

# Review Article on *Productivity Growth in Canada and Industry-level Productivity and International Competitiveness Between Canada and the United States*

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Early 2001 has seen the publication of two important contributions to the literature on productivity in Canada. In February, Statistics Canada released a research study entitled *Productivity Growth in Canada*,<sup>1</sup> and in March Industry Canada published a research monograph entitled *Industry-level Productivity and International Competitiveness Between Canada and the United States*.<sup>2</sup> This review article summarizes the key findings of these two studies and provides a commentary.

## Productivity Growth in Canada

The Statistics Canada study consists of eight chapters authored by different Statistics Canada researchers on specific productivity issues followed by five appendices and a glossary. John R. Baldwin, Director of the Micro-economic Analysis Division was the driving force behind the volume and co-authored all articles. The chapters of the study tackle the following topics: productivity concepts and trends, restructuring and productivity growth in the Canadian business sector, the precision of productivity measures, a comparison of productivity growth in Canada and the United States, the differences in

productivity performance of domestic and foreign-controlled establishments in Canada, the structure of investment in Canada and impact on capital accumulation, the cyclical behaviour of labour productivity, and a new framework for understanding manufacturing productivity.<sup>3</sup>

The main messages I took away from the volume are the following.

- There is significant imprecision in estimates of productivity growth rates, particularly multi-factor productivity so caution is warranted in interpreting these numbers, particularly in an international context.
- Given the large cyclical component to short-term productivity trends, longer-term, peak-to-peak growth rates are a more appropriate focus for the analysis of the determinants of productivity growth.
- Given Canada's relatively competitive market structures, sectoral productivity gains are generally manifested by changes in relative prices, not by sectoral wage changes. At the economy-wide level, real wage growth is determined by aggregate labour productivity growth.
- Canada's productivity growth has been comparable to that in the United States in the business sector, but inferior in manufacturing,

largely due to the greater size and better performance of the high-tech sector in the United States.

In my view, the volume succeeds admirably in its objective of providing a comprehensive guide to productivity measures in Canada. It will be an indispensable source of information for productivity researchers. A number of general and technical comments on the volume and suggestions for additional research follow.

A welcome theme of the study is the imprecision of productivity measurement. A full chapter addresses issues of capital measurement, international comparability, and revisions. It is suggested that the minimum confidence interval around multifactor productivity estimates should be 0.3 percentage points, or even larger. Given that multifactor productivity growth in the business sector in Canada over the 1961-99 period was 1.2 per cent per year and just 0.4 per cent in 1979-88 and 0.7 per cent in 1988-99, much of multifactor productivity growth, particularly in recent years, may be statistical mirage. The existence of confidence intervals around productivity growth estimates should not be forgotten in the productivity debate.

The study stresses that its objective is to focus on productivity growth, not productivity levels. In my view, this rigid distinction between growth rates and levels is artificial. Of course, the difference between the two concepts is crucial for the study of productivity and ignored by many observers, leading to needless confusion. But in the study of growth rates one cannot ignore levels since levels are in effect needed for the calculation of growth rates. Indeed, Statistics Canada publishes absolute labour productivity levels as part of its productivity program. Labour productivity levels for the aggregate economy or by province or sector are easily calculated from constant dollar gross output, or better yet value added data and persons employed or hours worked. It is true that international level com-

parisons are tricky because of the need for estimates of purchasing power parity (under no circumstances should the market exchange rate be used), but the study certainly could have provided more information on labour (or even multifactor) productivity levels by sector and their determinants.

In the first issue of the *International Productivity Monitor*, Richard G. Lipsey presented a critique of the concept of total factor or multifactor productivity, pointing out that this concept does not represent technological change. These criticisms appear not to have permeated into Statistics Canada thinking on the issue. At numerous places in the study multifactor productivity is identified with technological changes.<sup>4</sup> At no point is it noted that capital investment is needed to embody the latest technological change and that the identification of multifactor productivity with technological change is misleading if not wrong. Certainly, multifactor productivity can be considered a measure of disembodied technological change, but the overall concept of technological change must include both embodied and disembodied elements.

A number of technical points follow.

- The study rightly stresses that productivity trends are best viewed from a long-term perspective over a complete business cycle (preferably peak-to-peak). The year 1988 is chosen as the most recent peak based on productivity trends. The most recent business cycle peak is normally associated with 1989 so this different dating of peaks is somewhat confusing.
- Statistics Canada uses annual income shares to weight the contribution of labour and capital to output growth, but provides no discussion of the rationale for this choice. Short-term income shares can be very cyclical, with capital's income share falling sharply during a downturn when profits slump. It would seem

unlikely that capital's actual contribution to output would behave in such a cyclical matter. Long-term average income shares may be a more appropriate measure of a factor's contribution.

- The study defines structural change as increases or decreases in the relative importance of various sectors or changes in output shares. The term restructuring appears to be used interchangeably. Unfortunately, it is not spelled out whether changes in output changes are measured in real or nominal terms. For example, one could imagine a personal service industry whose current dollar output share remains stable, while its constant dollar output share falls because of below average productivity gains and above average price increases. Would such an industry be experiencing structural change?
- The study examines the impact of structural change on productivity but does not develop what in my view is a key finding, namely that employment shifts have significantly dampened productivity growth. The study finds that if productivity growth of individual sectors is weighted by 1961 labour shares, average productivity growth over the 1961-95 period is 1.85 per cent, whereas weighted by 1995 shares it is 1.39 per cent, 25 per cent less. It would have been useful to elaborate on the relative importance of these labour shifts within the period and to identify what have been the most important movements. Has it been the employment shift to low-productivity service industries that has impeded aggregate productivity growth?
- The study correctly points out that there is a close relationship between real wage growth and aggregate labour productivity growth. However, it would have been useful to have been more explicit that the appropriate wage

measure used in such productivity comparisons, namely the real producer wages (nominal wages/gross output prices or GDP deflator), and not real consumer wages (nominal wages/CPI). Because of falling prices for investment goods and increased indirect taxes, the CPI has risen at a faster rate than the GDP deflator. Consequently, real consumer wages have not kept pace with productivity growth, while the real producer wage has kept pace. This has created the mistaken public perception that real wage growth in the 1990s has been delinked from productivity growth. Clarification on this point would have been useful.

- Statistic Canada's productivity program uses data from various sources and makes various adjustments. Keeping track of this information is difficult. It would have been useful if this information had been succinctly summarized in one table, admittedly probably a large table. At a glance, one could then see for both labour and multifactor productivity estimates what price index is used, whether labour is adjusted for quality, what capital stock series is used, the period for which estimates are available, and other appropriate information. For example, this reader was confused whether a labour quality adjustment was made only to multifactor productivity estimates, or to both labour and multifactor productivity estimates.

As noted in the study, since 1973 productivity growth in Canada and other industrial countries had slowed significantly. This stylized factor has been the objective of an intensive research effort by economists for two decades, with a consensus still failing to emerge. The final chapter finds that a decline in the importance of scale economics accounts for some of the slowdown, but the relative importance of the host of other pos-

sible factors is not examined. It would have been useful for the volume to have given more systematic attention to this important development.

Since 1995, productivity growth has surged in the United States although not in Canada. While this development is mentioned in the volume, it is not explored in any detail. Again, a discussion of the outlook for productivity growth in Canada based on recent developments would have been very useful for the current debate on trend productivity in Canada.

The points raised above are minor in the context of the overall contribution *Productivity Growth in Canada* represents to productivity research in Canada. Statistics Canada is to be congratulated for this initiative in particular and in general for its decision to devote additional resources to expanding our understanding of the productivity issue.

### **Industry-level Productivity and International Competitiveness Between Canada and the United States**

The Industry Canada study was edited by the well-known productivity expert Dale Jorgenson of Harvard University and by Frank Lee with Industry Canada at the time of the study and now with the OECD. It contains four chapters on specific topics followed by seven appendices. The chapters deal with the following topics: the speed limit for U.S. economic growth, productivity growth in Canadian industries, a comparison of productivity growth in Canada and the United States, and productivity levels and international competitiveness between Canada and the United States.<sup>5</sup>

The first chapter by Dale Jorgenson and Frank Lee provides an excellent discussion of recent productivity trends in the United States. The authors point out that labour productivity

grew at 2.4 per cent per year in 1995-98, more than a percentage point faster than in 1990-95. They attribute 0.5 points of the acceleration to capital deepening, a direct consequence of price-induced substitution and rapid investment, and 0.6 points to faster total factor productivity growth, which largely reflects technical change in the production of computers and the resulting acceleration in their price decline. They note that this strong total factor productivity growth (1 per cent per year) may represent a new paradigm, although they caution that slow productivity growth in services must still be reconciled with massive high-tech investment in this sector. More recent information on service sector productivity, as documented in the article by this author in the inaugural issue of the *International Productivity Monitor* and by Kevin Stiroh in this issue, provide additional support for this new paradigm view.

Jorgenson and Stiroh note that the sustainability of labour productivity growth is the key issue for future growth projections. The critical factor in this regard is the pace of technological change in high-tech industries. They point to the fall in computer prices at a 28 per cent annual rate in 1995-98, compared to 15 per cent during 1990-95, as evidence of an acceleration of technological change. Continued price declines of this magnitude would imply a continuation of current productivity trends.

The second chapter by Wulong Gu, Frank Lee and Jianmin Tang analyses the sources of aggregate and sectoral output and labour productivity growth in Canada from 1961 to 1995. The authors adopt the Jorgenson framework, adjusting capital quality by aggregating capital stocks across different capital types (machinery and equipment, non-residential structures, engineering structures, inventories, and land) and adjusting labour quality by different worker characteristics [gender, employment status (three

categories), age (seven categories) and education (four levels)].

The authors found that 46 per cent of private business sector output growth over 1961-73, and 22 per cent and 26 per cent, respectively, over 1973-88 and 1988-95 were attributable to growth in quality-adjusted total factor productivity.<sup>6</sup> Over 80 per cent of the slowdown in output growth between 1961-73 and 1973-88 was attributable to the slowdown in total factor productivity growth; over the following interval (1973-88 to 1988-95) more than 80 per cent of the slowdown in output growth was attributable to slower capital and labour input growth.

For most of the 122 industries examined, input growth was a predominant source of output growth during 1961-73 and 1973-88. In the most recent period (1988-95) however, total factor productivity growth accounted for more than 50 per cent of output growth in slightly more than half of Canadian industries because of the greater slowdown in input growth between 1973-88 and 1988-95.

As the innovative work in this chapter lies in the quality adjustment of the factor inputs for Canada, it is interesting to examine the importance of these adjustments for our understanding of the sources of growth. In absolute terms, improved quality of labour and capital contributed 0.9 points in 1961-73, 0.5 points in 1973-88, and 0.6 points in 1988-95 to output growth. The relative contributions to output growth from quality improvements over the three periods were 15 per cent, 16 per cent, and 41 per cent respectively.<sup>7</sup> Improvements in labour quality were more important than improvements in capital quality over the 1961-95 period and in two of the three sub-periods. Without the quality adjustment, total factor productivity would have been higher by the amount of the adjustment since input growth would have

been lower by the amount of the quality improvement.

The third chapter by Wulong Gu and Mun Ho provides a consistent international comparison of productivity growth in Canadian and U.S. industries based on methods and definitions that are almost identical for the two countries. They find that in the 1961-73 period productivity growth in Canada exceeded that in the United States, bringing our productivity levels closer to U.S. levels. In the 1973-95 period productivity growth was almost identical in the two countries, leaving the gap unchanged.

The fourth chapter by Frank Lee and Jianmin Tang compares total factor productivity levels and international competitiveness between 33 Canadian and American industries, based on purchasing power parities for output and inputs by industry. They find that for the private business sector the total factor productivity level rose from 76 per cent of the U.S. level in 1961 to 92 per cent in 1980, then declined to 88 per cent by 1995. Canada's capital quality was actually slightly above (102 per cent) that of the United States in 1995, while labour quality was slightly below (97 per cent)

In 1995, 23 of 33 Canadian industries had lower total factor productivity levels than their U.S. counterparts and Canadian industries with higher total factor productivity levels than their U.S. counterparts tended to be more competitive in terms of relative output prices. However, over time movements in the exchange rate appear to be the most significant factor behind international cost competitiveness.

The growth accounting methodology pioneered by Jorgenson and others is a very powerful tool for apportioning the sources of growth. However, it is widely recognized that this approach has a number of weaknesses and limitations. In my view, the volume would have benefited from more recognition of these weaknesses

and limitations. For example, the growth accounting methodology assumes that labour quality is affected by the gender composition of the labour force. According to the volume, the quality of Canadian labour force fell 0.15 per cent per year over the 1961-95 period because of the growing female share of the labor force. But is gender relevant for labour quality when wage differentials reflect discrimination and other non-productivity-related differences, as well as differences in the number of years of paid work experience? A straightforward way to deal with this criticism would be to replace the gender dimension of labour quality with the experience dimension to capture this component of gender wage differences.

While the concept of labour quality is easily understandable, the concept of capital quality is less transparent. It does not reflect improvements in the effectiveness of capital goods arising from technological change as these quality improvements are captured in the falling deflators for capital goods and hence in the constant price capital stock estimates. Rather, quality of capital refers to the composition of the capital stock and quality improvements arise from a compositional shift toward asset types with higher user costs or marginal products. But should not competitive forces equalize tax-adjusted rates of return across different types of capital assets? It is true that differences in taxes across asset types result in different user costs of capital and that a capital quality improvement effect can result when capital shifts to the asset types with above average returns. But do these tax-driven differences in user costs of capital really represent differences in capital quality and true rates of return? The elimination of tax distortions by the adoption of a neutral tax policy on capital would equalize the user cost of capital across industries and have an effect on the cost of capital, yet it would have no direct effect on total capital input.

The strength of growth accounting lies in delineating the proximate sources of growth from a long-run, supply-side perspective. It does not provide much insight into the actual factors driving labour, capital and total factor productivity growth. This point applies to the volume under review. Key questions left unexplored include discussion of the role played by demographic structure, macroeconomic policy, commodity price shocks, and other factors in explaining changes in factor input and total factor productivity growth since 1961 in Canada? The relationship between actual economic growth and potential growth over the period is also not examined

Data limitations meant that 1995 was the last year for which productivity estimates were available for the analysis of Canadian trends in the volume. This is unfortunate given the intense interest in Canada's post-1995 productivity performance. Fortunately, Industry Canada is funding a new research project on productivity growth in the information age, again lead by Dale Jorgenson, which will shed light on post-1995 developments.

## Conclusion

The two volumes under review greatly augment our knowledge base on productivity developments in Canada in the 1990s. No productivity researcher on Canada can ignore their findings. As would be expected from Statistics Canada and from Dale Jorgenson, the volumes are excellent in exploring the data and conceptual issues related to productivity and in identifying the proximate sources of productivity growth such as capital accumulation and labour quality improvements. In short, the volumes greatly advance the productivity debate in this country.

By in large, however, the studies do not attempt to shed light of the big questions concerning the dynamics of productivity growth. Why did Canada experience a post-1973 productivity slowdown? Is productivity growth in Canada likely to follow the recent U.S. acceleration? What accounts for Canada's lower productivity levels relative to those in the United States? What are the most effective policies to boost productivity growth? With the resolution of a number of measurement issues by these studies, the research agenda for productivity researchers in Canada can hopefully move on to address these big issues.

## Notes

- 1 *Productivity Growth in Canada*, Cat. 15-204-XPE, John R. Baldwin, Desmond Beckstead, Naginder Dhaliwal, René Durand, Valérie Gaudreault, Tarek M. Harchaoui, Judy Hosein, Mustapha Kaci, Jean-Pierre Maynard, Statistics Canada, 2001, Ottawa, Ontario (can be ordered from Statistics Canada at [www.statcan.ca](http://www.statcan.ca), \$46.00 per issue, \$35.00 in electronic format).
- 2 *Industry-level Productivity and International Competitiveness Between Canada and the United States*, Dale W. Jorgenson and Frank C. Lee, editors, Industry Canada Research Monograph, Industry Canada Research Publications Program, March 2001, Hard copy available without charge. (Contact Publications Officer, MEPA, Industry Canada, 613-952-5704, Fax 613-991-1261, E-mail [mepa.apme@ic.gc.ca](mailto:mepa.apme@ic.gc.ca).)
- 2 In addition, the volume contains five appendices which deal with the concepts and methods of the Statistics Canada productivity program, the industrial detail for productivity measures, quality rating for productivity measures, productivity in CANSIM, and sources of economic growth by sector in Canada since 1961.
- 4 "Growth in labour productivity arises either because of increases in capital intensity or because of technological change. If the objective is to measure the effect of just technological change, labour productivity measures are seen as inferior to MFP measures because they do not capture only technological change....Measures of multifactor productivity remove the effect of changes in other measured inputs such as capital. In doing so, they provide a measure that is generally regarded as coming closer to the pure measure of technological change than growth in labour productivity measure." Page 26.
- 5 In addition, the seven appendices deal with estimating U.S. output; estimating U.S. capital services; estimating labour input; estimating U.S. industry-level productivity; measuring the quantity and cost of capital inputs in Canada; the changing composition of the Canadian workforce; and capital stock estimates for Canada.
- 6 Output growth on an average annual basis fell from 5.6 per cent in 1961-73 to 3.3 per cent in 1973-88 to 1.5 per cent in 1988-95. Total factor productivity growth decelerated from 2.6 per cent to 0.7 per cent and to 0.4 per cent over the same periods.
- 7 For labour productivity growth, the relative contributions of quality adjustments were 24 per cent, 44 per cent, and 54 per cent respectively over the three periods.
- 8 A number of these issues are discussed in the forthcoming volume *Productivity Issues in a Canadian Context*, edited by Someshwar Rao and Andrew Sharpe (Calgary: University of Calgary Press).