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Introduction

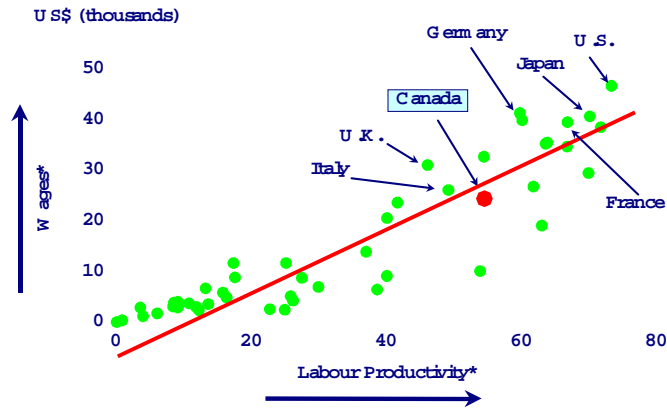
CONTEXT

PRODUCTIVITY GROWTH IS THE FUNDAMENTAL DRIVER of improvements in real incomes and living standards over the longer term. In the short to medium term, however, changes in the size of the working age population relative to the total population, the labour force participation rate, the unemployment rate, hours of work and the terms of trade (the ratio of the average price of exports to the average price of imports) also influence trends in real incomes. But, over the longer term, the contribution of these factors to improvements in living standards is not sustainable because they have an upper limit. On the other hand, there is no limit to productivity increases. Hence, productivity growth is the main driver of improvements in real wages and real incomes. Cross-country and time-series evidence shows clearly that productivity and real wages go hand in hand (Figures 1 and 2).

Similarly, trends in relative labour productivity (real GDP per employed person or output per hour) are the key determinant of relative living standards among regions/provinces and countries over the longer term. Moreover, only stronger productivity growth relative to that of its competitors can improve a country's international competitiveness without undermining its living standards. Slower growth or a decline in real wages, and a depreciation of the currency can also enhance a country's cost competitiveness, but they adversely impact the real incomes of the population.

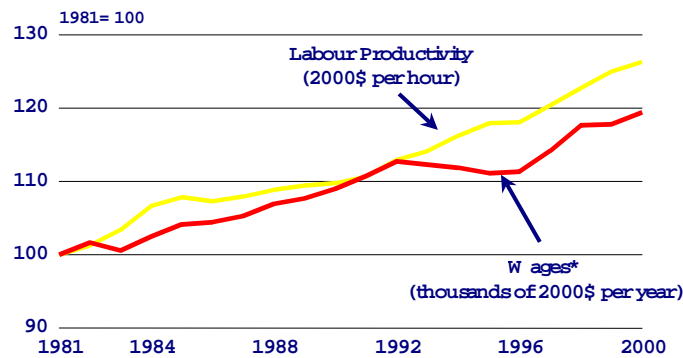
Small changes in productivity growth will have a large impact on living standards over the long term. For instance, with an annual productivity growth of 1 percent, real incomes double in 72 years. But, with productivity growth of 2 percent per year, real incomes will double in 36 years, and with 3 percent productivity growth, living standards will double in only 24 years. Prior to the first OPEC oil price shock in 1973, labour productivity (real GDP per employed person) increased at an average annual rate of about 3 percent in Canada.

FIGURE 1
WAGES AND PRODUCTIVITY ACROSS COUNTRIES, 1997



Note: * In manufacturing.
Source: UNIDO, *International Yearbook of Industrial Statistics*, 2000.

FIGURE 2
WAGES AND PRODUCTIVITY IN CANADA, 1981-2000



Note: * Real producer labour compensation (wages/salaries plus benefits) per worker.
Source: Statistics Canada.

But, in the post-1973 period, it only increased at about 1.2 percent per year. The productivity slowdown is not unique to Canada. All other OECD countries experienced a sharp decline in productivity growth. This phenomenon has been identified as the main reason for weak real income growth, and it has contributed to the deterioration of government fiscal balances, higher unemployment and social tensions in developed economies. Despite a large body of research, the causes of the productivity slowdown are still poorly understood.

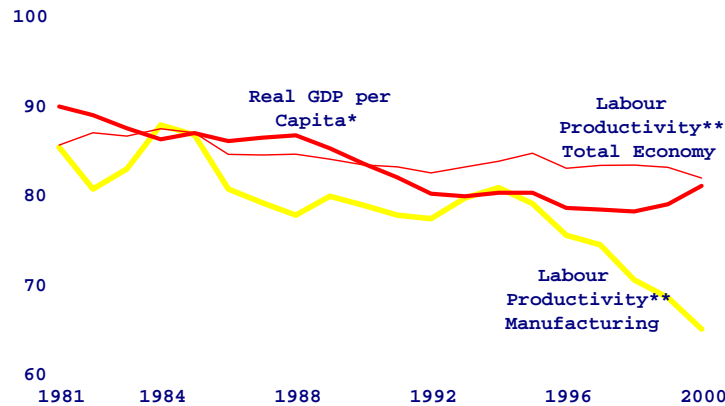
The economic well-being and quality of life of a country's citizens depend on many factors besides productivity growth. But, by increasing the economic pie, improvements in productivity offer more choices to governments and its citizens to invest additional resources in areas such as health, education, the environment and public security and infrastructure, and to alleviate poverty and economic inequalities. By contrast, in an era of stagnant real incomes, it is extremely difficult to devote more resources to these areas.

In the 1990s, Canada's productivity growth significantly lagged behind that of its southern neighbour and largest trading partner, the United States. The economy-wide gap in labour productivity level between Canada and the United States widened from about 14 percent in 1990 to over 18 percent in 2000. Similarly, the gap in real income levels between the two countries increased, averaging 20 percent in 2000. Much of the widening in the real income gap is due to an increasing productivity gap. In manufacturing – the battleground for fierce international competition – the Canada-U.S. gap in labour productivity level has grown from 21 percent in 1990 to over 35 percent in 2000 (Figure 3). Canada also lost ground to many OECD countries over the last twenty years.

This poor productivity and real income performance during the 1990s relative to that experienced by the United States has generated a great deal of research interest and fuelled a lively public debate in Canada. In November 1998, the OECD released a controversial country report on Canada in which it highlighted a situation of deteriorating productivity and living standards, forecasting more of the same for the future (OECD, 1998). The print media devoted significant space to the topic,¹ even commissioning theme issues on it (*Globe and Mail Report on Business Magazine*, 1999); the House of Commons Finance Committee (1999) and the House of Commons Industry Committee (2000) held hearings and published reports on the subject; public policy makers have focused on the formulation of a *productivity* or closely-related *innovation* agenda; government departments such as Industry Canada have undertaken or sponsored research in this area; Statistics Canada has devoted additional resources to the development of productivity

data and introduced a quarterly productivity series; and think tanks

FIGURE 3
CANADA-U.S. PRODUCTIVITY AND REAL INCOME GAPS
(CANADA AS A PERCENTAGE OF THE UNITED STATES)



Notes: * Purchasing power parity (PPP) based.
 ** Real GDP per hour worked, based on the methodology of the Centre for the Study of Living Standards.
 *** Real GDP per hour worked, PPP based.
 Source: Statistics Canada, U.S. Bureau of Labor Statistics, and U.S. Bureau of Economic Analysis.

have organized conferences and published studies.²

This volume, itself a manifestation of the heightened interest toward the productivity issue, brings together a large number of studies that Industry Canada, the lead federal department on productivity, has undertaken in-house or commissioned from outside researchers. Some of these studies have already been published by Industry Canada, several figuring prominently in the productivity debate, but many are published here for the first time.³ Our objective is to make these studies available to a wider public. To our knowledge, this is the first compilation of research papers devoted exclusively to productivity issues in a Canadian context to be published.

This introductory chapter is organized as follows. The next section highlights each of the 25 papers published in the volume. The third section outlines the key research and policy themes emerging from these studies. It also discusses some of the important knowledge gaps that remain about the measurement and determinants of productivity growth. The concluding section pulls together the main messages that emanate

from the volume. Finally, a short primer on key productivity concepts, trends and issues is provided in the Appendix for interested readers.

HIGHLIGHTS OF THE VOLUME

THE PAPERS PUBLISHED IN THE VOLUME ARE ORGANIZED into six main parts: productivity trends and determinants; innovation and productivity; investment and productivity; global linkages and productivity; productivity in the new economy; and social aspects of productivity. Each part contains a lead paper written by well-known Canadian economists. These authors were asked to do four tasks. First, pull together the main findings of the studies included in the volume under their heading. Second, integrate the results of other Canadian and international research in this area. Third, identify important research gaps, if any. Finally, spell out the research and policy implications of the key empirical findings from existing research. In what follows, we provide a brief overview of each study and review paper.

PRODUCTIVITY TRENDS AND DETERMINANTS

THE STARTING POINT FOR THE STUDY OF PRODUCTIVITY is an examination of actual productivity trends and a discussion of what determines productivity growth. This part contains six studies that do this within a Canadian context. The first, by Wulong Gu and Mun Ho, compares productivity growth in 33 Canadian and U.S. industries, on a consistent basis, over the 1961-95 period. Their main finding is a continuous deterioration of total factor productivity (TFP) growth in Canada relative to the United States, reflecting an erosion of the catch-up or convergence phenomenon. In the pre-1973 period, the rate of growth of TFP in most Canadian industries was higher than in corresponding U.S. industries; during the 1973-88 period, productivity growth was similar in the two countries; however, during the 1988-95 period, productivity grew at a slower rate in Canada in most industries.

In the second study, Frank Lee and Jianmin Tang examine differences in productivity levels and cost competitiveness between Canadian and U.S. industries. They use PPPs to estimate productivity levels and market exchange rates in order to evaluate trends in cost competitiveness. Consistent with the results of Gu and Ho about the erosion of the catch-up effect over time, they find that Canada's TFP level rose from 76 percent of the U.S. level in 1961 to 92 percent in 1980, but fell after 1985 to reach 88 percent in 1995. It is interesting to note that the TFP gap is considerably narrower than the gap in labour productivity (which was 82 percent of the U.S. level in 1995, as measured by GDP per worker, according to estimates from the U.S. Bureau of Labor Statistics), due to

a greater capital intensity of production in the United States. Trends in cost competitiveness were largely determined by exchange rate movements, with competitiveness worsening from 1963 to 1976 as the value of the Canadian dollar vis-à-vis the U.S. dollar appreciated, and then improving from 1976 to 1995 as the Canadian currency depreciated.

In the third study, Serge Coulombe looks at what he calls the Canada-U.S. productivity growth paradox. He defines this as faster multifactor productivity growth within the business sector in Canada than in the United States since the early 1980s despite slower labour productivity growth in Canada, according to official Statistics Canada and Bureau of Labor Statistics (BLS) estimates. Coulombe argues that this unusual situation can be explained by the different methodologies used by the two statistical agencies for calculating multifactor productivity, with regard to labour force composition, the definition of the capital stock, and depreciation patterns. He points out that the BLS methodology is, in all three instances, superior to that used by Statistics Canada, prompting him to recommend that the latter revise the methodology it employs to calculate multifactor productivity. Since this study was originally written in 1999, Statistics Canada has in fact modified the methodology used to calculate multifactor productivity in line with Coulombe's recommendations.

In the fourth study, Serge Nadeau and Someshwar Rao look at the role of industrial structure in explaining lagging labour productivity growth in Canada relative to the United States in the manufacturing sector. They find that two industries – electronics and other electric equipment, and industrial machinery and equipment – account for the difference observed in manufacturing productivity growth during the 1990s between the two countries. These industries are larger in the United States, where they have experienced faster productivity growth. The authors attribute Canada's relative weakness in these two industries to a failure to develop at the same pace as their U.S. counterparts and they document a number of examples of this country's inferior performance in important dimensions of innovation and knowledge acquisition and use.

In the fifth study, Richard Harris provides a detailed examination of the determinants of productivity growth based on a survey of the literature. In light of what he considers overwhelming empirical evidence, he identifies what he calls the *big three* productivity drivers or levers: investment in machinery and equipment, human capital development, and openness to trade and investment. Harris puts forward three suggestions for policy makers in pursuit of greater productivity: be cautious, sticking on balance to policies that promote these three drivers; pay attention to new evidence; and be a global realist, recognizing the intense international competition for factors of production.

Erwin Diewert, in addition to synthesizing the findings of the studies published in his part of the volume, presents his own estimates of aggregate labour and total factor productivity in Canada for the period 1962-98. He finds that, for both productivity measures, the performance has been stronger in the United States than in Canada over the entire period and within four sub-periods. One unresolved research question identified by Diewert is the possible role Canada's higher taxes and more generous social programs could play in explaining the productivity gap with the United States.

INNOVATION AND PRODUCTIVITY

IT IS WIDELY RECOGNIZED THAT INNOVATION is a necessary condition for productivity advances. The five studies presented in this part provide different yet complementary perspectives on the innovation issue. The first, by Manuel Trajtenberg, asks whether Canada is missing the *technology boat* and answers affirmatively. The author bases his response on new evidence from the patent activity of Canadians in the United States. He identifies four potentially worrisome trends: i) Canada is being overtaken by a group of high-tech countries (Finland, Israel, Taiwan and South Korea) in terms of the number of patents per capita and the ratio patents/R&D; ii) relative to other countries, computers and communications — the dominant general purpose technology of our era — are underrepresented in Canadian innovation activity; iii) Canadian corporations own a relatively low proportion of Canadian innovations patented in the United States, with a high proportion owned by foreign corporations and unassigned to a legal entity; and iv) the quality of Canadian patents based on citations is lower than that of patents in the United States and other countries.

In the second study, Steven Globerman examines the linkages between the distinct yet closely related concepts of technological change and productivity growth. He defines technological change as the rate at which new production processes and products are introduced and adopted in the economy and sees it as a contributor to productivity growth. Globerman identifies a number of areas of consensus on technological change issues, including the findings that social rates of return to R&D substantially exceed private rates and that government-funded R&D has significant private sector spillover benefits. He also notes that the reasons for the low rate of return to R&D in Canada are poorly understood, as are the dynamics of the relationship between technological change and productivity growth in service industries, particularly public services such as health and education, because of the traditional focus on manufacturing.

In the third study, Someshwar Rao, William Horsman, Ashfaq Ahmad and Phaedra Kaptein-Russell examine the key drivers of innovation to shed light on the nature and sources of Canada's innovation gap. They find a strong and positive relationship between a number of innovation indicators, such as the number of patents, and real GDP per capita. They document Canada's innovation record, pointing out its particularly weak performance in terms of the machinery and equipment ratio (lowest in the G-7) and the R&D/GDP ratio (second lowest in the G-7 after Italy). One encouraging finding is that the innovation gap appears to be narrowing based on a number of indicators. While recognizing that the Canadian government has been active in promoting innovation, they argue that more attention needs to be paid to education and training, and investment in R&D and machinery and equipment, and that our business framework and the regulatory system should be flexible, dynamic and competitive relative to that of other OECD countries, especially the United States.

In the fourth study, Randall Morck and Bernard Yeung provide a synthesis of existing research on the economic determinants of innovation. They begin by confirming the common belief that innovative countries and firms do in fact register superior economic performance. They go on to note that, in a knowledge-based economy, the primary form competition takes is innovation, not price cutting. Consequently, the perfect-competition model of economics does not apply in an environment where innovation bestows monopoly power, at least temporarily. The authors express scepticism regarding the potential benefit of government support to innovative activities of small firms because of rent-seeking, and they prefer a strategy aimed at subsidizing infrastructure and education.

Finally, in the review paper, Jeffrey Bernstein presents a detailed tour of the literature on innovation and productivity, including the four studies published in this part, with reference to measurement issues, the determinants of innovation, and innovation policy. Among the many aspects he addresses is the finding that U.S. R&D is of crucial importance to Canadian productivity growth because of its large spillover effects. He notes that there appears to be no secular decline in R&D-induced productivity gains in the United States, which bodes well for future productivity gains in Canada.

INVESTMENT AND PRODUCTIVITY

LIKE INNOVATION, INVESTMENT IS WIDELY RECOGNIZED as a key determinant of productivity growth. The three papers presented in this part of the volume examine in detail the relationship between investment and productivity. In the first, Kevin Stiroh offers a survey of investment and

productivity growth from both the neoclassical and new growth perspectives. He points out that the two schools of thought diverge on the transmission mechanism through which investment increases productivity. The neoclassical approach focuses on diminishing returns to capital that are primarily internal to the firm, while new growth models emphasize increasing returns and external effects as productivity gains spillover outside the firm. He sees the two approaches as complementary, with the neoclassical focus on input accumulation and internal returns explaining up to four fifths of economic growth and the new growth theory providing an explanation for the residual one fifth associated with technological progress.

In the second study, Edgar Rodriguez and Timothy Sargent ask whether underinvestment has contributed to the Canada-U.S. productivity gap. They find that Canada underinvests significantly in R&D and in machinery and equipment by comparison with the United States, but they argue that these investment gaps do not necessarily explain much of the productivity gap. According to the authors, for the difference in R&D investment to account for the productivity gap, the social returns to R&D must be much greater than the private returns, and a large proportion of the spillovers must stop at the border. For the lower investment in machinery and equipment to explain the productivity gap, it must represent greater differences in capital quality than the current data appear to suggest. The authors believe that the case is *not proven* for these suppositions. They conclude that the productivity gap does not seem to be the consequence of underinvestment in broad aggregates, implying that policy measures such as taxes and subsidies that target these aggregates may not be the most efficient means of reducing the gap.

In the review paper, Ronald Giammarino discusses the investment-productivity relationship in the context of the overall research literature, as well as the two studies published in the volume. He argues that the standard economic approach to investment could be enriched by insights from the corporate finance field, in particular how investment decisions are made in the presence of numerous market imperfections. This approach sees informational problems as central to the firm's investment decisions and looks at the links between these decisions and such factors as internally generated capital and the legal and accounting systems.

GLOBAL LINKAGES AND PRODUCTIVITY

A COUNTRY'S PRODUCTIVITY IS INFLUENCED by its economic relationships with other countries through international linkages such as technology transfers and investment and trade flows. This part contains three papers that explore the impact of these linkages on productivity. The first

study, by Daniel Trefler and Gary Sawchuk, examines the impact of the Canada-U.S. Free Trade Agreement on productivity in the manufacturing sector. Their main finding is that over the 1989-95 period, tariff cuts raised labour productivity by 3.2 percent per year in the most affected industries, and by 0.6 percent per year in the overall manufacturing sector.

In the second study, Someshwar Rao and Jianmin Tang envisage whether Canadian-controlled manufacturing firms are less productive than their foreign-controlled counterparts. They answer in the affirmative, finding that multifactor productivity levels of Canadian-controlled firms were on average 19 percent below those of foreign-controlled firms over the period 1985-95. They also find that conventional determinants of productivity differences such as labour quality, unionization, export orientation, and firm size do not account for the productivity gap. Rather the authors suggest that the difference is attributable to superior management practices and strategies and to the technological know-how of foreign-controlled firms.

In his review paper, John Ries provides an overview of the recent literature on foreign investment, trade, and industrial performance, and relates this material to the two studies published in this part of the volume. He notes the theoretical prediction that trade can lead to both static and dynamic gains in productivity growth, with reallocation of labour toward higher productivity industries being particularly important. In contrast, he points out that the empirical literature fails to verify consistently that openness to trade or the volume of trade are associated with greater productivity growth within countries, although many – if not most – studies, such as that of Trefler and Sawchuk, do find a positive relationship.

PRODUCTIVITY IN THE *NEW ECONOMY*

THE ACCELERATION OF LABOUR PRODUCTIVITY GROWTH in the United States in the second half of the 1990s has led to talk of a *new economy*, defined as one of permanently higher trend productivity growth fuelled by the productivity-augmenting effects of information technologies. The five papers presented in this part of the volume explore various dimensions of the new economy debate. The first, by Steven Globerman, defines and assesses the linkages between electronic commerce and productivity growth. While recognizing that electronic commerce is still at an early stage of development, the author believes that its economic consequences are likely to be evolutionary rather than revolutionary. Given the evidence to date of only limited spillovers from e-commerce, Globerman argues that there is little theoretical justification for emphasizing the promotion of e-commerce as a public policy goal.

The second study, also by Steven Globerman, examines the phenomenon of industrial clusters, given the growing perception that economic activity in knowledge-intensive sectors is characterized by regional clustering. As these activities are attracted to locations offering high levels of human capital and well-developed physical and social infrastructure, they could in principle be created in many places. Hence, governments could foster their formation through human capital and infrastructure development. Nevertheless, Globerman takes a *laissez-faire* approach to clusters, arguing that governments should not try to determine what location-specific clusters should be promoted, but that they could legitimately rationalize or mediate the competing claims of regions for public support. In the author's view, the greatest practical challenge facing the federal government is to use its leverage with the provinces to discourage wasteful competition to attract clusters.

The third study, by Andrew Sharpe and Leila Gharani, surveys the literature on trend productivity growth and the new economy. It examines the productivity revival in the United States since 1995, noting that service industries, such as trade and finance, are now finally experiencing improved productivity growth, thanks to their extensive investment in information technologies. They assess the views of new-economy advocates, such as Dale Jorgenson, and of its critics, such as Robert J. Gordon. The authors take a middle-of-the road position on the new economy. They attribute about half of the one percentage point acceleration in labour productivity growth during the second half of the 1990s to temporary or short-term factors such as the strength of the economy and the investment boom, and the other half of the permanent upward shift in trend productivity to the adoption of information technologies.

In the fourth study, Ronald Hirshhorn, Serge Nadeau and Someshwar Rao examine and assess the role of government with regard to innovation in a knowledge-based economy. They begin by noting that in 1996-97, the federal government allocated over \$7 billion to support scientific and technological activity through direct expenditures and tax relief. They point out that the rationale for government involvement in innovation is the market failure arising from the positive spillovers or externalities generated by private sector R&D. According to the authors, it is difficult to make the case that Canada is providing inadequate encouragement for innovation through tax incentive schemes and intellectual property laws. Indeed, they argue that it is not clear Canada is better off having a more generous system of R&D subsidies than other countries, and that we might be better off by rebalancing government R&D support toward lower corporate taxes and reduced tax credits and subsidies.

In the review paper, Peter Dungan and Thomas Wilson synthesize the debate on the new economy and discuss its implications for future productivity growth in Canada. While sharing in part the optimism of the new economy school, they argue that it is inappropriate to project for Canada the same rate of productivity growth that the United States has enjoyed since 1995. The authors believe that the superior U.S. productivity performance is not reproducible in other countries due to the large size of the information technology sector in that country and unique factors on the demand side. If the pattern of productivity growth in Canada in the first decade of this century were to track developments in the United States in the second half of the 1990s, they project that annual growth in output per worker will be around 1.8 percent, which would be a better performance than in each of the three previous decades.

SOCIAL DETERMINANTS OF PRODUCTIVITY

ASIDE FROM ECONOMIC DETERMINANTS, social factors can also influence, both directly and indirectly, productivity growth. The three papers presented in this part of the volume explore a number of dimensions of the social determinants of productivity. The first study, by Richard Harris, offers a comprehensive discussion of the linkages between social policy and productivity growth. The author points out that if it can be established that social determinants are a quantitatively major factor in productivity growth, then the traditional equity-efficiency trade-off would not exist. After an extensive review of the literature, Harris concludes that we do not yet have clear evidence of robust linkages running from social policy and equality to productivity growth, although he recognizes that the possibility of such linkages certainly exists and is a subject worthy of further investigation.

In the second study, Andrew Sharpe analyzes the two-way relationship between productivity and economic well-being, which is defined in terms of four components or dimensions: consumption, the stock of wealth, equality and economic security. The author examines how each component can be positively influenced by higher productivity and how, conversely, improvements in certain components of economic well-being, such as equality and economic security, can feed back to foster productivity growth. The study serves to remind us that the importance of productivity goes well beyond raising real incomes as it can have important positive effects on other components of economic well-being.

In the review paper, Lars Osberg looks at the social aspects of productivity in the context of the general literature and the two studies presented in this part of the volume. He argues that the production process occurs within a social context, whose characteristics heavily influence

the amount of labour and capital directly required to produce a given amount of goods and services. The author notes that unpriced inputs, such as the environment or social capital, are currently not factored into productivity measurement, but should be for a full accounting of economic and social inputs and outputs. He concludes by recommending that one of the priorities of future productivity research be a more accurate identification and measurement of these unpriced inputs.

KEY EMERGING THEMES OF THE VOLUME

IN A VOLUME CONTAINING 25 PAPERS and extending over 800 pages, a large number of issues are discussed. This section identifies and highlights for the reader a select number of issues that the editors consider particularly important. A key criterion used in their choice is the frequency with which these issues are discussed by the contributors to the volume.

ACCURATE MEASUREMENT IS CRITICAL

AS THE FIRST PAPER BY RICHARD HARRIS stresses, in the productivity field “measurement is everything.” If we cannot produce reliable and accurate productivity estimates, then we cannot intelligently discuss productivity trends and determinants. A large number of measurement issues face productivity researchers, including: the quality adjustment of prices and the contribution that *hedonics* can make in this area; the quality adjustment techniques for labour and capital; the development of improved service sector output measures, especially for finance and insurance and for non-marketed output in education, health and public administration; the choice of appropriate capital stock depreciation rates; and the estimation of PPPs for international productivity-level comparisons.

The study by Serge Coulombe demonstrates clearly the importance of productivity measurement for reliable international and inter-temporal comparisons. The author shows that the key question of whether Canada has experienced better or worse business sector multi-factor productivity growth relative to the United States depends crucially on the definitions and assumptions behind the productivity numbers. There has been a great deal of debate in Canada about the size and the widening of the Canada-U.S. labour productivity level gap. But, the size of this gap depends critically on the estimated value of the PPP exchange rate. We also need detailed estimates of PPP exchange rates by industry to make international productivity comparisons at the industry level.

It is encouraging to note that the importance of measurement issues is increasingly recognized by all parties with an interest in productivity,

including statistical agencies, international organizations, government departments and academic researchers. Indeed, Statistics Canada has devoted additional resources to the development of better productivity data for the Canadian economy.

Nevertheless, the quality of productivity data for many service industries in Canada and other OECD countries is not very good. Measured productivity growth in a number of service industries, such as business services, personal services, education, health and public administration, has been weak or even negative. It is unclear whether these trends reflect the true state of productivity advances in these sectors or problems associated with the measurement of real output. With the service sector already accounting for three quarters of total employment and this share still rising, it is important to measure accurately service sector productivity. Productivity measurement problems in the non-market sector are particularly severe. For example, labour inputs are used to measure real output in public administration, with the result that productivity growth is assumed to be zero. With the introduction of information technologies, it is likely that there have been productivity gains in public administration. Further work in this area should be a top priority for productivity researchers.

In view of the growing importance of service industries globally, especially knowledge-based services, more accurate and internationally comparable productivity estimates for service industries are extremely important for reliable international and inter-temporal comparisons. Statistics Canada should work more closely with other statistical agencies and the OECD towards developing more accurate estimates of output and productivity in service industries as well as detailed estimates of PPPs by industry on a regular basis.

CANADA HAS LOST SIGNIFICANT GROUND TO THE UNITED STATES

A NUMBER OF STUDIES PUBLISHED IN THIS VOLUME, especially those of Lee and Tang, and of Nadeau and Rao, address the issue of Canada's productivity gap with the United States. There is general consensus that Canada's aggregate labour productivity (GDP per person-hour worked) is significantly (about 20 percent) below that of the United States, and that the gap has widened during the 1990s. Similar results are obtained for total factor productivity comparisons. In addition, most industries have lower productivity levels in Canada than in the United States. It is particularly acute in the manufacturing sector, where Canada's labour productivity level is currently more than 35 percent below the U.S. level. However, Canada does have a productivity level advantage over the United States in primary and resource-based manufacturing industries.

It is important to note that the lion's share of the disparity in living standards, measured by GDP per capita, between Canada and the United States can be explained by the productivity gap. No consensus has emerged on the causes of the productivity gap, although many factors have been put forward as possible explanations. However, the study by Nadeau and Rao shows that the weakness of Canada's high-technology sector relative to that of the United States is the main reason behind the growing manufacturing productivity gap in the 1990s.

The continued widening of the productivity gap could have adverse consequences on Canada's future trend productivity growth by increasing the flow of investment, R&D spending and skilled labour going to the United States. Under this scenario, there is a risk that Canada could slide into a vicious cycle of weak economic performance relative to the United States. Future research should explore empirically the dynamics and interrelations among the Canada-U.S. productivity gap, investment, innovation, human capital, industrial structure and trend productivity growth.

Another key area for future research is that of Canada-Mexico productivity level comparisons. Mexico is emerging as a major North American player. Its share of U.S. imports almost doubled between 1990 and 2000. It has a huge labour-cost advantage over Canada and the United States. Mexico has made strong inroads in high-tech exports. Mexico and Canada depend heavily on the U.S. market for trade, investment and higher value-added activities. Hence, it is important to understand the evolution of Mexico's productivity performance and its comparative advantage vis-à-vis that of Canada, because of their potential impact on Canada's industrial structure and productivity. A detailed industry-level comparison of Canadian and Mexican productivity levels and their trends over time would be extremely useful in this regard.

INFORMATION AND COMMUNICATIONS TECHNOLOGIES MADE A MAJOR CONTRIBUTION TO CANADA'S PRODUCTIVITY GROWTH IN THE 1990S

AN ISSUE THAT PERMEATES VIRTUALLY ALL STUDIES presented in this volume is the impact of information and communications technologies (ICTs) on productivity. During the 1990s, all developed countries have witnessed the introduction of ICTs into the workplace on a massive scale. The obvious question is whether this development has led to faster productivity growth. In approaching this issue, it is important to distinguish between the contribution to productivity growth from the ICT-producing sector, especially the computer and telecommunications equipment manufacturing industries, and the contribution from the ICT-using sectors, which comprise virtually all other industries.

The ICT-producing sector has contributed significantly to labour productivity growth in both Canada and the United States during the 1990s. For instance, more than a quarter of aggregate labour productivity growth in Canada over the last decade was due to the superior productivity performance of the ICT-producing sector. In the United States, the contribution of this sector to aggregate productivity growth was even larger. In fact, the differences in size and productivity growth of the ICT-producing sectors between the two countries was largely responsible for the widening of the Canada-U.S. manufacturing productivity gap over the last decade.

As for the impact of ICTs on productivity growth in ICT-using industries, the available empirical evidence is mixed. There seems to be a general consensus that labour productivity growth in the United States increased dramatically during the second half of the 1990s in many service industries, including wholesale and retail trade and financial services, which are heavy users of ICTs. This evidence provides support to the argument that the massive investments in ICTs are finally paying productivity dividends. But, the evidence from other OECD countries, including Canada, is inconclusive at best. Unlike the United States, aggregate labour productivity growth did not increase during the second half of the 1990s in many OECD countries, despite a strong contribution from the ICT-producing sector. This trend implies that there was either no increase or a small decline in the average productivity growth of ICT-using industries in these countries.

Two key research questions emerge from the recent U.S. experience. First, is the pace of productivity advances during the second half of the 1990s in the United States (now estimated at 2.4 percent per year in the business sector) sustainable? Second, why did ICT-using industries not register an increase in trend productivity growth outside of the United States? The recently launched joint research project by Industry Canada, Statistics Canada and Dale Jorgenson of Harvard University will explore these two issues in detail.

NO CONSENSUS ON CANADA'S TREND PRODUCTIVITY GROWTH

THIS ISSUE, CLOSELY RELATED TO THE PRECEDING DISCUSSION, merits separate treatment because of its importance for a Canadian audience. Official data from Statistics Canada show that output per hour in the business sector increased at an average annual rate of 1.7 percent in the second half of the 1990s, up only 0.2 points from 1.5 percent during the first half of the decade. This suggests that trend productivity has not picked up significantly in Canada during the 1995-2000 period, as was the case in the United States. But the 1990s saw a significant improvement in productivity growth of around one half of a percentage point,

from 1.1 percent per year between 1973 and 1989 to 1.6 percent from 1989 to 2000. From this longer-term perspective, trend productivity growth in Canada seems to have picked-up.

The trend productivity growth that Canada can expect to experience in the first decade of the 21st century is, of course, uncertain and subject to debate. Some observers such as Peter Dungan and Tom Wilson see little change on the horizon, projecting a continuation of the current trend of around 1.8 percent per year for aggregate labour productivity growth. Others such as Andrew Sharpe and Leila Gharani believe that trend productivity growth will rise to 2 percent or more largely because Canadian industries too will reap the productivity benefits of ICTs, although with a lag. However, even under an optimistic scenario, Canada may not register a significant increase in productivity growth well into the decade because of the cyclical downturn in productivity expected at least in 2001 and 2002 and of the potential negative impact of the slowdown in economic activity on investment and R&D spending.

CANADA NEEDS TO CLOSE THE INNOVATION GAP

A NUMBER OF STUDIES PUBLISHED IN THIS VOLUME, especially that of Manuel Trajtenberg, and that of Someshwar Rao, William Horsman, Ashfaq Ahmad and Phaedra Kaptein-Russell, expose the weaknesses of Canada's innovation performance, suggesting that Canada's productivity problem is closely related to its problems on the innovation front. Canada fares poorly on a number of key innovation indicators, particularly the quantity and quality of patents, the ratio of R&D to GDP, the ratio of machinery and equipment investment to GDP, the adoption of new technologies and the commercialization of innovations. It is clear that Canada needs to address its innovation gap. But, there seems to be no general agreement among researchers on the precise causes of this gap.

A number of studies found in this volume, especially that of Jeffrey Bernstein, the first study by Steven Globerman, and the one by Randall Morck and Bernard Yeung, shed some light on the reasons for the R&D shortfall, particularly in light of the generous tax treatment and subsidies such expenditures receive. One explanation advanced is that Canadian firms feel less compelled to undertake R&D because they can access new technologies from abroad in a more cost-effective manner, either from their parent firm if they are foreign-owned or through a licensing agreement if they are Canadian-owned. A second explanation, following from Nadeau and Rao's analysis of the role of industrial structure, is that the relatively small size of the R&D-intensive high-tech sector in Canada may mean that less R&D takes place.

Despite many years of research, a satisfactory explanation of Canada's low level of private sector expenditures on R&D has proven elusive. The reasons behind the low take-up rate for the various benefit programs, such as an excessively narrow definition of eligible R&D expenditures, are poorly understood. Equally, the relative importance of the various factors affecting R&D, such as industrial structure, foreign ownership, and venture capital supply, merit closer attention from researchers.

In addition, an important question to explore is why Canadian firms are not investing as much as their counterparts in the United States and other OECD countries in machinery and equipment and in the commercialization of innovations. The role of taxes and incentives, the regulatory burden, the infrastructure, managerial practices and strategies, competition, framework policies and institutions in Canada's innovation process vis-à-vis the United States and other OECD countries should be analyzed in detail so that more effective policies can be developed to close this country's innovation gap.

The available research suggests that Canada has proportionately more small and medium-sized enterprises (SMEs) and that they account for a larger share of output and employment than in the United States. It shows also that SMEs in general are significantly less innovative and productive than larger firms. Therefore, a better understanding of the factors behind the relatively weak innovation performance of SMEs might also shed more light on the reasons for Canada's aggregate innovation and productivity gaps. Despite the growing importance of service industries in the economy, there has been little research until now on the innovation dynamics and performance of these industries in Canada and other OECD countries. We also need to know how well Canadian industries are performing relative to their counterparts in the United States and other OECD countries.

INCREASED OUTWARD ORIENTATION HAS BEEN GOOD FOR CANADA'S PRODUCTIVITY

THE IMPORTANCE OF INTERNATIONAL TRADE and foreign direct investment (FDI) for the Canadian economy has increased considerably during the 1990s. Exports of goods and services currently account for more than 45 percent of Canada's GDP, up from 30 percent just a decade ago. The share of imports in GDP has similarly risen. In addition, the ratios of inward and outward FDI stocks to GDP have also increased dramatically over the past decade. The buoyant U.S. economy, the FTA/NAFTA and the globalization of business have all contributed to the increased outward orientation of Canadian firms and the Canadian economy.

Economic theory predicts that an increased outward orientation will stimulate productivity by intensifying domestic competition, facilitating technology and knowledge transfers, and increasing specialization. However, aggregate productivity trends seem to suggest that increased outward orientation, and especially stronger North American economic linkages, did not have a positive impact on Canada's productivity performance in the 1990s. The Canada-U.S. productivity gap actually widened during that period.

But we cannot rely on simple aggregate data to make judgements about the relation between outward orientation and productivity, because productivity trends are influenced by a large number of factors, including outward orientation. Therefore, we need to disentangle the influence of outward orientation and other variables. The research by Trefler and Sawchuk and by Rao and Tang does precisely this. Their results clearly show that increased trade and investment orientation has had a positive effect on Canada's productivity growth. These findings are generally consistent with other studies in Canada and other countries. The implication of these findings is that Canada should maintain its market-oriented policies on both the domestic and international fronts, but that it needs to address the challenges related to investment and innovation. In addition, researchers and government need to better educate the general public about many of the misperceptions concerning increased outward orientation and Canada's productivity performance.

The available research generally shows that foreign-controlled firms in Canada are more productive than domestically controlled Canadian firms, even after controlling for the influence of factors such as size, industry, unionization, and investment and R&D intensities, presumably because of technology and knowledge transfers from their parent companies. But foreign-controlled firms can have positive technology and knowledge spillovers on domestic firms via their client/supplier relations. Increased competition from foreign firms may also stimulate innovation and increase technology adoption within domestic firms. Additional research is needed to shed light on these spillover mechanisms linked to inward FDI and their contribution to Canada's productivity. We also need to better understand the consequences of increased outward investment for Canada's innovation and productivity performance.

PRODUCTIVITY GROWTH IS IMPORTANT FOR IMPROVING QUALITY OF LIFE

THE STUDIES BY HARRIS AND SHARPE presented in the last part of the volume provide national and international evidence showing the positive influence of productivity growth on social outcomes and quality of

life. Higher productivity growth expands the economic pie and offers more choices to government and society to spend additional resources on education, health and the environment, and to fight poverty, reduce income inequalities and strengthen the social safety net. On the other hand, slower productivity growth constrains significantly the ability of government to invest in activities that enhance the quality of life of its citizens and mediate social tensions.

But the research to date is not conclusive about the potential positive feedback on productivity of improved social outcomes and quality of life. However, as expected, the available research shows that investment in human capital is very important for productivity. But there is no consensus on the impact of reduced income inequalities and improved social cohesion and quality of life on productivity. At this stage, the dynamics of the social determinants of productivity are poorly understood. While some work is underway in this important but relatively unexplored area, additional in-depth research is needed.

GOVERNMENT CAN PLAY AN IMPORTANT ROLE

ALTHOUGH PRODUCTIVITY IMPROVEMENTS are primarily the result of numerous decisions and strategies of individuals, households and firms, governments can play an important facilitating role. The study by Hirshhorn, Nadeau and Rao discusses the role of government in stimulating innovation and increasing trend productivity growth. Because of the public-good nature of investments in education, health, and physical and knowledge infrastructure, there will be serious underinvestment in these productivity-enhancing activities without the support and active involvement of governments. Another important means by which governments can influence productivity is by improving the business climate for investment, innovation, entrepreneurship and risk-taking via efficient regulations, competitive and flexible tax and market framework policies, sound industrial policies and freer trade. Governments can also play an important role toward improving the productivity performance of SMEs by helping them enter the export market, obtain access to capital at a reasonable cost and adopt technology. Governments can also contribute to strengthening the linkages between businesses, universities and government laboratories, and to expanding the commercialization of innovations.

The Canadian government has undertaken a number of initiatives to encourage R&D spending, stimulate innovation, facilitate the creation, diffusion and use of knowledge, promote the commercialization of innovations in Canada, and encourage the adoption and diffusion of new technologies. These measures include generous R&D tax incentives, the Canadian Foundation for Innovation, the Canadian Institutes of

Health Research, the Network of Centres of Excellence Program, the Industrial Research Assistance Program, Technology Partnerships Canada, Investment Partnerships Canada, SchoolNet/Community Access Program, and the Canada Research Chairs Program. In addition, in the January 2001 Speech from the Throne, the federal government announced its commitment to double federal R&D spending by 2010. Furthermore, recent fiscal measures have been designed to make the Canadian tax system more competitive and supportive of innovation and risk-taking.

Despite the above initiatives, it is widely recognized that the policy environment and the programs aimed at stimulating productivity growth could still be improved. While this volume is not strictly speaking a policy-oriented publication, it provides much insight on the most appropriate policy framework for productivity advance. Indeed, the findings and policy recommendations found in the 25 chapters of the volume are presented by recognized productivity experts and have important implications and relevance for public policy and private sector action to improve productivity. In this section, we provide a brief summary of these findings and recommendations.

Economists who are influenced by the neoclassical growth school tend to consider intervention seldom appropriate. They believe that margins are optimized and that few externalities or spillovers exist, so there is limited rationale for intervention. On the other hand, economists who subscribe to the new or endogenous growth school see markets, particularly for technology, as unreliable because of imperfect information and appropriability problems. They believe that the resulting market failures can be corrected by appropriate policy.

The traditional approach to industrial policy of picking individual sectors and firms as potential winners is soundly rejected by the studies published in this volume. Even subsidies to the high-profile e-commerce sector are considered bad policy. Contributors strongly prefer framework policies that improve the overall business environment, such as lower taxes, greater openness to trade and investment flows, including reduced barriers to foreign investment in certain protected sectors, and fewer restrictions on technology transfers.

No study has assessed the appropriateness of the federal government's goal of doubling the R&D/GDP ratio by 2010 and the policies and programs it intends to use in order to attain this goal. Given the already generous (too generous according to some authors) level of R&D incentives, contributors thought that the most effective measure the government could take to increase R&D would be to lower corporate tax rates.

Although there is wide recognition that no panacea or golden bullet exists to improve productivity performance, policies in the area of human capital development emerge as a top priority. There are, however,

few specific suggestions about the nature of policies and programs that would have the greatest impact on productivity.

A recent initiative in the United Kingdom is relevant to Canada's productivity, innovation and skills agendas. In order to meet the productivity challenge, the U.K. government (U.K. Department for Education and Skills, 2001) recently announced an innovative policy of funding private sector-led skills councils to work at the sectoral level to develop skills and improve productivity. The rationale for this initiative is threefold: first, given the differences among sectors, productivity improvement is most effectively approached at the sectoral level; second, skills development, an essential ingredient of productivity improvement, is also best approached at the sectoral level; and third, such an initiative is most effectively led by private sector parties, given their first-hand knowledge of the sector and strong interest in the success of the policies.

A final key message from the volume is that while policy initiatives should certainly be assessed and evaluated from the point of view of their impact on productivity, it is the impact of these policies on society's well-being that is more important in the final analysis. Productivity makes a significant contribution to well-being and quality of life, but it is not their only determinant by far. These limitations of the productivity agenda for improving societal well-being in no way reduce its importance, they merely serve to put it in perspective.

CONCLUSION

PRODUCTIVITY GROWTH IS THE FUNDAMENTAL DRIVER of improvements in real wages and real incomes in the long term. Canada, like other OECD countries, experienced a dramatic slowdown in productivity in the post-1973 period, the causes of which are still not very well understood. Nevertheless, business sector labour productivity growth increased somewhat in Canada in the 1990s. But despite increased outward orientation and many structural policies, the Canada-U.S. labour productivity and real income gaps widened significantly during the 1990s. These unexpected and worrisome trends stimulated considerable research interest and a lively public debate in Canada. Industry Canada commissioned a large number of studies to better understand the reasons for Canada's relatively poor productivity record. The present volume is the result of this research effort.

In this introductory chapter, we have presented the highlights of all 25 papers, outlining some of the key common themes that emerge from the studies, and pointing to some of the remaining gaps in our knowledge. These papers provide a rich body of information on productivity trends in Canada, Canada-U.S. productivity comparisons, the possible

causes of Canada's relatively weak productivity performance, the contribution of ICTs to productivity growth, and the role of government in raising trend productivity growth.

Here are the key messages emanating from the research reported in this volume: accurate measurement of productivity is critical to understanding and analyzing Canada's productivity problems and developing appropriate policies and strategies; Canada has lost significant ground in productivity and real incomes to the United States in the 1990s; Canada needs to pursue effective policies and strategies to close the innovation gap; the ICT-producing sector contributed in a major way to Canada's aggregate productivity growth, but there is no strong evidence of a pick-up in productivity growth in ICT-using industries; there is no consensus on whether trend productivity growth in Canada has increased; greater outward orientation has been positive for productivity in Canada; productivity growth can improve social outcomes, social cohesion and quality of life, but there is no consensus about the positive feedback on productivity performance of investments in social programs; finally, government can play an important role in increasing productivity growth.

ENDNOTES

- 1 According to the InfoGlobe database, the term *productivity* appeared in *The Globe and Mail* in 658 articles in 1999 and 622 articles in 2000, up from 527 articles in 1998 and an annual average of 514 articles over the 1994-98 period.
- 2 For example, the Centre for the Study of Living Standards organized a major international conference on the Canada-U.S. manufacturing productivity gap in January 2000. The papers are available at www.csls.ca under Past Events and will be published in an edited volume in 2002.
- 3 Of the 25 papers assembled in this volume, including 6 overview papers, 11 have already been or are being published as working or discussion papers by Industry Canada.

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APPENDIX

A PRIMER ON PRODUCTIVITY CONCEPTS, TRENDS AND ISSUES

A FRUITFUL OR PRODUCTIVE READING of the papers published in this volume requires a certain level of knowledge of productivity concepts, trends and issues. While this introduction cannot impart such knowledge on the reader unfamiliar with economics in general and the topic of productivity in particular, it does provide a brief primer which reviews basic information on productivity that repeatedly comes up throughout the volume. Hopefully, this information will benefit the reader who has some but less than a complete background in the productivity field.

THE MEANING OF PRODUCTIVITY

OF COURSE, THE STARTING POINT FOR A VOLUME ON PRODUCTIVITY must be the definition and meaning of that term. In its essence, productivity is the ratio or relationship between a measure of output and the inputs that were used to produce that output.

A fundamental distinction is made between partial and total productivity measures. The former relate output to only one input, such as labour or capital, even though it is recognized that other inputs contributed to output. Labour productivity is the best-known partial productivity measure. The latter measures relate output to a combination of inputs, such as capital and labour. These measures are known as total factor or multifactor productivity and represent the growth in output not accounted for by input growth.

A key issue in total factor productivity measurement is the weighting of inputs. Under competitive conditions, the income share of a factor of production is normally considered the relative contribution of that factor to output and is consequently used to weight the factor in calculating an index of total input, or the growth rate of the index. When markets are not competitive, the weighting issue is much more complex.

The meaning of total factor productivity is also controversial. Some economists interpret it as a measure of overall technological change, others as a measure of disembodied technological change, that is technological change that is not embodied in new machinery and equipment, and still others see it as essentially a meaningless concept (Lispey and Carlaw, 2000).

A second important distinction is between the level of productivity and productivity growth. The former refers to the output per unit of input at a given point in time. An example would be the level or value of output per hour for the total economy in 1999, say \$20, expressed in constant 1997 prices. The latter measure represents the percentage change in output levels, expressed in constant prices, between two points in time. An example would be a 5 percent increase in labour productivity between 1999 and 2000 when the level or value of output per hour rises from \$20 to \$21. One often hears the complaint that Canada's productivity is poor. This could be referring to a situation of a low aggregate productivity level or a low productivity growth rate, or both. It is important that commentators specify whether they are referring to levels or growth rates as their implications can differ significantly.

Labour input can be measured either in terms of the average annual number of workers or in terms of the total number of hours worked in a year. It is important to specify which concept of labour productivity is being employed. The growth rates of output per worker and output per hour worked may differ when there is a change in the number of hours worked over time. Indeed, the large fall observed historically in the average working time per worker has meant that output per hour has grown significantly faster than output per worker. Equally, international productivity comparisons may differ greatly when annual hours worked vary across countries. The greater number of hours worked annually by American workers compared to those of many European countries means that productivity measures based on output per worker portray U.S. productivity levels in a much more favourable light than estimates of output per hour worked.

PRODUCTIVITY TRENDS

ONE PART OF THE VOLUME IS DEVOTED to productivity trends so the discussion of trends in this section will be brief and to the point. Three distinct productivity trends or stylized facts can be identified in the post-war period for the United States and two for other developed economies including Canada. From 1945 to 1973, developed countries experienced a golden era of productivity growth, with labour productivity growth advancing 3 percent or more per year. After 1973, virtually all developed countries entered a period of slower productivity growth. Economists have still not reached a consensus on the causes of this productivity slowdown. The failure of productivity to pick up in the first half of the 1990s despite the introduction of information technologies lead observers to coin the expression *productivity paradox*. Since 1995, the United States has entered a period of much stronger productivity growth, resolving the productivity paradox at least for that country. This development is referred to and analyzed in a

This development is referred to and analyzed in a number of the papers in the volume. However, there is little evidence that productivity growth has picked up significantly outside the United States.

PRODUCTIVITY ISSUES

IN THE INTRODUCTION, there is a detailed discussion of some of the key issues that emerge from the studies published in the volume. Here, we highlight a small number of the more basic productivity issues that the reader should be familiar with.

International comparison of productivity levels requires that levels expressed in domestic currencies be converted to a common currency. This conversion can be done with either market exchange rates or exchange rates based on PPPs, that is the exchange rate that equalizes the price of a basket of goods and services between two countries. For accurate productivity level comparisons, it is imperative that PPPs be used, although the development of reliable PPPs is a complex task, particularly at the industry level. The existence of a range of PPPs produced by different agencies and researchers means that there is a range for relative productivity level estimates.

Statistical agencies revise regularly the economic series they produce. As productivity estimates draw upon a wide range of economic data, including estimates of employment, hours worked, nominal output, prices, and capital stocks, they are subject to frequent, and often large, revisions. Indeed, these revisions are the scourge of productivity analysts, but a necessary evil since the most recent data must be used. Unfortunately, the revision of productivity data can result in the rewriting and reinterpretation of productivity trends.

Two examples will serve to illustrate this point. In May 2001, Statistics Canada released its Aggregate Productivity Measures data, which showed that output per hour in the business sector advanced at a 1.2 percent average annual rate from 1995 to 2000, a performance characterized as weak by productivity analysts. Later that same month, Statistics Canada released new estimates of the national accounts, using for the first time the Fisher chain index and capitalizing software expenditures. These changes boosted productivity growth by a very significant 0.5 percentage points to 1.7 percent per year for the same period, which forced productivity analysts to change their characterization of productivity growth as weak over the period.

In July 2001, the U.S. Bureau of Labor Statistics revised its estimates of business sector output per hour based on new national accounts data from the Bureau of Economic Analysis. Instead of increasing at 2.8 percent annually over the 1995-2000 period as originally reported earlier that year, productivity growth was revised down-

ward to 2.4 percent per year. This indicates that the acceleration in productivity growth was less than previously believed.

Productivity fluctuates with the business cycle. Because of the existence of overhead labour, it tends to fall during downturns and rise during recoveries since employment adjusts less quickly than output. The studies published in this volume are much more concerned with long-run than with short-run productivity trends and determinants, so the movement of productivity within a business cycle is not a key consideration. Nevertheless, two points should be noted. First, with the Canadian economy in late 2001 entering a period of weak growth due to falling aggregate demand, slower productivity growth can be expected for cyclical reasons. This does not mean that long-term productivity growth has necessarily deteriorated as any productivity shortfall now can be recovered later in the cycle. Second, to minimize the impact of cyclical influences on productivity, growth rates should be calculated at comparable points of the cycle, preferably on a peak-to-peak basis.

Productivity researchers produce a massive amount of numbers to explain productivity trends and non-specialists often have difficulty interpreting the estimates, and particularly differences between estimates. One important reason for these differences is that some researchers adjust labour and capital inputs to account for changes in quality, while others do not. The advantage of this adjustment is that quality improvements increase the growth rate of the input and hence its contribution to output. It also reduces the size of the residual, or total factor productivity, shedding more light in the eyes of some on the sources of growth. The disadvantage of such adjustment, or the advantage of not adjusting, is that the inherent conceptual and methodological difficulties are avoided and the productivity figures are easier to interpret and understand.

An important issue in the productivity field is that of productivity convergence or catch-up. The idea is very simple, namely that countries not on the technological frontier have the potential for faster productivity growth than the country or countries on the frontier because they can import the best practice technologies from the leader(s), generally the United States. The catch-up phenomenon has been seen as the major reason why most OECD countries experienced faster productivity growth than the United States during the postwar period. It is important to note that productivity convergence is by no means an automatic process as many low productivity level countries have weak productivity growth. To exploit the potential for catch-up, a country must have an economic environment conducive to economic development. But productivity convergence does not always take place, even in countries with conditions favourable to growth. With the acceleration of productivity growth in the United States during the second half of the 1990s, the pro-

ductivity leader bound ahead of the followers and increased its productivity advance, a situation that can be characterized as *productivity divergence*.

