Difficulties Assessing Multifactor Productivity for Canada

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ABSTRACT

In 2011, Canada's business sector multifactor productivity (MFP) index, as estimated by Statistics Canada, was below that for 1977, a third of a century earlier. Over these years, public policies were enacted to try to improve Canada's productivity. Yet the nation's MFP continued to fall, relative to both the past and Canada's main trading partners. Policymakers and business decision makers need to know whether Canada's MFP statistics accurately reflect the nation's productivity. We argue that they do not.

Résumé

En 2011, l'indice de la productivité multifactorielle (PMF) du secteur des entreprises du Canada tel qu'estimé par Statistique Canada en 2011 était inférieur à celui de 1977, plus d'une trentaine d'années plus tôt. Pendant des années les politiques publiques ont été développées pour améliorer la productivité du Canada. Pourtant, l'indice du PMF continue à decliner, par rapport au passé et aux principaux partenaires commerciaux du Canada. Il est crucial pour les responsables des politiques et les décideurs des milieux d'affaires de savoir si la situation reflète fidèlement le rendement du Canada sur le plan de la PMF. Nous soutenons que cela n'est pas le cas.

IN 2011, CANADA'S BUSINESS SECTOR multifactor productivity (MFP) index, as estimated by Statistics Canada, was 94.8, which is lower than the value of 97.6 for 1977. For years now, governments in Canada have sought to improve the nation's productivity. Don Drummond (2006 and 2011) and Paul Boothe and Richard Roy (2008) describe some of the policy measures. Yet, as Drummond (2011:4) laments, "multifactor productivity did not grow at all." Drummond notes that the implementation of a large number of market-oriented policies by governments in Canada over the past several decades was expected to boost productivity

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growth. But this did not happen. In this article, we suggest that one reason for this situation may be that measurement issues have resulted in officially measured productivity growth underestimating true productivity growth.

We note that MFP statistics are fragile. They draw on a wide range of economic statistics, including estimates of output and labour and capital input as well as price information for these components. John Baldwin (2012) points out that the Statistics Canada productivity program integrates data from different sources that are not all perfectly comparable.

MFP growth rates are often of the order of only 1 to 2 per cent per year. The MFP growth rate is defined as the output growth rate minus the input growth rate. So, suppose output grew 4 per cent per year over a 50 year period, and input grew 3 per cent. Thus MFP grew at a 1 per cent rate. Now suppose the statistical agency overstates input growth by 1 percentage point. Then the measured input growth rate would be 4 per cent instead of 3 per cent. Looking at the input series, it would not necessarily be obvious that something was wrong. However, the same error would lead to no measured MFP growth! The point is that seemingly odd MFP results should lead us to examine the data and methods utilized.

Gu (2012:50) writes that, "since Canadian productivity performance is often compared to the productivity performance in the United States, the methodology behind the estimates for Canada should be comparable to the largest extent possible to that used by the U.S. Bureau of Labor Statistics (BLS)." Thus we begin with a brief review of the history of the BLS productivity program. We follow with a discussion of the rates of return used in computing the capital services input for MFP statistics. Next we introduce the EU KLEMS and World KLEMS data bases.

The official Statistics Canada and Bureau of Labor Statistics (BLS) MFP statistics are examined together with the MFP statistics for Canada and the United States given on the EU KLEMS and World KLEMS websites. The MFP estimates of Diewert and Yu (2012) are also examined. They find that the MFP performance of the Canadian business sector has been reasonably satisfactory over the past five decades - a striking difference from what the official MFP statistics for Canada show. Finally, we also compare the rates of return produced by Statistics Canada with the Canadian rates for the return on assets (ROA) for selected industries. The ROA statistics are widely used in corporate finance. We then give our conclusions.

A History of Transparency in the BLS Productivity Program

The BLS multifactor productivity program, established in 1983, carries out the computations needed for estimation of MFP for the United States at a highly detailed industry level.² The BLS does its calculation using data published by other U.S. statistical agency offices (e.g. the Bureau of Economic Analysis (BEA)). The source data have already met all confidentiality tests. Hence, the BLS need not suppress any part of the data or calculations. The data used in these calculations and the results are posted at two links.3 This sharing was instituted when these MFP measures were created 25 years ago to enable economists outside the BLS to assess BLS methods and replicate results. By 2010, the BLS was posting on its website all the detailed information behind

² For more on the origins of the BLS MFP program, see BLS (1983 and 2003), Dean and Harper (1998), Gullickson and Harper (1987), Harper (1983), and Harper, Berndt and Wood (1989). Material on the origins of the methods can also be found in Diewert (1980, 2001, 2005, and 2006), Diewert and Lawrence (2000), Diewert and Nakamura (2007), Jorgenson (1963), Jorgenson and Griliches (1967), and Schreyer (2001 and 2009).

its MFP statistics on the same day it released an update.⁴

The provision of full data and details for the U.S. BLS statistics has proven to be important for both U.S. economic policy and data quality improvement. For example, in 1996, Federal Reserve Board Chairman Alan Greenspan contended that U.S. output and productivity were, in fact, growing faster than shown by the official estimates. The ensuing debate led to close examination of the methods and data used in producing these estimates. Outcomes that ensued were:

- The BLS undertook to account for its "topdown" MFP data by also constructing "bottom-up" industry-level MFP data. Using the parallel data sources and methods at the industry level, the BLS was able to reconstruct its aggregate growth rates for each of three separate time periods to within twotenths of a percentage point.⁵
- Gullickson and Harper (1999) found suspiciously low MFP growth in several service industries, and identified correctable measurement problems in each.
- BEA made several methodological changes to the U.S. National Accounts.

There were lasting benefits from some of these efforts. For instance, the BLS has continued to compare its official "top-down" measures to a revamped industry model that yields "bottom-up" measures and the two continue to closely agree: an important consistency check.⁶

The Rate of Return Used in Measuring the Capital Input Component of MFP

The most intricate part of the BLS MFP productivity calculation is the capital input model. BLS, like Statistics Canada and the other national statistics agencies, uses annual data on investment by type of asset and by industry, and investment goods prices to create an annual model of real capital inputs. This involves computing capital stocks, depreciation rates, and asset revaluation rates by asset and by industry, and rates of return (both endogenous and exogenous) by industry. This information is used, in turn, to compute rental prices and cost-share weights for each asset type within each industry.

In MFP measurement, the cost of capital plays two main roles. First, it is used in calculating capital inputs. Second, capital's income share is the weight for capital when it is aggregated with labour into total input.

Firms own different types of assets of various ages. Examples of types include buildings, computers, other machinery, and land. Assets of each type are measured by adding up assets of all ages in inflation-adjusted real terms. The result is an asset-type capital stock. The best practice method for doing cross-asset aggregation is to calculate a Törnqvist index using capital rental prices to construct cost-share weights for the various asset types. Each asset-type rental price is an estimate of the cost of owning that asset.⁷

³ Data for manufacturing are at ftp://ftp.bls.gov/pub/special.requests/opt/mp/prod3.renprmfg.zip and for nonmanufacturing at ftp://ftp.bls.gov/pub/special.requests/opt/mp/prod3.renprnonmfg.zip. Users are given not only the computational methods and the results used in compiling the MFP statistics, but also intermediate computations that were deemed to be implausible results, and hence were disregarded in the MFP calculations. The intermediate results, say, for the internal rates of return can be identified by comparing the entries in the first and second of the tables where the rates of return computed and used are given.

⁴ The current data can be accessed at http://www.bls.gov/mfp/mprdload.htm.

⁵ This decomposition is found in Gullickson and Harper (1999:57).

⁶ The most recent example of this is Harper, Khandrika, Kinoshita and Rosenthal (2010:27).

⁷ The data collected allow an estimate to be made of asset holdings, whether or not the assets were put to active use. Theoretically, of course, an estimate of asset usage would be preferred.

Estimates of what is referred to as the rate of return are a key component in these calculations.

Many official statistics agencies use a prespecified interest rate for the above-mentioned rate of return such as the rate for a high-grade bond. This is the exogenous (or ex ante) approach. However, some experts argue that a balancing rate should be computed instead by comparing the actual property income earned by all assets to the total capital stock. This is called the internal rate of return (also the endogenous or ex post) approach (Schreyer, 2009, chapter 18). Gu (2012:50) notes an advantage of endogenously determined internal rates of return (IRRs) is that they permit development of productivity accounts that are fully integrated with the industry accounts for a nation. While agreeing in principle, Schreyer (2001 and 2009) cautions that the data requirements are also more demanding and that missing and erroneous capital data can result in biased IRRs.

The Statistics Canada productivity program uses an internal rate of return approach. The BLS also computes IRRs. However, for some industries in some years, the computed IRRs are judged by the BLS to be implausible. The BLS has found that when negative, very low or very high, or volatile IRRs are used, the Törnqvist calculation of the index of real capital can be greatly affected. So the BLS, in fact, uses what we refer to as a pragmatic blend of internal and external rates of return.⁸

The EU KLEMS and World KLEMS Data Bases

In producing Canada's official MFP statistics, the Statistics Canada productivity group states it has followed the methods of EU KLEMS and World KLEMS.⁹ There are numerous references in Gu (2012) to EU KLEMS, but little information about what this is. It is a project to build a database for the analysis of productivity and growth. Initially financed by the European Commission, it was developed by a consortium of 15 organisations from across the European Union (EU), and with the active support of some of the EU national statistical agencies and the OECD.¹⁰

EU KLEMS has created two databases: the "analytical module" and the "statistical module." The analytical module includes capital services series that are based on what are described by the EU official statistics agency, Eurostat, as "pioneering assumptions." The statistical module is a sub-set of the analytical module, containing the data accepted by the national statistical agencies of participant countries. Eurostat recommends the use of EU KLEMS data only for growth and productivity analysis, noting that the EU KLEMS data lack consistency with parts of the official national accounts statistics. For example, final consumption expenditure estimates from the EU KLEMS data set differ significantly from official figures.

Data provided by Statistics Canada through 2004, including MFP statistics and the IRRs behind these estimates, are included in the EU

⁸ When the BLS introduced its industry-based capital calculations in 1991, it assumed a 3.5 per cent real rate of return wherever an exogenous rate was needed. The BLS subsequently replaced this arbitrary exogenous rate with an empirically-based rate calculated for each asset type at the private business level. What is important in this context is simply to note that the BLS procedure, in this regard, is very different from the Statistics Canada procedure. Baldwin and Gu (2007:16) state that Australia also uses an internal rate of return approach for their productivity accounts. While true, it is also the case that the Australian Bureau of Statistics (2007) has experienced problems with this approach. The report of MacGibbon (2010) on New Zealand's aborted attempts to follow Australia in using internal rates of return is also of interest in this regard.

⁹ Information on EU KLEMS can be accessed at http://www.euklems.net and World KLEMS at http:// www.worldklems.net.

¹⁰ http://epp.eurostat.ec.europa.eu/portal/page/portal/eu_klems/introduction

Table 1 MFP Growth Rates for Canada and the United States

(compound annual growth rates, per cent)

		Can	ada	United States				
	Market	Economy	Busines	s Sector	Market	Business Sector		
	EU KLEMS	World KLEMS	Statistics Canada	Diewert and Yu	EU KLEMS	World KLEMS	BLS	
1961-2004		0.77	0.43	1.23		0.77	1.26	
1961-1970		1.82	1.25	2.44		0.74	2.08	
1970-2004	0.45	0.49	0.21	0.91	0.86	0.77	1.04	
1970-1995	0.31	0.35	0.08	0.88	0.55	0.58	0.79	
1995-2004	0.84	0.87	0.56	1.01	1.74	1.32	1.76	
2004-2007		-0.40	-0.54	-0.16		0.48	0.61	
2007-2009		-2.21	-2.33	-2.04			-0.99	
2009-2011			0.91	1.58			1.84	
2010			1.72	1.49			3.40	
2011			0.11	1.67			0.29	

Notes: The World KLEMS data goes back to 1961 for Canada and the United States. EU KLEMS contains data for Canada and the United States (SIC based) for 1970-2004. There has been special interest in what happened to MFP growth before and after the mid-1990s, and in the years leading up, to during, and since the recent financial crisis. These are the reasons for the choice of periods for which growth rates are shown in this table. The EU KLEMS and World KLEMS MFP growth rates are for the market economy; the official Statistics Canada and BLS MFP statistics are for the business sector.

KLEMS analytical database. In addition, data provided by Statistics Canada through 2008, including the IRRs, are on the World KLEMS website.¹¹ There are links on EU KLEMS to World KLEMS, and vice versa. The two projects are related conceptually too, but also differ in potentially important ways. These are valuable international data compilation and research efforts; the importance of these projects, and of the participation by Statistics Canada in the projects, is illustrated by our use of the data from the project websites.

Statistics Canada and BLS MFP Estimates versus EU KLEMS and World KLEMS Estimates

Table 1 shows that the BLS MFP growth rates for the United States of 1.26 per cent and 0.61

per cent per year over the 1961-2004 and 2004-2007 periods are well above the official Canadian MFP growth rates of 0.43 and -0.54 per cent, respectively. This pattern continues for 2007-2009 and 2009-2011.

The market sector EU KLEMS and World KLEMS MFP growth rates for Canada are fairly similar to the official Canadian rates. However, from Table 1 we see that the EU KLEMS and World KLEMS rates for the United States are lower than the official BLS rates.¹²

Note also the similarities between the summary rates we have calculated and show in Table 1 for MFP statistics for Canada from Diewert and Yu (2012) and the official MFP statistics for the United States. While beyond the scope of this article to further substantiate, our view at this point is that the Diewert-Yu MFP statistics

¹¹ Data can be found on the World KLEMS website for the following nine countries (when the estimates were prepared by an official statistical agency, the name of the agency is given in parentheses): the Netherlands (Statistics Netherlands), the United Kingdom, Germany, Italy (the Italian National Institute of Statistics), France, Austria, Spain, Canada (Statistics Canada), and the United States. The link for the source for the U.S. data is to Dale Jorgenson at Harvard. Also, links are given for directly downloading KLEMS data from the Australian Bureau of Statistics and from other organizations for China, Japan and Korea. http://www.worldklems.net/ data/index.htm.

¹² This finding is contrary to earlier results of Gu (2008).

behave more as one would expect, given other economic indicators such as profitability for Canada and the United States, than the official Statistics Canada MFP statistics.

The IRRs Given on EU KLEMS and World KLEMS for Canada the United States

According to the tables on the EU KLEMS and World KLEMS websites, Canada's industries sometimes had negative rates of return.¹³ Also, the IRRs for a considerable number of industries are over 40 per cent for multiple years, which we regard as implausible (the World KLEMS IRRs for Canada are reproduced in Diewert (2012:Appendix Tables 1-3). Using rates of return that are negative or unreasonably large or volatile can contribute to overstated capital input growth and understated MFP growth.

Gu (2012:55-56) reports that getting rid of "unreasonably high or low" IRRs that were used by the Canadian Productivity Program (CPP) in producing the official Canadian MFP statistics reduced the difference between the official CPP capital input growth figures and those of Diewert-Yu by 0.4 percentage points, half of the total difference caused by switching from a "bottomup" to a "top-down" approach. This suggests to us that a significant share of the difference between the official MFP statistics for Canada and the United States arises from this same factor. Relatedly, Schreyer (2012:74) writes that "The significant size of the reallocation effect in the Canadian case (valued by Gu (2012) at 0.8 percentage points per year for capital input over the 1961-2011 period)" may reflect "a measurement issue associated with large variances of industry-specific input prices." Schreyer notes

that, in the case of capital, input prices correspond to user costs, and the IRRs are a main component of those. However, none of us have access to the data or computational details needed to properly explore possible problems with Canada's official MFP statistics.

Gu (2012:59) states that Statistics Canada cannot release the details of its MFP calculations like the BLS does because of a combination of the Canadian Statistics Act and the smaller size of the economy. While confidentiality of source information is important, we argue that it cannot be an argument for suppressing this information. We must find ways to achieve both the objectives of confidentiality and transparency.

An example of where Statistics Canada could be more transparent is in publishing its IRRs on its own website along with, or soon after, publication of the MFP statistics released, with the most recent release being for 2011. The rates of return published for Canada on the World KLEMS website only go through year 2008. The fact that Statistics Canada has published the IRRs for their MFP statistics on the publically accessible EU KLEMS and World KLEMS websites suggests there are no problems arising from the Canadian Statistics Act that prevent the publication, at least, of up-to-date IRRs.

A Look at How the Statistics Canada IRRs Compare with Canadian ROAs

As others have also suggested, Baldwin and Gu (2007:14) write that the IRRs might be thought of as either the opportunity cost of using capital or financing costs. In this case, these rates of return should be broadly comparable in terms of the values with industry estimates of rates of return (ROA), a commonly used prof-

¹³ Canadian IRRs are given through 2004 in the 2008 release for EUKLEMS at http://www.euklems.net/data/08i/ input/can_capital_input_08I.xls. Canadian rates of return are given as part of the 2012 release for World KLEMS at http://www.worldklems.net/data/index.htm under the very last tab, labelled IRR. The values as of November 26, 2012, go to 2008.

itability measure showing the amount of profits generated by each dollar of assets. In Appendix Table 1, the ROA values shown range from -0.3 per cent to 17.8 per cent. These rates are in almost all cases lower than the IRRs found in the same table, and in many cases substantially lower. The BLS rates of return used in their MFP computations are generally between a small positive per cent and 15 per cent.

Conclusions

In a much cited paper, Erwin Diewert and Kevin Fox (1999) ask: "Can measurement error explain the productivity paradox?" Though Diewert and Fox were referring to a different paradox, their question applies as well to the one that is our focus in this article, and our answer is "probably so." This is the new research perspective we bring to Canada's long standing alleged productivity malaise; this is our response to the challenge of explaining Canada's poor productivity growth eloquently posed by Don Drummond in his 2011 "Confessions" paper. Our conclusions:

The large differences between the MFP statistics for Canada and the United States, despite the many similarities of the economies over much of their shared history, might be a warning sign, we believe, of underlying problems with the data or the methodology utilized for the official Canadian and/or the official BLS MFP statistics (U.S. data problems are being actively investigated by a large U.S. project that is a continuation of an earlier one in which Harper, Nakamura, and Diewert are participating).¹⁴

- We find the gaps between the stated procedures for MFP estimation used by Statistics Canada and the BLS are substantial.
- In our view, productivity debate in this country would benefit if Statistics Canada adopted a practice of greater transparency by providing along with its MFP releases all IRRs and compilation details used for the agency's MFP estimates.

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¹⁴ See http://www.bea.gov/papers/pdf/bea_2010_conference%20papers_final.pdf, http://www.upjohn.org/ Research/GlobalIssues/Globalization and http://www.upjohn.org/Research/GlobalIssues/Productivity. Papers arising from this U.S.-based project, to be released in 2013, address the question of whether Canada, in fact, has had dismal labour productivity performance relative to the United States. Even if it were agreed that Canada's MFP performance has been reasonably satisfactory, all concur that it would still be a serious problem if Canada's labour productivity compared to the United States has, in fact, been as poor as what the official labour productivity statistics for the two countries currently show.

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Appendix Table 1
Internal Rates of Return and Returns on Assets for Canadian Industries, 2000-2008

	2000		2002		2004		2006		2008	
	IRR	ROA	IRR	ROA	IRR	ROA	IRR	ROA	IRR	ROA
Agriculture, Hunting, Forestry and Fishing	0.107	0.052	0.134	0.040	0.204		0.119		0.213	
Mining and Quarrying	0.156	0.014	0.098	0.008	0.196		0.221		0.220	
Food, Beverages and Tobacco	0.490	0.069	0.477	0.072	0.527		0.553		0.563	
Textiles, Textile , Leather and Footwear*	0.465	0.076	0.308	0.066	0.258	0.041	0.140	0.041	0.083	0.032
Pulp, Paper, Paper , Printing and Publishing*	0.244	0.062	0.191	0.046	0.167	0.038	0.154	0.040	0.149	0.032
Coke, Refined Petroleum And Nuclear Fuel	0.049	0.162	0.067	0.111	0.089	0.178	0.079	0.165	0.081	0.145
Chemicals and Chemical Products*	0.251	0.086	0.264	0.075	0.257		0.218		0.186	
Rubber And Plastics*	0.402	0.086	0.405	0.075	0.378		0.329		0.264	
Other Non-Metallic Mineral	0.267	0.093	0.256	0.104	0.286	0.100	0.343	0.111	0.293	0.106
Basic Metals and Fabricated Metal	0.287	0.075	0.240	0.061	0.294		0.344		0.354	
Machinery, Nec*	0.564	0.082	0.457	0.068	0.488		0.536		0.490	
Electrical and Optical Equipment*	0.565	0.086	0.021	-0.003	0.078	0.027	0.099	0.060	0.131	0.044
Manufacturing Nec; Recycling	0.511	0.088	0.507	0.082	0.526	0.061	0.482	0.063	0.429	0.041
Electricity, Gas and Water Supply	0.094	0.068	0.085	0.061	0.119	0.063	0.127	0.068	0.107	0.064
Construction	0.233	0.038	0.318	0.052	0.423	0.055	0.531	0.077	0.610	0.081
Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale Of Fuel*	0.038	0.051	0.088	0.059	0.107	0.057	0.142	0.065	0.214	0.060
Transport and Storage*	0.077	0.046	0.070	0.057	0.083		0.117		0.112	
Post and Telecommunications*	0.052	0.050	0.047	0.047	0.063	0.047	0.189	0.101	0.240	0.097
Financial Intermediation*	0.178	0.025	0.165	0.019	0.219	0.026	0.270	0.028	0.296	0.022
Real Estate Activities	0.091	0.049	0.105	0.052	0.117	0.046	0.124	0.042	0.077	0.039

Notes:

- Canadian industry rates of return from 2000 to 2004 are from the March 2008 release of EUKLEMS: http:// www.euklems.net/. Canadian industry rates of return in 2006 and 2008 are from World KLEMS: http://www.worldklems.net/data/index.htm. These two datasets provide mostly comparable industry rates of returns. The differences during the overlapping years are no bigger than 0.052.
- 2. The Canadian industry return on assets is defined as the ratio of profits over assets. The "operating profits/loss" are v3871168-v3871216 from CANSIM Table 1800-003 "Financial and Taxation Statistics for enterprises, by North American Industry Classification System (NAICS)". The "assets" are v3869008-v3869056 from the same table.
- 3. Using the corresponding industry classification table provided by Statistics Canada (http://www.euklems.net/data/08i/ sources/can_sources_08I.pdf), we identified 20 corresponding industries in CANSIM Table 1800-003. The other ten NAICS industries listed in the industry classification table are not in CANSIM Table 1800-003. Among these 20 identified industries, ten of them involve a certain level of estimation. For example, "electrical and optical equipment" is defined as NAICS 334+3351+3353+3359, while we use 334+335 since the more detailed classification is not available. We put asterisks on the estimated industries.
- 4. CANSIM Table 1800-003 started in 1999, and some of the industries are terminated after 2002. This is why 8 industries have missing ROAs in 2004 and after.
- 5. The data source of profits and assets are the financial statements of enterprises in the "Quarterly Survey of Financial Statement" (http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=2501&lang=en&db=imdb&adm=8&dis=2.