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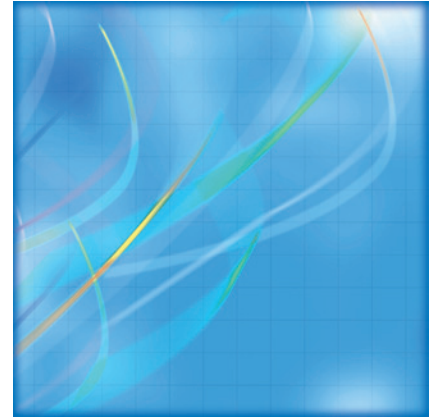
Insights on the Canadian economy

Productivity and prosperity in the information age: a Canada-U.S. comparison

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Abstract

This paper examines three sets of issues: a) the extent to which information technology has contributed to Canada's productivity growth; b) how Canada's productivity performance compared to the U.S. and c) what was the impact of the recent Canadian productivity revival on prosperity. The study concludes that, in the late 1990s, Canada's multifactor productivity performance compared favourably to the U.S., information technology user industries contributed to a large extent to Canada's productivity revival and Canada's standard of living improved significantly primarily because of the increase in the labour utilization rate.

Introduction

In the late 1990s, the Canadian economy displayed several remarkable features. The first was its strong economic growth. Since 1995, economic growth has been more rapid than that of the 1981-1988 period (3.8% compared to 3.1%).¹ A second was its unusually low levels of both inflation and unemployment. In the past, low levels of unemployment have usually meant sharply rising inflation. Yet despite an unemployment rate that has been close to 7% in 1999 and 2000, core inflation has remained in check with a moderate 2.3% increase. A third was the disappearance of Federal budget deficits. The structural budget balance has moved steadily from a massive deficit to a large surplus. A fourth was the strength of the Canadian multifactor productivity performance and the fact that it compared favourably to the United States.

Productivity is not only the key to the performance of firms and industries; it is fundamental to the living standards of Canadians. There is now a general recognition that Canada experienced a transformation in its productivity record through the late 1990s. The causes and industry origins of the productivity surge are perhaps less well known. A series of recent Statistics Canada's studies have provided some useful insights, not only reaffirming the role of information technology, but also revealing the mechanisms by which it has operated.

This paper draws heavily on that research to describe trends in Canada's productivity; the role of different industries in the recent acceleration; the contribution made by information technology and the implication for Canada's prosperity.

Key features of Canada's productivity performance in the business sector

Canada's productivity surge in the 1990s has been highlighted in a number of previous studies.² A few key features are summarized here.

¹ The paper used data from the December 2002 vintage for Canada and March 2002 for the United States.

² See Statistics Canada 2002, *The Daily*, July (<http://statcan.ca>). Crawford 2002; Trends in Productivity Growth in Canada, Bank of Canada Review, 19-30 p. Spring. OECD 2001; OECD Science, Technology and Industry Scoreboard. Towards a Knowledge Based Economy, Paris.

Two productivity measures are presented for the business sector:

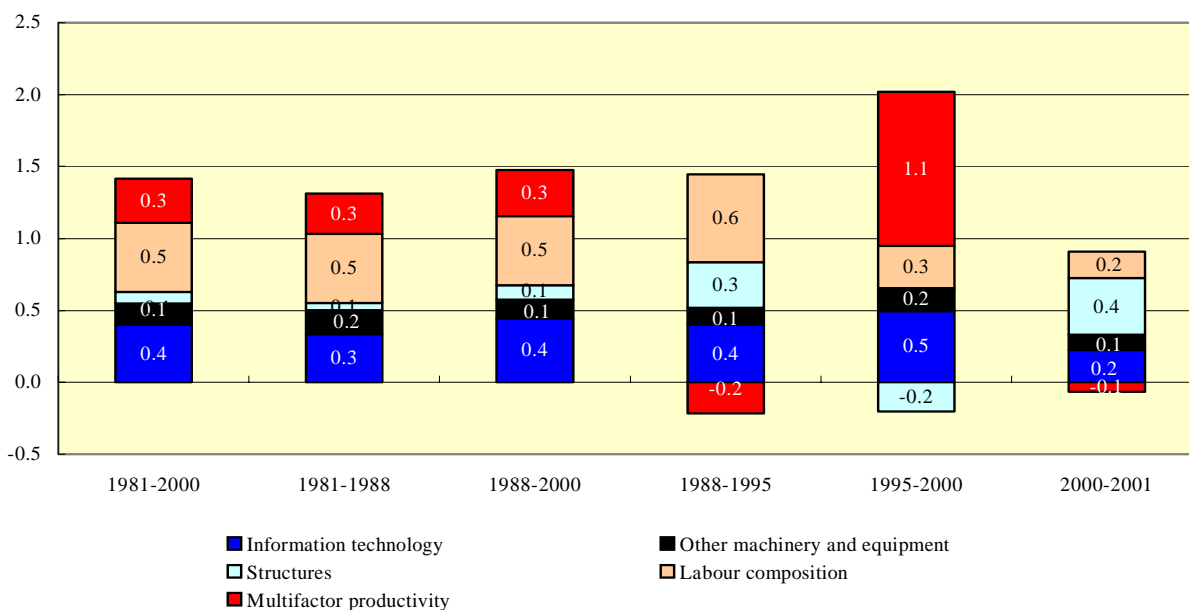
- labour productivity—the amount of output produced per unit of labour used; and
- multifactor productivity—the amount of output produced per unit of combined input of labour and capital (buildings, machinery, equipment, etc).

Improvements in productivity have connotations of increased efficiency—the use of resources in terms of labour and capital in ways that generate more value added.

Figure 1 illustrates three phases of Canada’s productivity performance over the 1981-2001 period:

- strong productivity growth from 1981 through to the mid-1980s;
- a pronounced deceleration from the mid-1980s through to the early 1990s; and
- a renewed surge in productivity growth from the early 1990s.

Figure 1. Productivity trends, Canadian business sector (1981=100)



The 1990s surge peaked in 2000. There was a downturn in 2001, as the business sector recorded a 0.9% increase in output, and a 1% increase in the combined capital and labour inputs.

It is apparent from the figure that the 1990s presented the longest period of continuous positive growth in multifactor productivity during the last 20 years.

Figures 2a and 2b show the underlying rates of productivity growth over the two business cycles (1981-1988, 1988-2000) and 2001 and different sub-periods for both Canada and U.S. (the data sources are highlighted in the methodology box). The rate of growth in labour productivity is indicated by the height of each column.

Figure 2a. Percentage points contribution to the Canadian business sector labour productivity growth

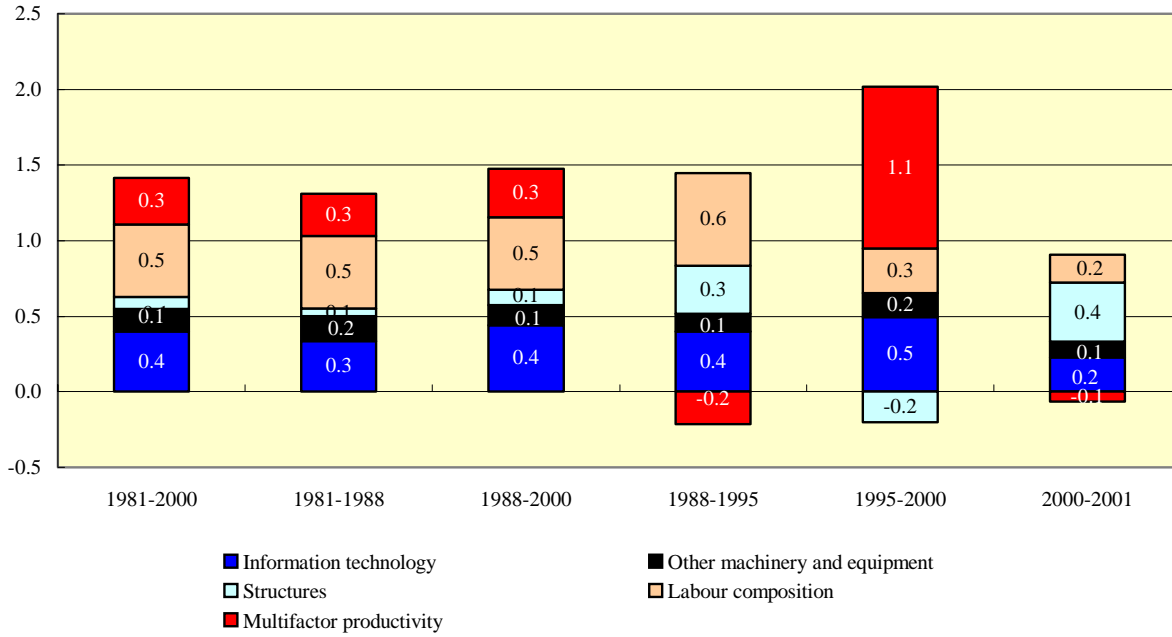
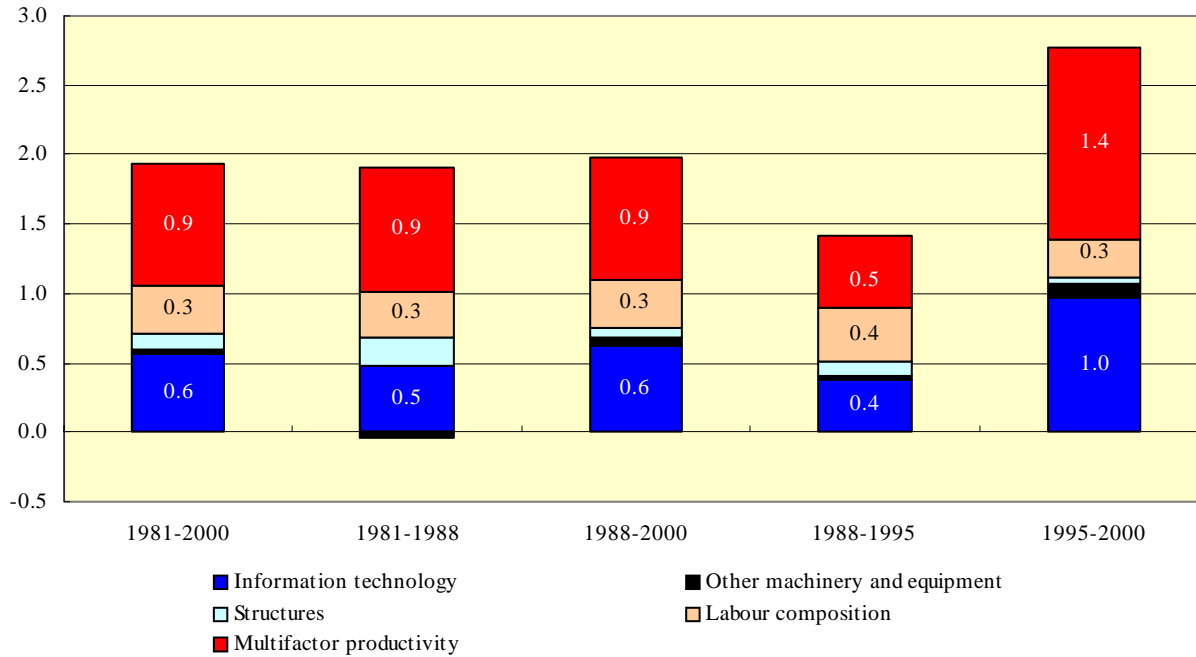


Figure 2b. Percentage points contribution to the U.S. business sector labour productivity growth



Methodology

There have been a number of U.S. studies of information technology contributions to productivity growth. For brevity, however, this paper focuses on comparisons with the U.S., based on the Bureau of Labor Statistics (BLS) data. Using BLS data brings two advantages:

- The Canadian Productivity Accounts uses methods similar to the BLS, and this enhances comparability; and
- Access to the BLS dataset assists flexibility in choosing periods for comparison.

Computers, telecommunication systems and the Internet have brought revolutionary changes to businesses, consumers, education, health, entertainment and many other aspects of life. A defining characteristic is that the costs of storing, accessing and exchanging information have been greatly reduced. In so doing, information technology has reduced the costs of coordination, communications and information processing. But, increasingly, they have also facilitated changes in what businesses do and how they do it.

A particular analytical interest has centered on the links between information technology and productivity growth. We are interested in the extent to which information technology contributes to labour productivity growth. The framework provides three avenues for information technology to influence labour productivity:

Increases in capital intensity. Labour productivity can rise as a result of higher capital use per unit of labour. Stronger investment in information technology can raise capital intensity.

Productivity gains in information technology production. Producers' ability to manufacture much more powerful information technology equipment, with little increase in inputs, generates substantial multifactor productivity gains. If the gains are of sufficient magnitude and production is on sufficient scale, they can show up as contributions to aggregate multifactor productivity growth.

Productivity gains in information technology-using industries. This entails that use of information technology generates multifactor productivity gains.

Three important points are apparent from the figure:

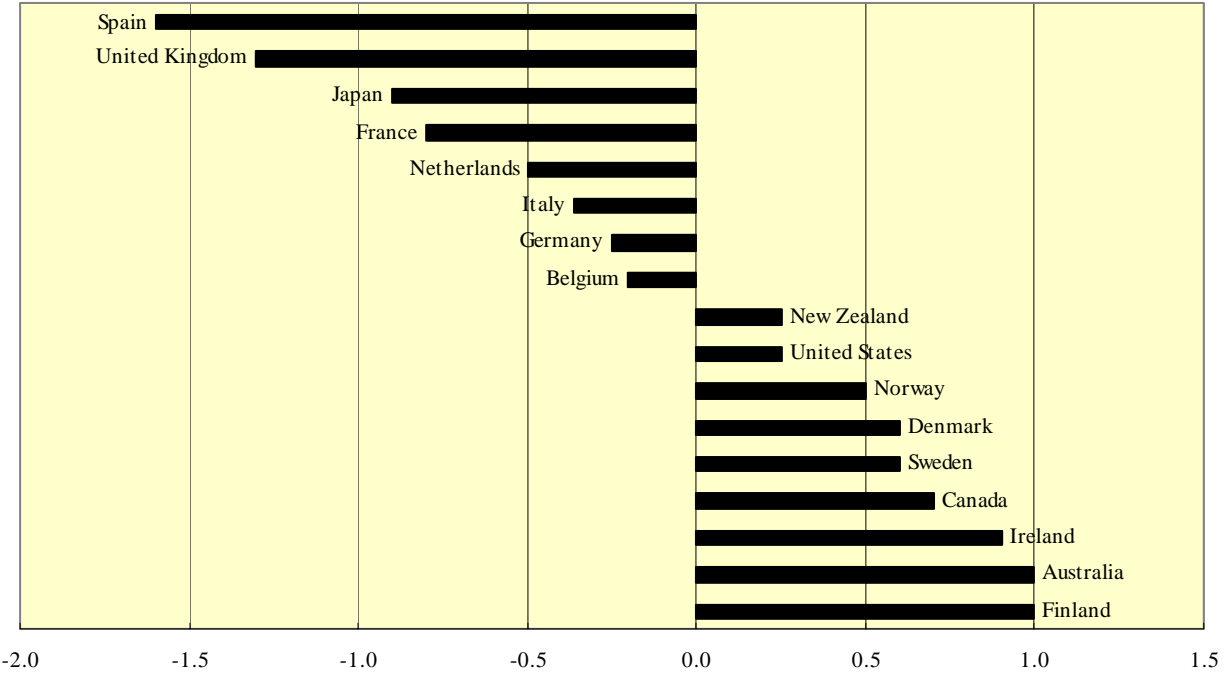
- The 1980s are similar to the 1990s for both Canada and the U.S. as labour productivity growth remained virtually unchanged. For both periods, there is a productivity gap in favour of the U.S. (about 0.5 percentage points).
- In Canada, during the 1980s and the 1990s, labour composition—which captures the increasing importance of skilled workers—was the largest contributor to labour productivity, followed by increases in information technology capital intensity and multifactor productivity growth. In contrast, for the U.S. during these two periods,

multifactor productivity growth drove the labour productivity increase, followed by information technology capital intensity and labour composition.

- Between the early 1990s and the late 1990s, labour productivity growth increased from 1.2% to 1.8% in Canada, largely as a result of the multifactor productivity revival. In contrast, owing to a surge in information technology capital intensity and multifactor productivity growth, the U.S. labour productivity doubled (from 1.4% to 2.8%) between these two periods.

Canada’s multifactor productivity performance in the 1990s has not only improved compared to the U.S. but also by *international* standards. Figure 3 shows that Canada was one of only four developed countries to experience a strong productivity acceleration in the 1990s.

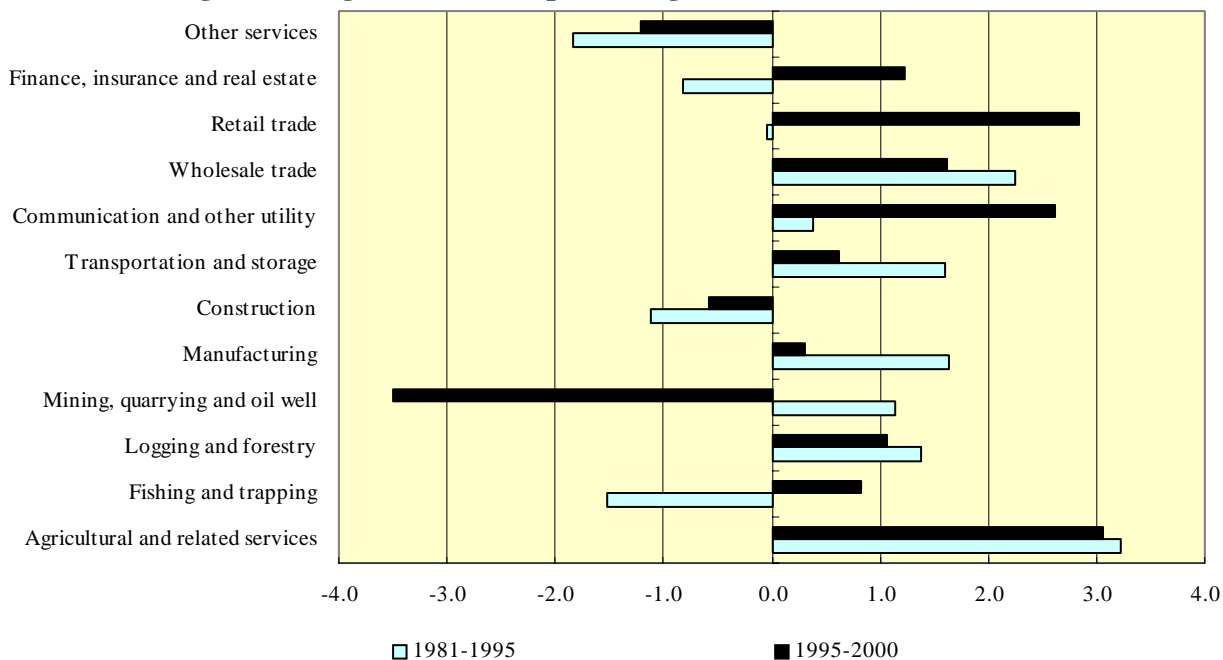
Figure 3. Multifactor productivity revival in OECD countries (average annual growth rate in percentage), business sector



Note: Change in average annual growth rate from 1980-1989 to 1990-1999. The Canadian figures reported in this chart are not comparable to those reported elsewhere in this paper.
 Source: OECD (2001)

A convenient way to assess the breadth of the Canadian productivity revival is to examine the productivity performance of the industries that make up the Canadian business sector. Figure 4 compares the average annual multifactor productivity growth in the 1995-2000 period to that in 1981-1995 for twelve broad sectors that compose the business sector. The change in the average productivity growth rates from the earlier to the later period differs considerably across sectors, ranging from -3.6 in mining to 3.1 in agriculture.

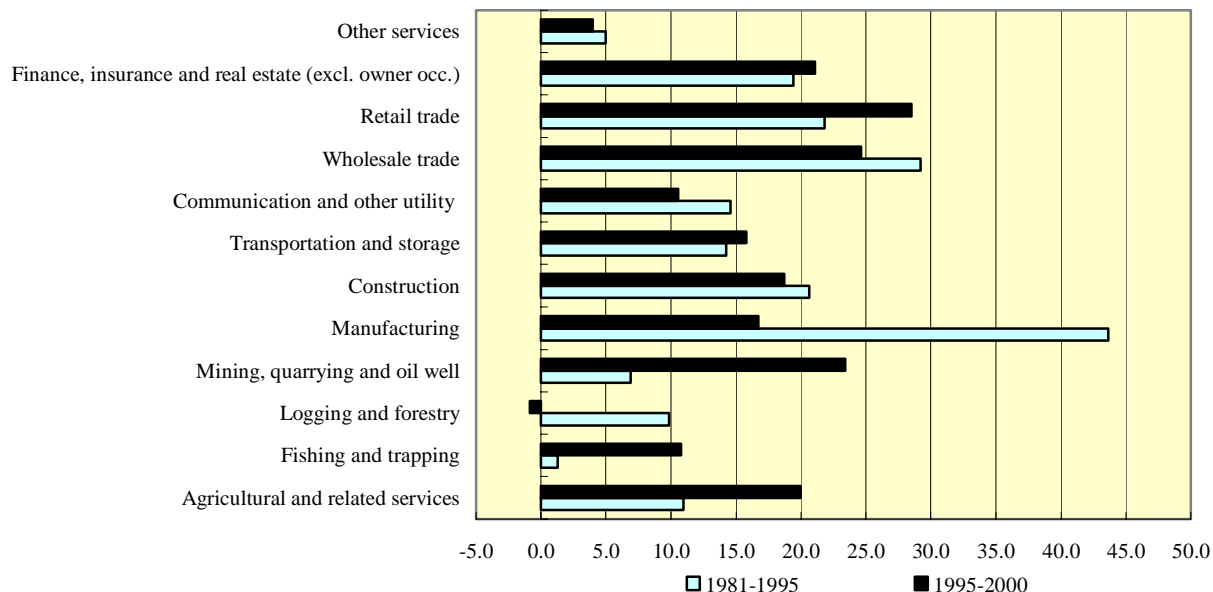
Figure 4. Sectoral sources of Canada's multifactor productivity revival (compound average annual growth rate in percentage)



The multifactor productivity growth revival during the late 1990s was not confined to only one sector. There is a strong productivity revival after 1995 in major sectors of the Canadian economy such as retail trade, communication and utility and finance and real estate. Parallel to the gains, two major important sectors, manufacturing and wholesale, experienced a productivity deceleration during the late 1990s. Part of the success of some industries such as retail trade and finance, insurance and real estate is linked to information technology. The financial sector has been restructured to operate much more through information technology (for example, ATMs, Internet and phone banking) than through traditional face-to-face contacts. Likewise, information technology played a part in the restructuring of retailing activities.

Retailers were able to use bar-code and scanning technology and inventory management systems as part of the process of transforming wholesaling from a storage-based to a fast flow-through operation. These two industries reported the highest growth of information technology capital during the late 1990s (see Figure 5).

Figure 5. Trends of information technology capital for Canadian sectors (average annual growth in percentage)



Prosperity in the economy as a whole

We now turn to relating living standards to two questions. What has the productivity surge meant for growth in average incomes in Canada? What has stronger productivity growth meant for the distribution of income?

A simple relationship can be used to illustrate just how important productivity growth is to prosperity. For this purpose, productivity is measured as labour productivity.³ Prosperity is measured as per capita GDP—a measure subject to a number of well-known criticisms as a welfare indicator, but a meaningful and useful indicator nonetheless.

$$\frac{GDP}{Persons} = \frac{GDP}{Hours Worked} \times \frac{Hours Worked}{Employees} \times \frac{Employees}{Persons}$$

Or, in other words,

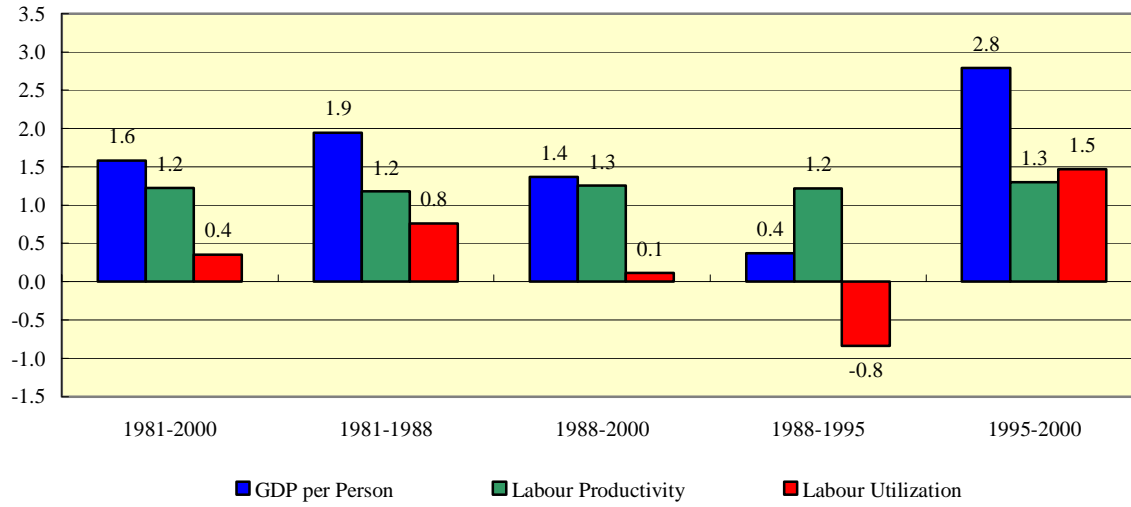
$$GDP \text{ per capita} = \text{Labour productivity} \times \underbrace{(\text{Average Hours Worked} \times \text{Employment Ratio})}_{\text{Labour utilization}}$$

³ The coverage of the labour productivity measure differs in this section (whole economy output and hours worked) from that used in the previous section (business sector output and hours worked). The business sector measures are generally considered to be more representative of productivity trends as they exclude activities (such as government administration) for which output is hard to measure.

The last two terms on the right hand side are sometimes combined and referred to (at least by the OECD 2001) as the rate of ‘labour utilization’. This measures the extent to which the population is actively engaged in employment activity—hours worked per head of population.

Figure 6 displays the contributions of labour productivity and utilization to average income growth over the last two business cycles, 1981-1988 and 1988-2000 periods. The rate of growth in labour utilization plus the rate of labour productivity growth equals the rate of growth in per capita GDP.

Figure 6. Standards of living in Canada (average annual growth rate in percentage)



During the 1990s, real income advanced at 1.4%, down from 1.9% during the 1980s, a reflection of a slower growth of labour utilization (from 0.8% to 0.1%). In contrast, labour productivity growth remained virtually unchanged between these two periods. The 1990s brought a major turnaround in growth in Canada’s prosperity as a result of a slowdown in the labour utilization rate. In contrast, productivity growth remained unchanged between the early and the late 1990s.

Changes in labour utilization in the late 1990s boosted the average real income, which grew at a remarkable 2.8% per year. When real income grows at this pace, it means that each generation experiences a far more affluent lifestyle than the previous one, and over the course of a lifetime, Canadian parents can provide their children with a standard of living that is twice the level that they themselves enjoyed as children.