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The Canadian Productivity Review

Revisions to the Multifactor Productivity Accounts

by John R. Baldwin, Wulong Gu, Ryan Macdonald, Weimin Wang and Beiling Yan
Economic Analysis Division

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..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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The Canadian Productivity Review

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

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Abstract

This paper highlights revisions to multifactor productivity (MFP) growth and related variables in the business sector and in individual industries that resulted from the historical revision of the Canadian System of National Accounts (CSNA) released October 1, 2012, revisions to the labour productivity accounts released October 12, 2012, and changes in the estimation of capital input that were made to improve its consistency in industry multifactor productivity growth estimates.

Before the revision, the endogenous (or internal) rate of return method was used to estimate the user cost of capital. The revision introduces a variant of that approach. The exogenous (or external) rates of return are now used to estimate the user cost of capital for industries with extremely high and low internal rates of return. In addition, for a number of service industries where internal rates of returns are high and exhibit a downward trend in the 1970s and 1980s, capital input is imputed by dividing the nominal value of capital services by the user cost of capital estimated using the external rates of return, and capital stock is then benchmarked to sectoral totals that were previously constructed from investment data.

The revisions to the estimation of capital input have a small effect on the growth of capital input, labour input, and MFP in the total business sector for the period after 1980. But the revisions reduced aggregate capital input growth for 1961 to 1980, and therefore increased MFP growth for that period. The MFP growth is revised up from 0.7% per year to 1.1% per year for that period.

1 Introduction

This paper highlights revisions to multifactor productivity (MFP) growth and related variables in the business sector and in individual industries, which resulted from the historical revision of the Canadian System of National Accounts (CSNA) released October 1, 2012, revisions to the labour productivity accounts released October 12, 2012, and changes in the estimation of capital input that were made in order to improve its consistency in industry MFP growth estimates.

The multifactor productivity program produces indexes of MFP and related measures (output, capital input, labour input and intermediate inputs) for the business sector, broad economic sub-sectors, and their constituent industries. The MFP program divides growth in labour productivity into its key determinants: capital intensity (changes in capital per hour worked), investment in human capital, and MFP, which includes technological change, organizational innovation and economies of scale.

The CSNA 2012 revisions led to changes in all the variables used to measure MFP growth. The revisions that affect MFP growth estimates are: 1) the capitalization of research and development (R&D) expenditures, which resulted in changes to gross output, intermediate inputs, gross domestic product (GDP) and capital input; 2) the treatment of exploration, which resulted in changes to output and intermediate inputs in construction, oil and gas extraction and mining industries; and 3) statistical revisions to output and input estimates.

In addition, changes were made to the estimation of capital inputs at the industry level to improve consistency with other industry aggregates. The discrepancy was related to relatively large and small capital income, compared with investment and capital stock estimates at the industry level. The discrepancy is most apparent for the 1960s and 1970s in several service-producing industries that are relatively new constructs as a result of changing industry definitions.

The paper starts by documenting revisions to the output and input variables used to estimate MFP growth, and MFP growth estimates over the 1961-to-2011 period. It then summarizes the overall effect of the revisions on MFP growth estimates and related variables in the total business sector. It concludes with an examination of the impact of the revisions on the Canada–United States difference in labour productivity growth and its three key determinants: MFP growth, capital deepening, and investment in human capital.

2 Revisions to gross output, intermediate inputs, and value-added

The MFP program provides annual data on chained-Fisher volume indices and nominal values of output, capital input, labour input, and intermediate inputs for the total business sector and for individual industries. The chained-Fisher index of value-added, gross output, and intermediate inputs is estimated from the make-and-use tables in the input-output accounts of Statistics Canada. It starts with the make-and-use tables in current and constant dollars, derives implicit price indices for commodity outputs and inputs, and then applies the Fisher aggregation to estimate the chained-Fisher index.

Total business sector output is measured as value-added at basic prices, calculated using the "bottom-up" approach by aggregating industries in the business sector. At the industry level, various output measures—gross output and value-added, each of which responds to a different analytical need—are employed.

The 2012 historical revision to the CSNA had a substantial impact on the input-output tables from the reference year (2009) onward. The revisions that directly affect the estimates for business sector industries are the changes in commodity classification, the capitalization of research and development expenditures, and changes in the treatment of exploration services output (Statistics Canada 2013).

The input-output tables for 2009 onward have more services and fewer goods for both industries and commodities. The new commodity classification is based on the North American Product Classification System (NAPCS). The total number of commodities decreased from 727 to 481. Because the output and inputs are estimated as Fisher aggregations of commodity output and intermediate output across commodities, the new estimates may not be fully comparable with the previous estimates, which were based on a different commodity classification. Nonetheless, the effects of the changes in commodity classification on the estimates of value-added, gross output and intermediate inputs are small for the total business sector and for major sectors.

The 2012 revision to the CSNA capitalized R&D expenditures, which had previously been treated as intermediate consumption. Capitalization of own-account R&D expenditures adds to the output and value-added of industries that performed R&D. For industries that purchase R&D, capitalization results in the reclassification of purchased R&D services from intermediate inputs to investment. This increases the output of industries that purchased R&D, but reduces their intermediate inputs. The purchased R&D output remains to be recorded as the output of the North American Industry Classification System (NAICS) 5417 (Scientific research and development services) after the revisions. However, capitalization of R&D has little effect on real GDP growth in the total business sector (Gu, Terefe and Wang 2012).

Before the 2012 CSNA historical revision, exploration expenditures had been capitalized, but the revision changed how the exploration services are reported in the input-output tables. Prior to the revision, oil and gas exploration services were recorded as output of the oil and gas construction industry for oil and gas exploration, and as output of other engineering construction industries for mining exploration. As a result of the revisions, they are recorded as output of the oil and gas extraction industry (NAICS 2111) for oil and gas exploration, and as output of support activities for the mining and oil and gas extraction industry (NAICS 2312) for mining exploration.

The 2012 CSNA introduced these revisions in the published input-output tables for the reference years 2009 and 2010; they are also in the unpublished make-and-use tables for the reference years 2007 and 2008. Those tables are used to estimate the real and nominal values of output and intermediate inputs for 2007 to 2010 at the industry level.

To construct consistent time series of output and inputs at the industry level, the MFP program introduced the historical revisions as in the 2012 CSNA revision and Statistics Canada (2013) to the make-and-use tables for 1961 to 2007. More specifically, own-account R&D is introduced as the output of R&D-performing industries, and purchased R&D is reclassified as investment and output from intermediate inputs. The output of exploration services is classified as output of oil and gas extraction and support activities for the mining industries.

The 2012 CSNA revisions also changed the level of gross output and intermediate inputs for some industries. To construct time series estimates, the revised gross output and intermediate input at the industry level for the 1961-to-2007 period constructed by the MFP accounts are linked with the gross output and intermediate inputs for the years 2007 to 2010. The commodity mixes of industry output and intermediate inputs are set to be the same as those before the revisions.

The effect of the revisions on the long-term growth rate of value-added at the industry level is minor (Table 1). Revisions before 2007 tend to be small; later revisions are larger because they include the typical National Accounts revisions for the reference years 2009 and 2010.

Table 1
Revisions to average annual growth of real gross domestic product, by industry, 1961 to 2007 and 2007 to 2011

Industry	Revised estimate		Previous estimate		Difference (revised minus previous)	
	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011
			percent			
Agriculture, forestry, fishing and hunting	1.5	1.6	1.7	1.7	-0.1	-0.1
Mining and oil and gas extraction	2.8	0.2	2.7	0.0	0.1	0.2
Utilities	4.1	1.7	4.3	1.8	-0.2	0.0
Construction	2.8	2.9	2.8	1.4	0.0	1.5
Manufacturing	3.4	-2.8	3.4	-2.7	0.0	-0.1
Wholesale trade	5.4	1.3	5.5	0.5	-0.1	0.8
Retail trade	4.5	1.5	4.6	1.9	-0.1	-0.4
Transportation and warehousing	3.8	0.5	3.8	1.2	0.0	-0.7
Information and cultural industries	6.3	1.2	6.3	0.6	0.0	0.6
Finance, insurance, real estate and renting and leasing	4.2	1.1	4.2	1.6	0.0	-0.4
Professional, scientific and technical services	6.0	1.1	5.9	1.0	0.0	0.0
Administrative and support, waste management and remediation services	6.6	-0.6	6.7	-0.1	-0.1	-0.6
Arts, entertainment and recreation	5.0	-0.9	5.1	-0.9	-0.1	-0.1
Accommodation and food services	2.3	0.5	2.3	0.7	0.0	-0.2
Other private services	3.3	1.3	3.3	1.0	0.0	0.3

Note: Authors' calculations based on data from the source below.

Source: Statistics Canada, CANSIM table 383-0022.

3 Revisions to capital input

Each year, with sources available at Statistics Canada, the MFP program constructs capital input data that accord with the CSNA production framework.

The methodology used to measure capital input recognizes that the characteristics of various categories of capital assets differ—assets have different service lives, depreciation rates, tax treatments, and ultimately, marginal products. To derive capital input estimates, the growth rates of the various capital assets are Fisher-chain-weighted by their corresponding user costs. The capital assets in the national MFP measures are machinery and equipment, construction, intangible assets (R&D, software, exploration), land, and inventories.

The user cost of capital can be thought of as the price that, in a well-functioning market, a user would pay to rent an asset from an owner. That price would comprise a term reflecting the opportunity cost of capital or the rate of return, a term reflecting depreciation of the asset, and a term reflecting capital gains or losses from holding the asset (reflecting changes in the market price).

The rate of return can be calculated *endogenously* with data from the National Accounts on capital income and estimates of capital stock. Alternatively, the rate of return can be drawn *exogenously* from other sources—for example, a rate of return observed in financial markets. In this case, several choices are available: a risk-free rate of return such as a government-bond rate; a corporate debt rate that takes into account the risk of the business sector; or a weighted average of corporate debt and corporate equity rates that recognizes that the corporate sector is financed by a mixture of debt and equity.

Advantages and disadvantages are associated with the choice of an endogenous (internal) or exogenous rate of return (Baldwin and Gu 2007; Diewert and Yu 2012; OECD 2001). Statistics Canada has chosen the endogenous rate of return, because it provides a fully integrated set of accounts. The surplus is taken directly from the CSNA, and from the investment flows that are also part of the CSNA. In addition, MFP measures based on the endogenous rate are more comparable with MFP measures for U.S. industries published by the Bureau of Labor Statistics (BLS), which uses a variant of the endogenous rate of return method to calculate capital and the user cost of capital. This continues to be the approach adopted here in the main.

A disadvantage of the endogenous method is that the capital income and capital stock data used to estimate the rate of return may not be fully consistent as industry accounts are constructed further back in time. Some industries may have unusually high or low internal rates of return (IRRs). For that reason, the BLS adopted a variant of the endogenous rate that replaced extreme rates of return by an external rate of return. Although results generally show that those IRRs have a minor impact on long-run aggregate MFP growth estimates (Baldwin and Gu 2007, 2013), the extreme values of IRRs raise the issue of consistency of the variables used to calculate MFP growth at the detailed industry level.

Inconsistency may result from changes in industry and commodity classifications over time, in data sources, and in what is included in output and inputs. Inconsistency may also arise because capital is allocated to an industry based on purchase and ownership, not on the use of assets, which is more appropriate for productivity measurement.

To improve the industry productivity database, the MFP accounts adopted a variant of the endogenous method (as the BLS did) for a subset of industries and replaced unusually high and low rates of return with external rates of return. The external rate of return for one of these industries is set equal to the average endogenous rate of return calculated at broad sectoral levels. Capital costs calculated based on the external rate of returns are used to calculate MFP

growth and the contribution of capital input to output and labour productivity growth. The capital cost based on external rates is also used to aggregate capital input across industries to derive aggregate capital input in the total business sector and in more aggregated sectors.

This approach provides an estimation of a residual—the difference between capital income from the National Accounts and capital services (or capital costs). This difference could be the result of imperfect competition. It could also arise because the list of inputs included in the MFP estimates is incomplete (for example, intangibles are excluded). Or it could arise because of economies of scale, so that input costs do not completely exhaust total product.

For a small number of service industries (other finance, insurance and real estate [FIRE]; professional service industries; health services industries), IRRs are high and exhibit a downward trend in the 1970s and 1980s, which is contrary to the relatively stable trend in the share of capital income in value-added in those industries and the trend in the rate of return in other industries. This suggests that capital stock might be low compared with capital income for those industries, and capital income and capital stock are inconsistent. To improve the consistency of the underlying variables used to estimate MFP growth, capital input is imputed in these industries by dividing capital services by the user cost of capital, which is estimated based on an external rate of return set equal to the average rate in service industries other than FIRE. This dual approach, introduced by Jorgenson and Griliches (1967), has been applied to provide an alternative estimate of capital input and MFP growth when capital stock and investment are judged to be of lesser quality than the user cost of capital (Hsieh 2002). In addition, the value of capital services or capital for those industries is set equal to a fraction of capital income from the National Accounts, where the fraction of capital income that goes to capital cost is based on the average difference between the sum of capital income and the sum of capital costs estimated from the average external rate of return in all non-FIRE service industries. This ensures that the total capital stock for those industries remained the same, but results in a surplus for those industries, which could be attributed to returns to human capital and other intangible assets or to imperfect competition.

To capture the concept of capital gains expected from holding assets, the capital gain term for the user cost of capital calculation is the three-year moving average. Both the internal rate of return and external rate of return for industries with extremely high internal rates are calculated as three-year moving averages so as to correspond to the concept of an expected rate of return. The use of three-year moving averages of the rate of return results in a difference between the value of capital services and capital income from the National Accounts, even for industries where IRRs are used.

The depreciation rate term for the user cost of capital is based on a Statistics Canada study that re-estimated depreciation rates by incorporating more data on the price of used assets disposed. The depreciation rate applied in the revision is slightly higher than in previous estimates for machinery and equipment, and slightly lower for construction. The use of slightly different rates has almost no effect on the growth of capital stock and capital input (Baldwin, Liu and Tanguay forthcoming).

The effect of these revisions on capital input growth is presented in Table 2. The revisions generally had a small effect on capital input growth in most industries. The exception was service industries where the dual approach was adopted to estimate capital input (for instance, professional, scientific and technical services; arts, entertainment and recreation; and other private services). Revised capital input growth was lower than previous estimates, mostly for the 1961-to-1980 period.

Table 2
Revisions to average annual growth of capital input, by industry, 1961 to 2007 and 2007 to 2011

Industry	Revised estimate		Previous estimate		Difference (revised minus previous)	
	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011
	percent					
Agriculture, forestry, fishing and hunting	1.0	0.6	0.9	0.6	0.1	-0.1
Mining and oil and gas extraction	5.6	5.1	5.4	1.3	0.2	3.7
Utilities	3.5	3.5	3.4	5.4	0.2	-1.9
Construction	4.5	4.3	3.9	3.4	0.6	1.0
Manufacturing	3.1	-1.4	3.0	-1.5	0.1	0.1
Wholesale trade	4.7	3.2	4.6	2.9	0.1	0.3
Retail trade	5.0	1.6	4.7	1.2	0.3	0.4
Transportation and warehousing	3.1	4.3	3.6	3.9	-0.5	0.4
Information and cultural industries	5.6	0.5	5.1	1.6	0.5	-1.2
Finance, insurance, real estate and renting and leasing	6.7	-0.7	6.8	1.5	-0.1	-2.1
Professional, scientific and technical services	14.9	11.7	18.9	6.9	-4.1	4.9
Administrative and support, waste management and remediation services	11.4	11.3	13.5	9.1	-2.1	2.2
Arts, entertainment and recreation	7.7	5.1	11.7	6.3	-4.0	-1.2
Accommodation and food services	5.4	4.2	9.8	4.0	-4.3	0.1
Other private services	5.3	6.7	8.8	5.8	-3.5	0.9

Note: Authors' calculations based on data from the sources below.

Sources: Statistics Canada, CANSIM tables 383-0021 and 383-0022.

4 Revisions to labour input

Much like the estimates of capital input, which capture substitution across asset classes, the estimates of labour input used to measure MFP incorporate substitution between types of heterogeneous labour (for instance, workers cross-classified by age, education, experience). The growth rates of the different types of labour are Fisher-chain-weighted by their corresponding wages.

The growth in labour input is the sum of the growth in hours worked and the growth in labour compositional shifts toward workers with high relative wage rates (more educated, more experienced). The revisions to labour input growth are the result of the changes in the estimates of hours worked and labour compensation in the CSNA.

The 2012 CSNA revisions did not introduce conceptual changes in employee compensation per se. However, the estimates were affected by a large number of statistical revisions that shifted the distribution of employee compensation and hours worked from the business sector to the government sector. After the revision, in the 2007-to-2011 period, hours worked were about 2% lower for the business sector, and about 10% higher for the non-business sector.

The effect of the revisions on labour input growth was minimal for the period before 2007 (Table 3). The revisions after 2007 were due to normal revisions in hours worked and labour compensation in the labour productivity accounts for the post-reference year.

Table 3
Revisions to average annual growth of labour input, by industry, 1961 to 2007 and 2007 to 2011

Industry	Revised estimate		Previous estimate		Difference (revised minus previous)	
	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011
			percent			
Agriculture, forestry, fishing and hunting	-1.2	-1.6	-1.1	-1.8	-0.1	0.2
Mining and oil and gas extraction	2.8	3.5	2.8	1.1	0.0	2.4
Utilities	2.5	0.1	2.4	3.1	0.0	-3.0
Construction	2.0	3.6	2.0	2.0	0.0	1.6
Manufacturing	1.1	-3.6	1.1	-3.2	0.1	-0.5
Wholesale trade	3.0	-0.9	3.0	-0.7	0.0	-0.3
Retail trade	2.5	-0.6	2.5	0.6	0.0	-1.2
Transportation and warehousing	2.0	0.5	2.0	-0.4	0.0	0.9
Information and cultural industries	3.0	1.9	3.0	1.5	0.0	0.4
Finance, insurance, real estate and renting and leasing	3.6	3.0	3.6	0.7	0.0	2.2
Professional, scientific and technical services	5.5	1.1	5.5	2.5	-0.1	-1.3
Administrative and support, waste management and remediation services	7.6	0.1	7.6	0.5	0.0	-0.4
Arts, entertainment and recreation	6.3	-0.6	6.2	1.5	0.0	-2.1
Accommodation and food services	3.3	0.2	3.3	0.2	0.0	0.0
Other private services	2.7	1.5	2.6	1.9	0.0	-0.4

Note: Authors' calculations based on data from the sources below.

Sources: Statistics Canada, CANSIM tables 383-0021 and 383-0022.

5 Revisions to multifactor productivity growth

MFP growth is calculated as the difference between the growth in output and the growth in combined inputs. Table 4 shows the overall effects of the revisions to real GDP, capital and labour inputs on MFP growth at the industry level. The effects on estimates of MFP growth are small, except for industries (such as professional services, and arts and entertainment) where capital input was re-estimated to be consistent with capital income in the National Accounts. Although estimated MFP growth for those industries is negative after the revisions, the rate of decline is less as a result of the downward revision in their capital input growth.

Table 4
Revisions to average annual multifactor productivity growth, by industry, 1961 to 2007 and 2007 to 2011

Industry	Revised estimate		Previous estimate		Difference (revised minus previous)	
	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011	1961 to 2007	2007 to 2011
			percent			
Agriculture, forestry, fishing and hunting	1.8	2.0	1.9	2.0	-0.1	0.0
Mining and oil and gas extraction	-2.0	-4.4	-1.9	-1.3	-0.1	-3.0
Utilities	0.9	-0.7	1.1	-2.9	-0.3	2.2
Construction	0.6	-0.7	0.4	-0.9	0.2	0.1
Manufacturing	1.7	0.1	1.6	-0.2	0.1	0.3
Wholesale trade	1.9	0.6	1.9	-0.1	-0.1	0.7
Retail trade	1.5	1.4	1.5	1.1	0.0	0.3
Transportation and warehousing	1.5	-1.5	1.3	0.2	0.1	-1.7
Information and cultural industries	1.9	0.1	2.1	-1.0	-0.2	1.1
Finance, insurance, real estate and renting and leasing	-1.0	0.0	-1.2	0.4	0.2	-0.4
Professional, scientific and technical services	-0.2	-1.1	-2.2	-2.2	1.9	1.1
Administrative and support, waste management and remediation services	-1.3	-2.0	-2.2	-2.3	0.9	0.3
Arts, entertainment and recreation	-1.6	-1.8	-3.1	-3.5	1.5	1.7
Accommodation and food services	-1.1	-0.1	-2.6	-0.3	1.5	0.2
Other private services	0.3	-1.0	-0.8	-2.0	1.1	1.0

Note: Authors' calculations based on data from the sources below.

Sources: Statistics Canada, CANSIM tables 383-0021 and 383-0022.

The combined effects of revisions to MFP growth estimates and related variables for the total business sector are summarized in Table 5. The revisions have little effect on growth in real GDP and labour input over the entire 1961-to-2011 period. The revisions reduced aggregate capital input growth for 1961 to 1980, but thereafter, the effect was minimal. Annual capital input growth from 1961 to 1980 was 6.6% before the revision, and 5.7% after it. The lower growth after the revision was partly due to: 1) the downward revision in capital input growth in service industries where the revised capital input was imputed in order to be more consistent with capital income from the National Accounts; and 2) the use of external rates of return for industries with extremely high and low rates of return.

Table 5
Revisions to multifactor productivity growth and related variables in the business sector, selected periods, 1961 to 2011

	1961 to 1980	1980 to 2000	2000 to 2011	1961 to 2011
		percent		
Revised annual average growth rates				
Real gross domestic product	5.0	3.2	1.7	3.5
Labour input	2.9	2.2	1.3	2.2
Capital input	5.7	3.9	3.4	4.5
Multifactor productivity growth	1.1	0.5	-0.4	0.5
Previous annual average growth rates				
Real gross domestic product	4.9	3.2	1.7	3.5
Labour input	2.8	2.1	1.4	2.2
Capital input	6.6	4.0	3.2	4.8
Multifactor productivity growth	0.7	0.3	-0.4	0.3
Difference (revised minus previous)				
Real gross domestic product	0.0	0.1	0.0	0.0
Labour input	0.0	0.0	0.0	0.0
Capital input	-0.8	-0.1	0.2	-0.3
Multifactor productivity growth	0.4	0.2	0.0	0.2

Note: Authors' calculations based on data from the sources below.
Sources: Statistics Canada, CANSIM tables 383-0021 and 383-0022.

The revisions do not change the long-term trend in MFP growth or the sources of labour productivity growth in the total business sector (Table 6). Aggregate labour productivity growth decelerated, especially after 2000, mostly because of the decline in MFP growth.

Table 6
Revisions to sources of labour productivity growth in the business sector, selected periods, 1961 to 2011

	1961 to 1980	1980 to 2000	2000 to 2011	1961 to 2011
		percent		
Revised annual average growth rates				
Labour productivity growth	2.9	1.7	0.9	2.0
Contributions:				
Capital deepening	1.2	0.8	1.0	1.0
Labour composition	0.6	0.4	0.3	0.4
Multifactor productivity growth	1.1	0.5	-0.4	0.5
Previous annual average growth rates				
Labour productivity growth	2.9	1.7	0.9	2.0
Contributions:				
Capital deepening	1.7	1.0	1.0	1.3
Labour composition	0.5	0.4	0.3	0.4
Multifactor productivity growth	0.7	0.3	-0.4	0.3
Difference (revised minus previous)				
Labour productivity growth	0.0	0.0	0.0	0.0
Contributions:				
Capital deepening	-0.5	-0.1	0.0	-0.2
Labour composition	0.0	0.0	0.0	0.0
Multifactor productivity growth	0.4	0.2	0.0	0.2

Note: Authors' calculations based on data from the sources below.

Sources: Statistics Canada, CANSIM tables 383-0021 and 383-0022.

The revisions have little effect on the comparison between Canada and the United States of the sources of labour productivity growth (Table 7). During the 1980-to-2012 period, Canada's business sector had lower labour productivity growth than did that in the United States primarily because of lower MFP growth. After 2000, annual MFP growth in Canada was negative (-0.5%), compared with 1.1% in the United States.

Table 7
Sources of labour productivity growth in the business sector, Canada and the United States, selected periods, 1961 to 2012

	1961 to 1980	1980 to 2000	2000 to 2012	1961 to 2012
		percent		
Canada				
Labour productivity growth	2.9	1.7	0.8	1.9
Contributions:				
Capital deepening	1.2	0.8	1.0	1.0
Labour composition	0.6	0.4	0.3	0.4
Multifactor productivity growth	1.1	0.5	-0.5	0.5
United States				
Labour productivity growth	2.5	2.0	2.2	2.3
Contributions:				
Capital deepening	0.9	0.8	0.9	0.9
Labour composition	0.1	0.3	0.3	0.2
Multifactor productivity growth	1.5	0.9	1.1	1.1

Note: Authors' calculations based on data from the sources below.

Sources: Statistics Canada, CANSIM table 383-0021; and Bureau of Labor Statistics, Productivity Program.

6 Conclusion

This paper highlights revisions to multifactor productivity (MFP) growth and related variables in the business sector and in individual industries that resulted from the historical revision of the Canadian System of National Accounts (CSNA) released October 1, 2012, revisions to the labour productivity accounts released October 12, 2012, and changes in the estimation of capital input that are made to improve its consistency in industry multifactor productivity growth estimates.

The CSNA 2012 revisions led to changes in all the variables used to measure MFP growth. The revisions that affect MFP growth estimates are: 1) the capitalization of research and development (R&D) expenditures, which resulted in changes to gross output, intermediate inputs, gross domestic product and capital input; 2) the treatment of exploration, which resulted in changes to output and intermediate inputs in construction, oil and gas extraction and mining industries; and 3) statistical revisions to output and input estimates.

In addition, changes are made to the estimation of capital inputs at the industry level to improve consistency with other industry aggregates. Before the revision, the endogenous (or internal) rate of return method was used to estimate the user cost of capital. The revision introduces a variant of that approach. The internal rate of return is still used generally. But, the exogenous (or external) rates of return are now used to estimate the user cost of capital for industries with extremely high and low internal rates of return. In addition, for a number of service industries where internal rates of returns are high and exhibit a downward trend in the 1970s and 1980s, capital input is imputed by dividing the nominal value of capital services by the user cost of capital estimated using the external rates of return.

The revisions have a small effect on the growth of capital input, labour input, and MFP in the total business sector for the period after 1980. But they reduced aggregate capital input growth for 1961 to 1980, and therefore increased MFP growth. The MFP growth is revised up from 0.7% per year to 1.1% per year for that period. The lower capital input growth (and higher MFP growth) after the revision was partly due to: 1) the downward revision in capital input growth in service industries where the revised capital input was imputed in order to be more consistent with capital income from the National Accounts; and 2) the use of external rates of return for industries with extremely high and low rates of return.

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