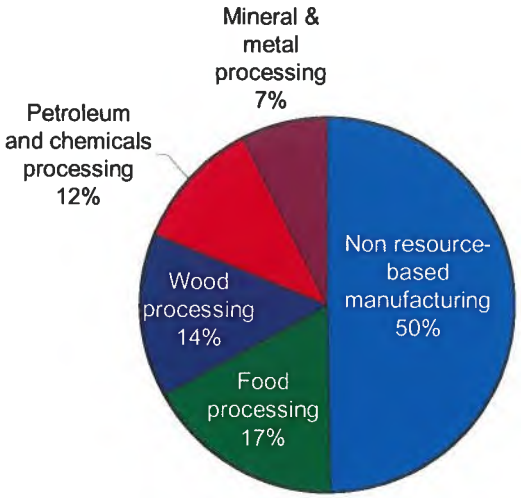
## GDP and Employment in Resource-based Manufacturing

Real GDP in resource-based manufacturing was about $82.6 billion in 2012. Resource-based manufacturing represented 55.6 percent of nominal manufacturing GDP in 2009. Food processing had the biggest nominal GDP share of the resource-based manufacturing industries in 2009, followed by petroleum and chemicals processing.

In 2012, resource-based manufacturing employed close to 750,000 workers, representing about half of manufacturing employment. The largest number of employees in 2012 were in food processing, and the least in mineral and metal processing (Figure 2).

Similar to other parts of the manufacturing sector, increasing competitive pressures from emerging economies have affected resource-based

**Figure 2: Resource-based industries in manufacturing employment (2012)**




[1] See Annex Table 1 for a definition of industries included in resource-based manufacturing.

manufacturing in Canada. Resource-based manufacturing's real GDP declined 1.3 percent per year between 2002 and 2012, similar to total manufacturing's annual average decline of 1.0 percent. Employment declined by over 200,000 workers, or 21.8 percent, compared to a decline of 440,000 workers, or 22.8 percent, in total manufacturing.

## Productivity

In 2007, only five of the eleven resource-based manufacturing industries had a higher level of labour productivity than total manufacturing (Figure 3). Beverage and tobacco product manufacturing had a very high labour productivity level of $106.7 of output per hour. Plastics and rubber product manufacturing had the lowest level of labour productivity at $29.2 of output per hour. In manufacturing, the 2007 labour productivity level was $47.8.

From 1997 to 2007, six of the eleven resource-based manufacturing industries had stronger productivity growth than in total manufacturing (Figure 4). Primary metal manufacturing had the highest annual average productivity growth of 4.4 percent, and petroleum and coal product manufacturing had the weakest growth of -2.8 percent.

**Figure 3: Labour Productivity Levels in Resource-Based Manufacturing Industries (2007)**

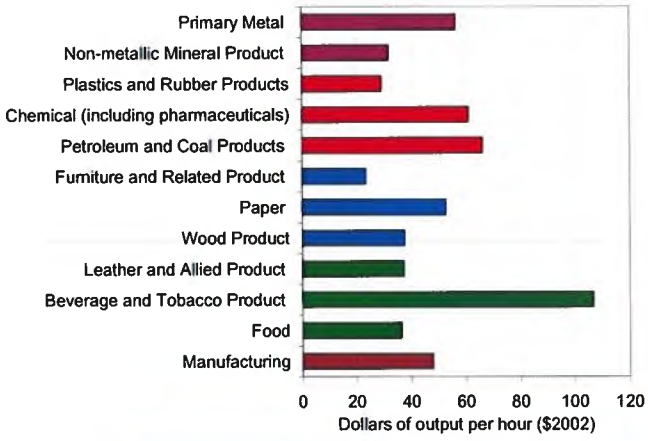
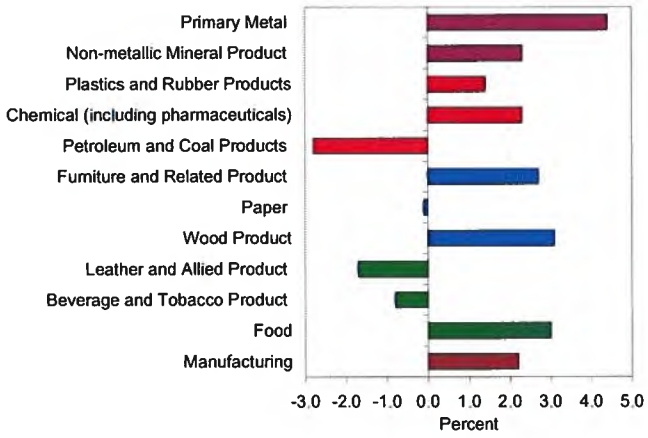



**Figure 4: Annual Average Productivity Growth in Resource-Based Manufacturing Industries (1997-2007)**




## Prices

The industry price indices for resource-based manufacturing industries have generally increased between 2002 and 2012. The rising prices of resource-based manufactured goods are due in large part to increasing costs of inputs. For example, the price index for primary metal products (mainly steel and aluminum) has shown a similar trend as the steel foundry input price index (Figure 5).

Since 2002, commodity prices have on average more than doubled, with effects being particularly felt in the metals and minerals and energy sectors (Figure 6)

**Figure 5: Primary metal products - producer price versus input price indexes**

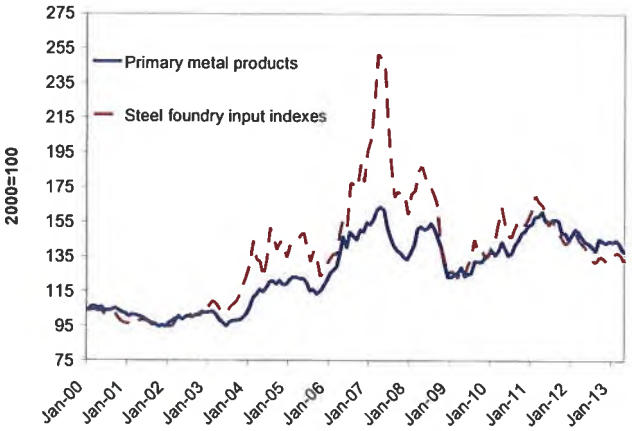



**Figure 6: Bank of Canada Commodity Price Indexes**

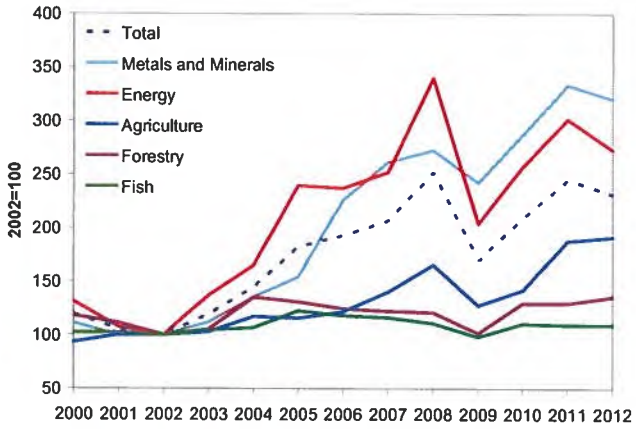
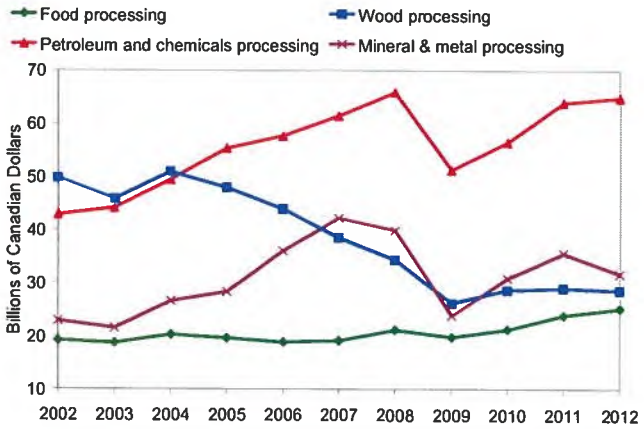



**Figure 7: Canadian exports of resource-based manufacturing**




## Trade

Resource-based manufacturing industry exports represented about half of total manufacturing exports in 2012. Exports of resource-based manufacturing in Canada has grown relatively strongly. From 2002 to 2012, resource-based manufacturing's exports grew at an annual average rate of 1.1 percent, compared to a decline of 2.1 percent per year in non resource-based manufacturing. Petroleum and chemicals processing exports grew 4.2 percent per year, and minerals and metals manufacturing exports grew at 3.3 percent (Figure 7). In contrast, the non-resource manufacturing sector had negative annual average growth of 1.9 percent over the 2001 to 2011 period. Wood processing manufacturing also had negative annual average growth of 5.4 percent.

## Capital Expenditures

Because of strong commodity prices during the 2002-2012 period, in general, investment by the resource-based manufacturing sector grew relatively strongly. Growth in real machinery and equipment (M&E) investment by food processing was 4.5 percent per year, for wood product manufacturing it was 5.1 percent per year and for chemical manufacturing, it was 5.6 percent per year. Plastics and rubber products had average annual real M&E growth of 3.9 percent, and non-metallic mineral products had 4.5 percent per year growth. Paper products had negative growth of 1.3 percent. By comparison, the manufacturing sector as a whole had real M&E investment growth of 3.5 percent per year.

## Regional Distribution

Resource-based manufacturing is located all across the country, with production facilities typically located close to key natural resource inputs. Quebec, Ontario and B.C. all have strong paper manufacturing. Petroleum and coal product manufacturing occurs in Ontario and Alberta, and plastics and rubber products are manufactured in the Maritimes, Quebec, Ontario, Alberta and B.C.. Wood products and food manufacturing is found in all provinces. Primary metal is manufactured mainly in Quebec, Ontario and B.C. Chemicals are mainly manufactured in Quebec, Ontario, Manitoba, Saskatchewan, Alberta and B.C.

## Future Opportunities and Challenges

Strong demand for natural resources produced in Canada by emerging economies, such as China, who are expanding their manufacturing activity, will increase the competition faced by domestic producers for inputs and for market shares in finished product markets.

Many natural resources, especially oil, are becoming harder to extract, which increases costs. As well, in addition to their position as low-cost competitors, emerging markets are driving up demand for, and prices of, natural resources that Canadian manufacturers use as inputs. This, coupled with competitive pressures and lingering low demand from the economic downturn, limits the ability to increase prices and maintain margins. In this context, a focus on improving competitiveness through productivity-improving investment and on producing higher-value, niche products, is key to improving profitability.

Taking full advantage of Canada's comparative advantage in natural resources will depend on efforts throughout the entire value chain, including R&D, extraction, manufacturing and distribution. Key challenges facing the natural resource extraction and manufacturing sectors include encouraging efficient resource extraction, increasing investment and increasing valued added both upstream and downstream.

## References

The note is based on work done by the Economic Research and Analysis Branch and the Manufacturing Industries Directorate of the Manufacturing and Life Sciences Branch. Data is from Statistics Canada, the Bank of Canada and the Centre for the Study of Living Standards.

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## Annex Table 1: Manufacturing sectors included in resource manufacturing

| Resource manufacturing sub-sectors | NAICS code |
|---|---|
| **Food processing** | |
| Food Manufacturing | 311 |
| Beverage and Tobacco Manufacturing | 312 |
| Leather and Allied Product Manufacturing | 316 |
| **Wood processing** | |
| Wood Product Manufacturing | 321 |
| Paper Manufacturing | 322 |
| Furniture and Related Manufacturing | 337 |
| **Petroleum and chemicals processing** | |
| Petroleum and Coal Product | 324 |
| Chemical Manufacturing (excluding pharmaceutical and medicine manufacturing) | 325 (excluding 3254) |
| Plastics and Rubber Manufacturing | 326 |
| **Mineral & Metal processing** | |
| Non-Metallic Mineral Manufacturing | 327 |
| Primary Metal Manufacturing | 331 |

# Venture Capital in Canada and the Venture Capital Action Plan

Venture capital (VC), a form of equity financing, plays an important role in promoting a more innovative economy by providing the investment and resources needed for high-potential small and medium-sized enterprises (SMEs) to grow. Some of Canada's top innovative businesses have benefitted from venture capital investments at key stages of their growth and it has helped spur numerous successes including Radian6[2] and Q1 Labs[3]. In addition to capital, VC investments often come with intangible benefits such as mentoring, better developed networks, and strategic advice.

Canada's venture capital industry has been challenged on a number of fronts in recent years. Persistent poor returns have led to low fundraising and have limited the amount of capital available to fuel the growth of start-up businesses. According to the Small Business Branch's Venture Capital Monitor (www.ic.gc.ca/vcmonitor), venture capital investment for 2012 was $1.5 billion, an improvement since the recession but well below the $6 billion invested in 2000.

Long-term economic competitiveness in the knowledge economy will be driven by globally competitive businesses that innovate and create high-value jobs. Canada has strong fundamentals for innovation, with a highly-skilled workforce and world leading post-secondary research, but Canadian SMEs continue to lag behind competitors in terms of overall innovation performance, including with regard to private sector investment in research and development, and the commercialization of research. A 2012 Small Business Branch research report[4] found that research and development intensive firms were five times more likely to request equity financing than non-research intensive firms, highlighting the importance for these firms of being able to access venture capital.

The 2011 Expert Review Panel on Research and Development in its final report to the government recommended that government support high-growth innovative firms to access risk capital. This recommendation follows the trend of other nations, which have been expanding similar venture capital initiatives. In FY 2012, the U.S. Small Business Investment Company (SBIC) debenture program recorded the highest single-year volume in the more than 50-year history of the Small U.S. Business Administration following a number of program improvements[5].

Over the Summer and Fall of 2012, the Government conducted extensive consultations with key stakeholders to

[2] http://business.financialpost.com/2011/03/30/salesforce-snaps-up-frederictons-radian6-for-us326m/?__lsa=69de-7994

[3] http://www.bdc.ca/EN/solutions/venture_capital/newsroom/Pages/PressReleaseDetail.aspx?PressReleaseId=399#.Ubs-9tgcNc0

[4] Credit Conditions Faced by Small and Medium-Sized Enterprises Investing in R&D. December 2012. http://www.ic.gc.ca/eic/site/061.nsf/eng/h_02756.html

[5] http://www.sba.gov/about-sba-services/7367/342171

determine how to structure this support to best contribute to the creation of a sustainable, private sector-led venture capital sector in Canada. During the consultations, stakeholders emphasized the need to implement private sector-led initiatives that demonstrate the return potential of the Canadian venture capital market to investors. Stronger venture capital returns will draw additional investors into the sector, creating a virtuous venture capital investment cycle.

Based on the results of these extensive industry consultations, the Prime Minister announced the Venture Capital Action Plan (VCAP) in January 2013. VCAP is a comprehensive strategy for deploying the $400 million in new capital over the next seven to ten years, which is expected to attract close to $1 billion in new private sector investments in funds of funds. VCAP recognizes the need to demonstrate that Canada's innovative firms represent superior return opportunities, and that private sector investment and decision-making is central to long-term success.

The action plan is a three-pronged approach to make available $250 million to establish new, large private-sector led national funds of funds[6] in partnership with institutional and corporate strategic investors, as well as interested provinces; up to $100 million to recapitalize existing large private sector-led funds of funds, in partnership with willing provinces; and up to $50 million in three to five existing high-performing venture capital funds in Canada.

The Minister of Finance has established an Expert Panel, comprised of private sector representatives, to advance key elements of the Action Plan. These efforts are being supported by the Small Business Branch and the Business Development Bank (BDC)[7], which will implement VCAP.

Canada requires a strong, sustainable venture capital industry to support high-potential young businesses, to ensure that they are able to grow into globally competitive firms that drive job-creation, innovation and economic growth. Improvements in VC investment and fundraising, combined with the Government's VC Action Plan, are contributing to a more optimistic view over the mid-to long-term for the Canadian VC ecosystem.

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[6] A fund of funds is a venture capital fund that invests in other venture capital funds

[7] https://www.bdc.ca/EN/solutions/venture_capital/

# Is the Canada-U.S. ICT Investment Gap a Measurement Issue?

In 2011, business sector investment per worker in Information and Communications Technologies (ICT) in Canada was only 57.8 percent of the U.S. level. ICT investment is comprised of computer hardware, telecommunications equipment and software. Software investment, which is the largest component of ICT investment in both countries, was only 39.8 percent of the U.S. level. Software includes three components: pre-packaged, own account and custom built. This low level of ICT investment per worker is troubling, as investment – and ICT investment in particular – increases labour productivity, an important determinant of potential economic growth and a measure by which the United States (U.S.) has also consistently outperformed Canada over the last decade.

Numerous explanations have been advanced to explain this gap, one of which is that the ICT investment data from Statistics Canada and the U.S. Bureau of Economic Analysis are not strictly comparable. In May 2013, the Centre for the Study of Living Standards released a report, funded by Industry Canada, that examined in detail to what extent differences in measurement methodology affect our ability to compare ICT investment per worker in Canada and the United States.[8]

[8] The report by Andrew Sharpe and Vikram Rai is entitled "Can the Canada-U.S. ICT Investment Gap be a Measurement Issue" (CSLS Research Report 2013-03) is posted at http://www.csls.ca/reports/csls2013-03.pdf The report was funded by Industry Canada.

## The Canada-U.S. ICT Investment per Worker Gap

The report provides a comprehensive analysis of ICT investment in Canada and the United States. Some of the key findings are:

- **There have been very different trends in the three components of ICT investment.** In 1987, the gap for ICT investment per worker was essentially the same in all components. However, in 2011, software investment per worker in Canada was only 39.8 percent of the level in the U.S. Within software investment, the gap is the greatest for pre-packaged software. In comparison, computer investment per worker in Canada was higher than the U.S. (108.8 percent of the U.S. level), while investment in communications equipment rose to 72.9 percent.

- **Canada is not the only country with a gap in ICT investment relative to the United States.** The Canada-U.S. ICT investment per worker gap is close to the average gap between the United States and most OECD countries.

- **In 2011, software investment accounted for 92.2 percent of the difference in ICT investment per worker.** If software investment per

worker in Canada and the United States were the same, the gap would almost completely disappear.

- **The Canada-U.S. ICT investment per worker gap is heavily concentrated in a few industries.** Information industries, professional services and finance and insurance are consistently the largest contributors to the gap. In 2011, seven industries in Canada actually had greater ICT investment per worker than their U.S. counterpart. This strongly suggests that the Canada-U.S. ICT investment per worker gap is largely due to industry-specific factors that affect software investment.

## Proximate Causes of the Gap

The report also analyzed the role that differences in industrial structure and labour productivity levels (and hence income levels) between Canada and the U.S. play in determining the ICT investment gap.

Industrial structure was found to explain 2.5 percentage points of the ICT investment per worker gap as the United States has greater relative employment in ICT-intensive industries, such as information services and finance and insurance.

The study found that the ICT investment per worker gap would be 12 percentage points (30 percent) lower if Canada had the same level of labour productivity as the U.S. The higher level of labour productivity in the United States means that a U.S. worker will generate more gross domestic product (GDP) per capita. This, in turn, leads to more ICT investment per worker for a given ICT investment share of GDP, since the absolute level of ICT investment is determined by the absolute level of GDP.

## Differences in the Measurement of ICT Investment in Canada and the United States

The main contribution of this report was to examine the methodology used by Statistics Canada and the U.S. Bureau of Economic Analysis to prepare their estimates of investment in computers, communications equipment, and software. We highlight our key findings below.

- The methodology for data collection, quality control, and the entities surveyed are substantially the same for these data.

- No significant inconsistencies in the definition of ICT assets or the survey and data collection methodology for ICT investment data in Canada and the U.S. were identified.

- The methodologies used to account for intermediate purchases of pre-packaged and custom software and for purchases of used equipment differ between Canada and the United States. However, the impact of these differences on overall ICT investment appears minor.

- Investment in internally developed or own account software is based primarily on the labour cost to

employers of their software developers. This means that, even if two software developers spend the same amount of time developing the same software for internal use, a higher level of investment in the United States than in Canada would result due to higher salaries. We estimate that this conceptual challenge to valuing own account software results in the gap being overestimated by as much as 4 percentage points (10 percent of the gap).

## Conclusion

On balance, it is estimated that differences in measurement explain approximately one tenth of the gap in ICT investment per worker in Canada and the U.S. Differences in labour productivity levels between the two countries account for 30 percent and differences in industrial structure 6 percent. This leaves 44 percent of the gap to be explained by other factors. Further research is needed to shed light on these factors and currently Industry Canada is funding another CSLS study on understanding the difference in software investment between the two countries better.

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# Multifactor Productivity Growth in Canada: Is it Sensitive to Alternative Methodologies?

## Introduction

This feature article summarizes research that studies the sensitivity of multifactor productivity (MFP) growth to alternative methodological assumptions. It uses comparable data for output, labour and capital for the business sector in Canada and the United States.

The paper was prompted by a debate on multifactor productivity measurement issues that was published in the Fall 2012 issue of the *International Productivity Monitor* (IPM). For a brief overview of the debate, see Box 1.

## Productivity

Productivity measures the efficiency with which inputs are translated into outputs. Productivity growth is the single most important driver of an economy's health over the longer-term. It is the key determinant of economic growth, improvements in living standards, quality of life, and competitiveness. Productivity gains are also important for workers, consumers, businesses and governments because they translate into real wage gains, lower prices, higher profits, and increased tax revenue.

The term "productivity" is commonly used to refer to labour productivity, which is usually defined as output per hour worked. Labour productivity is commonly used because it is closely related to GDP per capita and it is easy to measure directly from published data as real GDP per hour worked and is relatively easy to interpret.

However, labour productivity is only a partial measure of productivity. A better and overall production efficiency indicator is multifactor productivity (MFP), also called total factor productivity (TFP).

## Multifactor Productivity

MFP measures the efficiency with which all inputs are used in the production process and is calculated as the residual of growth in real output minus the weighted sum of growth of labour and capital inputs. MFP typically takes into account changes in the quality of the inputs, due to shifts in their composition. For example, labour input measures are adjusted to reflect the age and education levels of workers. As a result, changes of inputs quality are excluded from the MFP measure.

Because MFP is calculated as a residual, other factors are not explicitly included in the calculation, such as business innovation, management practices, allocation of productive resources, and economies of scale and scope influence MFP and its growth. In contrast to capital and labour, these factors are difficult to quantify and isolate in practice. This is true at the plant, firm, industry and country level. In addition, mis-measurements of either labour or capital will also be included in MFP.

**Box 1: MFP Measurement Issues**

Issues related to measuring MFP are highlighted in the Symposium on the Measurement of MFP in Canada in the 2012 Fall issue of the *International Productivity Monitor* (IPM). The IPM Symposium highlighted a debate between Statistics Canada and Diewert and Yu (2012) and demonstrated that MFP estimates are sensitive to the choice of methodologies and the assumptions made in the measurement of inputs.

To estimate MFP growth in the Canadian business sector, one needs to estimate output and inputs (capital and labour) at the aggregate level.

- The Statistics Canada productivity program (CPP) assumes different real returns for different capital assets and follows a bottom-up approach to aggregate each variable from the industry level.
- Diewert-Yu assume the same real return for all capital assets and follows the top-down approach by ignoring the industry dimension.

As a result, Diewert-Yu estimates that MFP growth in Canada was 1.03 percent per year over the 1961-2011 period, compared with the CPP's estimate of 0.28 percent. The difference was mainly driven by different capital service estimates, reflecting differences in data and methodology used in estimating capital services.

The essential difference in methodology in estimating capital services inputs between the CPP and Diewert-Yu is that the former allows the real rate of return to vary by asset and industry, while the latter does not.

- Gu (2012), on behalf of the CPP, argues that growth in capital services by the CPP is higher because their methodology controls more for shifts in the composition of capital input.
- In particular, the CPP gives more weight to rapidly depreciating assets such as high-tech equipment (including computers, software and communications equipment), which typically have higher real rates of return because of the substantial decline in prices for those assets.
- As a result, total capital services as estimated by the CPP grew faster than that estimated by Diewert-Yu, because investment in high tech equipment became increasingly important over the historical period.

### MFP Growth Estimates under Alternative Methodologies

In contrast to the direct calculation of labour productivity, MFP estimates require that researchers adopt a methodology to estimate of labour and capital services inputs. The alternative methodologies used to estimate labour and capital services inputs embody different assumptions, for which there is no international standard. National statistical agencies employ different complex methodologies and even those employing similar methodologies may choose among alternative assumptions, which vary with, among other things, the quality of the underlying data and the preferred approach of the agencies.

To assess the sensitivity of MFP growth estimates to different methodological assumptions, this study constructs relatively comparable input and output data for both Canada and the United States.

For labour and capital, it includes 18 types of workers (2 genders, 3 education levels and 3 age groups) and 28 different asset types (3 information and communication technologies, 12 non-ICT machinery and equipment, 7 building structures, and 6 engineering structures) at the industry level.

This paper considers three alternative assumptions related to the estimation of output and capital input:

- different depreciation rates (Statistics Canada (SC) or Bureau of Economic Analysis (BEA) asset depreciation rates for capital services),
- alternative assumptions about nominal or real rates of return to capital being equal across all assets (for capital services), and
- alternative approaches to aggregation (top-down or bottom-up)

This leads to different estimates of MFP growth based on eight scenarios or combinations of assumptions.

The MFP growth estimates under these

**Table 1: MFP Growth in the Canadian Business Sector (annual average % change)**

| | 1987-2000 (1) | 2000-2010 (2) | 1987-2010 (3) | Difference (2)-(1) |
|---|---|---|---|---|
| 1. Bottom-up, SC depreciation, equal nominal rate of return to capital | 0.39 | 0.11 | 0.16 | -0.28 |
| 2. Bottom-up, SC depreciation, equal real rate of return to capital | 0.43 | 0.15 | 0.20 | -0.28 |
| 3. Bottom-up, BEA depreciation, equal nominal rate of return to capital | 0.39 | 0.09 | 0.15 | -0.30 |
| 4. Bottom-up, BEA depreciation, equal real rate of return to capital | 0.44 | 0.14 | 0.20 | -0.30 |
| 5. Top-down, SC depreciation, equal nominal rate of return to capital | 0.24 | -0.09 | -0.02 | -0.33 |
| 6. Top-down, SC depreciation, equal real rate of return to capital | 0.29 | -0.06 | 0.02 | -0.35 |
| 7. Top-down, BEA depreciation, equal nominal rate of return to capital | 0.22 | -0.04 | -0.02 | -0.26 |
| 8. Top-down, BEA depreciation, equal real rate of return to capital | 0.27 | -0.01 | 0.03 | -0.28 |

alternative methodologies for the Canadian business sector are reported in Table 1. In general, the estimates based on the bottom-up approach grew faster than those based on the top-down approach did. Despite the differences, however, MFP growth estimates for the Canadian business sector are fairly robust to alternative approaches and assumptions. For instance, for 1987-2010, the largest MFP growth estimate for the Canadian business sector is 0.20 (percent per year) and the lowest is -0.02, a difference of 0.22 percentage points. In addition, the MFP growth rate differences between 1987-2000 and 2000-2010 were similar, suggesting that the slowdown in MFP growth was also fairly robust to the alternative assumptions.

**Table 2: MFP Growth Comparisons**

| | 1987-2010 |
|---|---|
| Our estimates | -0.02 to 0.20 |
| Statistics Canada | -0.05 |
| Diewert and Yu (2012) | 0.35 |

In addition, the estimates from this paper found a range of average annual MFP growth in Canada over the 1987 to 2010 period of 0.0 to 0.2 percent, which lies between the Diewert-Yu estimate of 0.4 percent, and the Statistics Canada estimate of 0.0 percent over this period (Table 2).

Table 3 reports the difference in MFP growth estimate between Canada and the United States using the same methodologies for both countries. It shows that Canada lagged the United States in MFP performance in the 1987 to 2000 period, and the gap widened in the post-2000 period.

## Conclusions

MFP growth estimates are sensitive to the methodology adopted and assumptions made to estimate inputs. As it is shown in this article, MFP growth estimates are in general fairly robust to the alternative assumptions considered, which were identified as key contributors to the difference between

**Table 3: MFP Growth Difference between the Canadian and the U.S. Business Sectors**

| | US-Canada | | |
|---|---|---|---|
| | 1987-2000 | 2000-2010 | 1987-2010 |
| 1. Bottom-up, SC depreciation, equal nominal rate of return to capital | 0.18 | 1.06 | 0.57 |
| 2. Bottom-up, SC depreciation, equal real rate of return to capital | 0.25 | 1.05 | 0.60 |
| 3. Bottom-up, BEA depreciation, equal nominal rate of return to capital | 0.18 | 0.98 | 0.53 |
| 4. Bottom-up, BEA depreciation, equal real rate of return to capital | 0.24 | 0.97 | 0.55 |
| 5. Top-down, SC depreciation, equal nominal rate of return to capital | 0.28 | 1.50 | 0.81 |
| 6. Top-down, SC depreciation, equal real rate of return to capital | 0.32 | 1.48 | 0.83 |
| 7. Top-down, BEA depreciation, equal nominal rate of return to capital | 0.37 | 1.38 | 0.81 |
| 8. Top-down, BEA depreciation, equal real rate of return to capital | 0.42 | 1.37 | 0.84 |

Statistics Canada and Diewert-Yu's estimates. Further, it suggests that the difference between Statistics Canada and Diewert-Yu in part reflects differences in the data used.

All of the methodologies considered showed that MFP growth slowed in the post-2000 period in the Canadian business sector. In addition, Canada lagged the United States in MFP growth and the gap widened substantially in the post-2000 period, in line with other published estimates.

## References

The note is based on the Economic Research and Policy Analysis Branch research paper "Canada-U.S. Multifactor Productivity Growth Comparisons: Do Different Methodologies Matter?" by Jiang Li, Larry Shute and Jianmin Tang

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# *IC Insights* Databoard

| | Monthly Economic Indicators | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Month-over-month growth (at monthly rates) | | | Q-o-q growth | Year-over-year growth | |
| | Reference period | Latest month | Prev. month | 2 Months before | 2013Q1 | 2012 | 2011 |
| Manufacturing shipments (current $) | Apr '13 | -2.7 | -0.6 | 3.5 | 0.1 | 3.5 | 8.0 |
| Manufacturing shipments (constant $) | Apr '13 | -1.6 | 0.0 | 2.7 | -0.5 | 3.0 | 3.5 |
| Retail trade (current $) | Mar '13 | 0.0 | 0.7 | 1.0 | 0.1 | 2.5 | 4.1 |
| Retail trade (chained $) | Mar '13 | 0.7 | 0.0 | 1.1 | 0.4 | 1.7 | 1.9 |
| Real GDP | Mar '13 | 0.2 | 0.3 | 0.3 | 0.6 | 1.8 | 2.6 |
| -Services | Mar '13 | 0.2 | 0.1 | 0.3 | 0.4 | 1.8 | 2.2 |
| -Manufacturing | Mar '13 | -0.2 | 0.7 | -0.1 | 0.1 | 1.5 | 2.5 |
| Exports (bop) (current $) | Apr '13 | -0.2 | 2.6 | 1.3 | 2.8 | 1.3 | 13.1 |
| Imports (bop) (current $) | Apr '13 | 1.2 | 0.5 | 2.0 | 2.1 | 4.1 | 10.2 |
| All-items CPI | Apr '13 | 0.0 | 0.2 | 0.4 | 0.5 | 1.7 | 1.7 |
| LFS employment (change in 000s) | May '13 | 95.0 | 12.5 | -54.5 | 33.3 | 200.7 | 262.5 |
| Unemployment rate (%) | May '13 | 7.1 | 7.2 | 7.2 | 7.1 | 7.3 | 7.5 |
| | Monthly U.S. Indicators | | | | | | |
| U.S. CPS employment (change in 000s) | May '13 | 319.0 | 293.0 | -206.0 | 63.3 | 2,587.2 | 804.7 |
| U.S. unemployment rate (%) | May '13 | 7.6 | 7.5 | 7.6 | 7.7 | 8.1 | 8.9 |

| | Financial Indicators | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Monthly average | | | Annual average | |
| | Reference period | Current value | Latest full month | Prev. month | 2 months before | 2012 | 2011 |
| Bank rate (%) | Jun 20 '13 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Exchange rate (Can. Cents per $U.S., spot rate) | Jun 20 '13 | 103.9 | 102.0 | 101.9 | 102.5 | 99.9 | 98.9 |

| | Quarterly Economic Indicators | | | | | |
|---|---|---|---|---|---|---|
| | | Quarter-over-quarter (at annual rates) | | | Year-over-year growth | |
| | Reference Period | Latest quarter | Prev. quarter | 2 Quarters before | 2012 | 2011 |
| Real GDP | 2013Q1 | 2.5 | 0.9 | 0.8 | 1.7 | 2.5 |
| Final consumption expenditure | 2013Q1 | 1.1 | 2.2 | 1.9 | 1.6 | 1.9 |
| Gross fixed capital formation | 2013Q1 | -1.1 | 2.8 | 0.0 | 4.3 | 4.2 |
| -Machinery & equipment | 2013Q1 | -0.7 | 3.1 | 1.3 | 5.2 | 8.6 |
| Exports | 2013Q1 | 6.2 | 0.8 | -3.6 | 1.5 | 4.7 |
| Imports | 2013Q1 | 1.2 | -3.1 | 4.1 | 3.1 | 5.7 |
| Final domestic demand | 2013Q1 | 0.6 | 2.4 | 1.5 | 2.3 | 2.4 |
| Labour productivity | 2013Q1 | 0.6 | 0.4 | -2.1 | -0.2 | 1.0 |
| Unit labour cost | 2013Q1 | -0.4 | 2.4 | 5.0 | 3.0 | 2.5 |
| Industrial capacity utilization (%) | 2013Q1 | 81.1 | 80.5 | 80.9 | 80.9 | 79.7 |
| | Quarterly U.S. Indicators | | | | | |
| Real U.S. GDP | 2013Q1 | 2.4 | 0.4 | 3.1 | 2.2 | 1.8 |