# Canada's Productivity Performance in International Perspective

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THE PROMOTION OF GROWTH and productivity are on the policy agenda in most OECD countries, as governments seek to address problems related to sluggish growth, such as weak employment growth, high unemployment or fiscal deficits. This agenda has also affected the work of the OECD. A comprehensive study of growth performance in the OECD area, including a set of policy recommendations, was presented to the OECD Ministerial meeting in May 2001 (OECD, 2001). Further empirical findings and policy recommendations, focusing on the role of firm dynamics, regulatory factors and information and communications technology (ICT), were released in 2003 and 2004 (OECD, 2003a, 2003b, and 2004a).

This article returns to the findings of these OECD studies and presents further empirical evidence on economic growth and productivity at the aggregate, industry and firm level. It particularly focuses on the different growth experiences of the main OECD regions, notably Europe, the United States and Japan, and pays special attention to the position of Canada. The next section discusses aggregate growth patterns in the OECD area, examining the main factors affecting growth as well as some of the policies that may help strengthen growth. The third section focuses on multifactor productivity (MFP) growth, or the overall efficiency of labour and capital, and some of the factors that may have influenced the pick-up in MFP growth in certain OECD countries, such as investment in R&D and more rapid innovation, as well as the impacts of ICT use and firm turnover. The final section draws some conclusions.

## Growth Patterns in the OECD Area

### Growth diverged in the OECD area

The interest of many OECD countries in economic growth over the past years has been partly linked to the strong performance of the United States over the second half of the 1990s and the reversal of the catch-up pattern that had characterized the OECD area over the 1950s and the 1960s. During much of the early post-war period, most OECD countries grew rapidly as they recovered from the war and applied U.S. technology and knowledge to upgrade their economies. For most OECD countries, this catch-up period came to a halt in the 1970s; average growth rates of GDP per capita over the

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1973-92 period for much of the OECD area were only half that of the preceding period, and many OECD countries no longer grew faster than the United States (Maddison, 2001).

During the 1990s, a different pattern emerged. Even though the United States already had the highest level of GDP per capita in the OECD area at the beginning of the decade, it expanded its lead on many of the other major OECD countries during the second half of the 1990s. A few other OECD countries, including Australia, Canada, Finland, Greece, Ireland, Portugal and Sweden, also registered markedly stronger growth of GDP per capita over the 1995-2002 period compared with the 1980-1995 period (OECD, 2003a and De Serres, 2003). Some of these countries continued to catch up with the United States in the second half of the 1990s. In contrast, the increase in GDP per capita in several other OECD countries, including Japan, Germany and Italy, slowed sharply over the second half of the 1990s, leading to a divergence with the United States.

Even though U.S. growth performance is no longer considered to be as exceptional as was claimed during the "new economy" hype, its strong performance over the second half of the 1990s has increased interest in the analysis of economic growth and the sources of growth differentials across countries. The OECD work suggests that the divergence in growth performance in the OECD area is not due to only one cause, but that it reflects a wide range of factors. These are discussed below in more detail. Differences in the measurement of growth and productivity might also be contributing to the observed variation in performance. A recent OECD study (Ahmad et al., 2003) suggests that such differences do play a role, but that they probably only account for a small part of the variation in growth performance. To reduce the uncertainty of empirical analysis related to the choice of data, the OECD has developed a new Productivity Database, which is used in this paper.[2]

## Labour utilization plays a key role

The first factor affecting growth differences concerns labour utilization (Chart 1). In the first half of the 1990s, most OECD countries, in particular many European countries, were characterized by a combination of high labour productivity growth and declining labour utilization. The high productivity growth of these EU countries may thus have been achieved by a greater use of capital or by dismissing (or not employing) low-productivity workers. In the second half of the 1990s, many European countries improved their performance in terms of labour utilization, as unemployment rates fell and labour participation increased. However, this was accompanied by a sharp decline in labour productivity growth. In contrast, some other OECD countries, such as Canada and Ireland, experienced a pick-up in both labour utilization growth and labour productivity growth from 1990-95 to 1995-2003, showing that there need not be a trade-off between labour productivity growth and increased use of labour.[3]

Achieving a combination of labour productivity growth and growing labour utilization requires well-functioning labour markets that permit and enable reallocation of workers. This is particularly important during times of rapid tech-

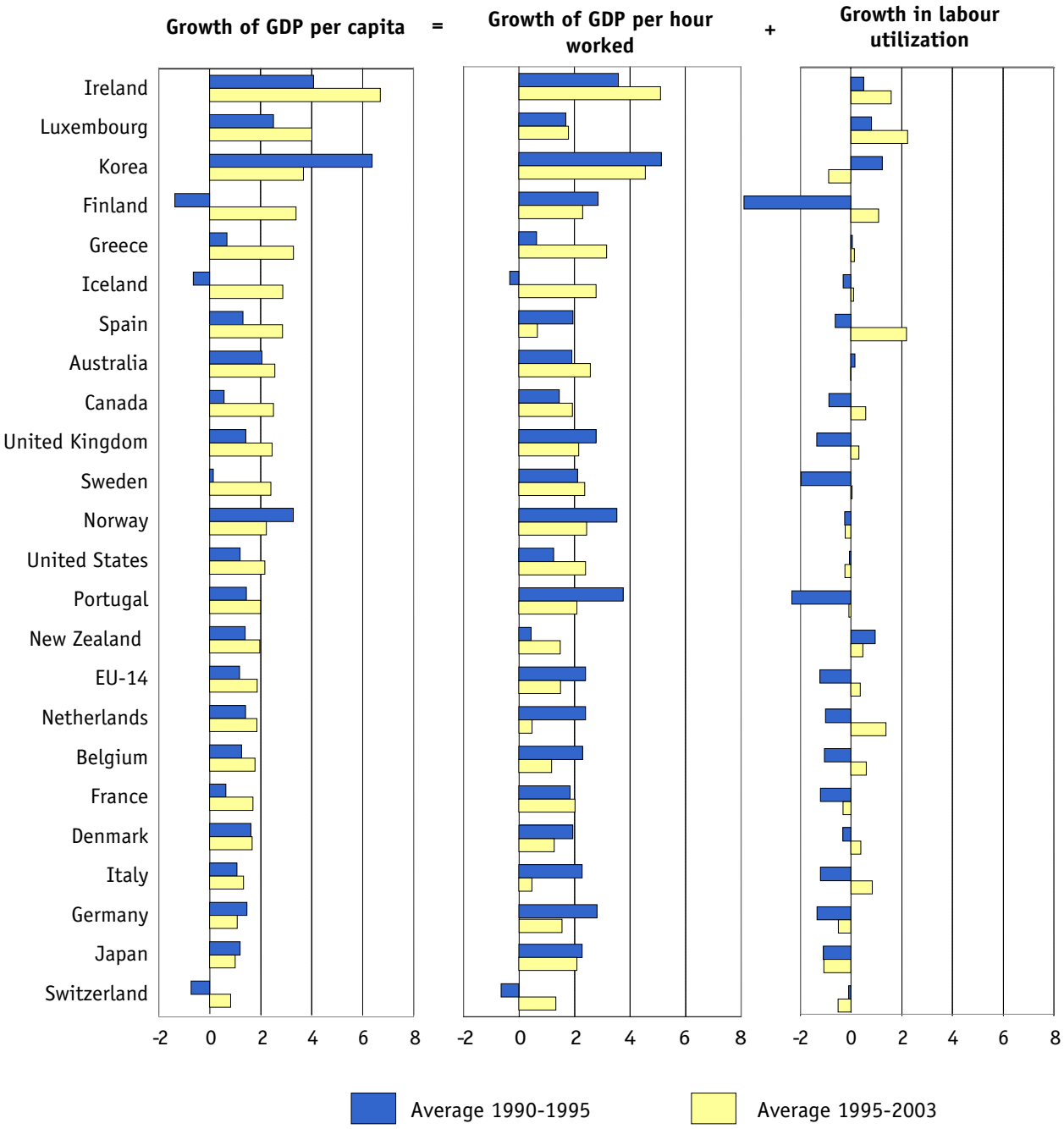
2 The Productivity Database can be accessed at http://www.oecd.org/statistics/productivity/. See Pilat and Schreyer (2004) for an overview. It should be emphasised that the OECD Productivity Database aims to provide a set of internationally comparable estimates of productivity. The best possible estimates of productivity growth for any individual country are produced by statistical offices, such as Statistics Canada. Moreover, the OECD productivity estimates refer to the total economy, whereas those by Statistics Canada refer to the business sector.

3 The estimates shown in Chart 1 are not adjusted for the business cycle. Trend-adjusted estimates prepared by the OECD Economics Department broadly confirm the findings of Chart 1 (De Serres, 2003).

**Chart 1**

**Changes in Labour Utilization Contribute to Growth in GDP per capita**

(percentage change at annual rates, 1990-95 and 1995-2003)

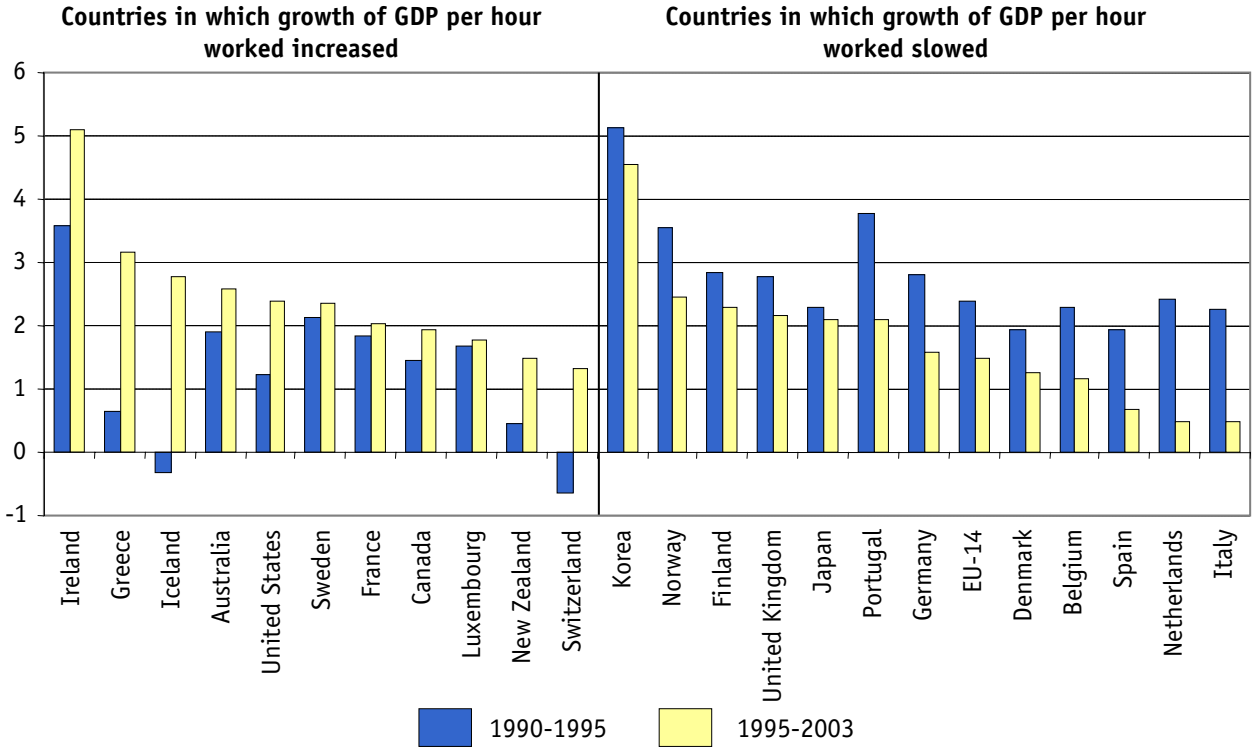



EU-14: Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom.

Source: OECD, Productivity Database, March 2005, see De Serres (2003) for cyclically adjusted estimates.

nological change. Labour market institutions have to ensure that affected workers are given the support and the incentives they need to find new jobs and possibly to retrain. In many countries,

**Chart 2**
**Growth in GDP per Hour Worked, 1990-95 and 1995-2003**
(annual compound growth rates, in per cent)




Source: OECD, Productivity Database, March 2005.

institutions and regulations hinder the mobility of workers and prevent the rapid and efficient reallocation of labour resources (OECD, 1999). In most of the countries characterized by a combination of increased labour utilization and labour productivity, reforms over the 1980s and 1990s improved the functioning of labour markets, effectively enabling more rapid growth. Despite the progress in enhancing labour utilization that has been made in many OECD countries over the 1990s, further improvements will be needed, in particular as the population in many OECD countries is ageing rapidly. Moreover, for several OECD countries, notably many European countries, there is still a large scope for improvement in labour utilization, as it accounts for the bulk of the gap in GDP per capita with the United States (OECD, 2005).

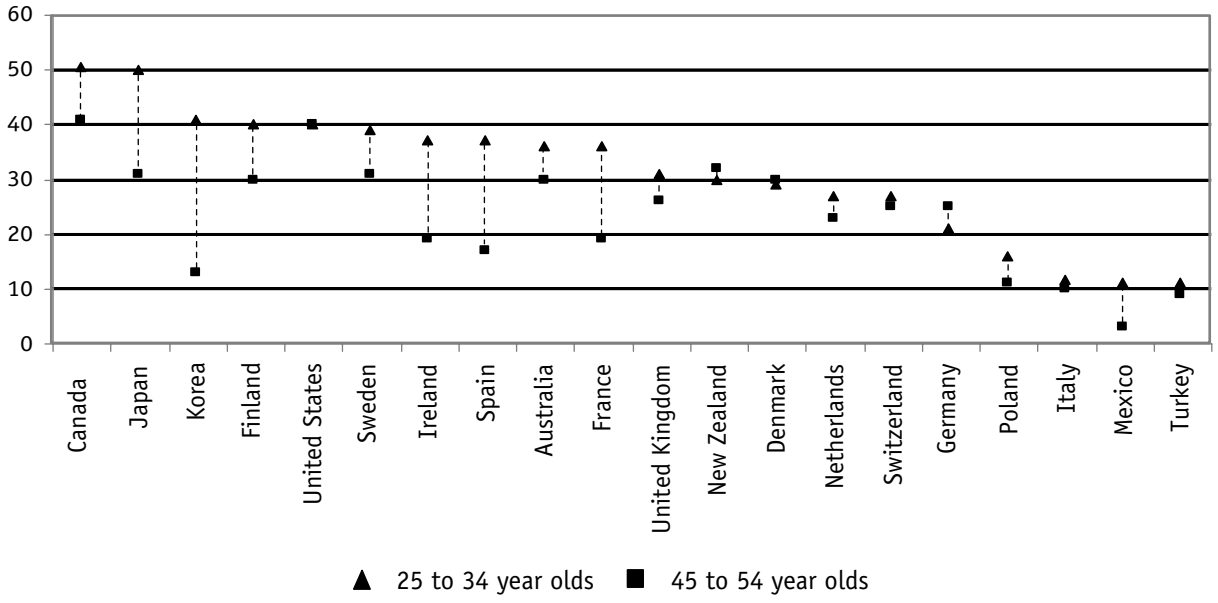
### Labour productivity

Labour productivity is the other main component of GDP per capita shown in Chart 1. It is also the key determinant of the gap in income levels between the United States and other OECD countries, such as Canada. As shown above, labour productivity growth accelerated in a number of OECD countries in the second half of the 1990s, including Australia, Canada, Greece, Ireland and the United States (Chart 2). In contrast, it declined in a large number of other OECD countries. With the slowdown of the world economy since 2000, most OECD countries have experienced a marked slowdown in labour productivity growth, the United States and some small European countries being the main exceptions. Labour productivity growth in Canada also slowed down in

**Chart 3**

**Percentage of the Population that has Attained Post-secondary Education, 2002**

(percentage points)




Source: OECD, *Education at a Glance*, 2004.

recent years, and business sector productivity growth remained flat in 2004 (Statistics Canada, 2005).

### The impact of human capital

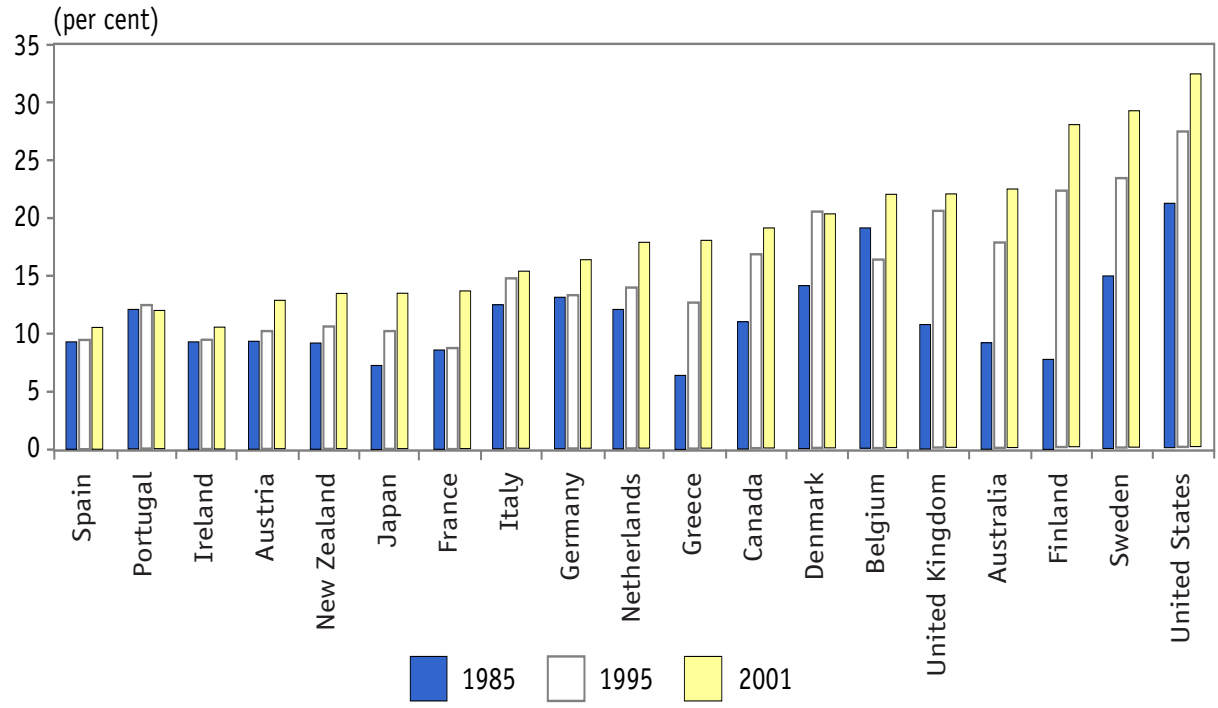
Labour productivity growth can be increased in several ways: by improving the composition of labour used in the production process; increasing the use of capital and improving its quality; and attaining higher multifactor productivity (MFP). The composition of the labour force is the first of these, and plays a key role in labour productivity growth. This is partly because in all OECD countries, educational policies have ensured that young entrants on the job market are better educated and trained on average than those who are retiring from it. For example, in most OECD countries, and with Canada in a leading position, more 25-34 year olds have attained post-secondary education than 45 to 54 year olds (Chart 3).

The available empirical evidence suggests that improvements in the composition of labour have directly contributed to labour productivity growth in virtually all OECD countries (Bassanini and Scarpetta, 2001 and Jorgenson, 2003). The OECD Productivity Database does not yet include estimates of labour composition, although their inclusion is planned for the near future. Estimates of labour composition for the G7 countries are included in a recent study by Dale Jorgenson (2003), however, and point to a contribution of about 0.2 percentage points per year to Canadian GDP growth over the 1995-2001 period. These estimates also suggest that the contribution of labour composition to labour productivity growth has slowed in most G7 countries over the second half of the 1990s, Italy being the only exception. This is typically attributed to the large number of low-skilled workers that were integrated in the labour force in many OECD countries over

**Chart 4**

**ICT Investment in Selected OECD Countries, 1985-2001***

(as a percentage of non-residential gross fixed capital formation, total economy)




* 2002 for Australia, Canada, France, Germany, Japan, New Zealand and the United States.

Note: Estimates of ICT investment are not yet fully standardized across countries, mainly due to differences in the capitalization of software in different countries. See Ahmad (2003).

Source: OECD, Productivity Database, March 2005.

the second half of the 1990s. Moreover, the contribution of labour composition may also decline over time if the gap in education levels between cohorts of new and retiring workers becomes smaller over time. Jorgenson's estimates differ from those by Gu and Wang (2004) for the Canadian business sector, however, as the latter show a significantly larger and growing contribution of labour composition to labour productivity growth, rising up to 0.45 percentage points per year in 1995-2000. Growth accounting estimates typically only take account of changes in educational attainment, however; increases in the level of post-educational skills are also important, but few hard measures are available.

### The role of investment in fixed capital

Investment in physical capital is the second factor that plays an important role in labour productivity growth. Capital deepening expands and renews the existing capital stock and enables new technologies to enter the production process. While some countries have experienced an overall increase in the contribution of capital to growth over the past decade, information and communications technology (ICT) has typically been the most dynamic area of investment. This reflects rapid technological progress and strong competitive pressure in the production of ICT goods and services and a consequent steep decline in prices. This fall, together with the growing scope for application of ICT, has

encouraged investment in ICT, at times shifting investment away from other assets. The available data show that ICT investment in Canada rose from between 10 and 20 per cent of total non-residential investment in the business sector in the mid 1980s to between 15 and 30 per cent in 2002 (OECD, 2003b and Chart 4). In Canada, the share of ICT investment in 2002 was higher than that in France, Germany, Italy or Japan, but lower than in the United States, the United Kingdom or Australia.

While ICT investment accelerated in most OECD countries, the pace of that investment and its impact on growth differed widely. For the G7 countries and Australia, ICT investment accounted for between 0.35 and 0.85 percentage points of growth in GDP per capita over the 1995-2002 period (Table 1).[4] Australia, the United States and the United Kingdom received the largest boost; Canada and Japan a sizeable one; and Germany, France and Italy a much smaller one.

In some OECD countries, e.g. France, Germany and Japan, the growing contribution of ICT capital was accompanied by a decline in the contribution of non-ICT capital (Table 1). In these countries, ICT investment partly substituted for investment in other assets. In Australia and the United States, on the other hand, capital deepening in the 1990s was a broad phenomenon as the contribution of non-ICT capital increased too. For France, Germany and Japan, the declining contribution of non-ICT capital has been attributed to weaknesses in domestic demand (Jorgenson, 2003).

One important difference between OECD countries is thus the extent to which countries have invested in ICT (Chart 4). A range of indicators on ICT use show that the highest rate of uptake of ICT can typically be observed in the United States, Canada, New Zealand, Australia, the Nordic countries and the Netherlands (OECD, 2003c). The question that follows concerns the reason why the diffusion of ICT is so different across OECD countries. A number of reasons can be noted. In the first place, firms in countries with higher levels of income and productivity typically have greater incentives to invest in efficiency-enhancing technologies than countries at lower levels of income, since they are typically faced with higher labour costs. Moreover, the structure of economies may affect overall investment in ICT, as countries with a larger service sector or with a large average firm size are likely to have greater investment in ICT. Both of these factors may have had some impact on the overall intensity of ICT investment in Canada.

More specifically, the decision of a firm to adopt ICT depends on the balance of costs and benefits that may be associated with the technology. There is a large range of factors that affect this decision (OECD, 2004a). This includes the direct costs of ICT, e.g. the costs of ICT equipment, telecommunications or the installation of an e-commerce system. Considerable differences in the costs of ICT persist across OECD countries, despite strong international trade and the liberalization of the telecommunications industry in OECD countries. Moreover, costs and implementation barriers related to the ability of the firm to absorb new technologies are also important. This includes the availability of know-how and qualified personnel, the scope for organizational change and the capability of a firm to innovate. In addition, a competitive environment is more likely to lead a firm to invest in ICT, as a way to strengthen performance and survive, than a more sheltered envi-

4 These estimates are based on official data on ICT investment from individual countries' national accounts. They are based on a harmonized deflator for ICT investment, which adjusts for cross-country differences in the measurement of ICT prices (see Schreyer, Bignon and Dupont, 2003). Methodological differences in the measurement of software investment may affect the results, however (Ahmad, 2003), and are particularly likely to affect the results for Japan (Jorgenson and Motohashi, 2004).

**Table 1**

**Contributions to GDP Growth, Total Economy, 1990-95 and 1995-2002***

(percentage points per year, based on cost shares and harmonized ICT price indices)

| | Australia | Canada | France | Germany | Italy | Japan | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|
| **1990-95** | | | | | | | | |
| Labour input | 0.87 | 0.27 | -0.58 | -0.76 | -1.41 | -0.55 | -0.79 | 0.91 |
| ICT capital, of which | 0.54 | 0.34 | 0.18 | 0.33 | 0.20 | 0.37 | 0.49 | 0.53 |
| ICT hardware | 0.31 | 0.17 | 0.08 | 0.19 | 0.09 | 0.23 | 0.27 | 0.26 |
| Software | 0.17 | 0.12 | 0.05 | 0.08 | 0.03 | 0.09 | 0.19 | 0.19 |
| Communications equipment | 0.06 | 0.05 | 0.04 | 0.06 | 0.08 | 0.05 | 0.04 | 0.09 |
| Non-ICT capital | 0.38 | 0.63 | 0.60 | 0.67 | 0.60 | 0.94 | 0.64 | 0.22 |
| MFP | 1.41 | 0.45 | 0.86 | 1.05 | 1.87 | 0.74 | 1.31 | 0.79 |
| GDP growth | 3.19 | 1.70 | 1.06 | 1.29 | 1.26 | 1.50 | 1.65 | 2.45 |
| **1995-2002*** | | | | | | | | |
| Labour input | 0.86 | 1.40 | 0.13 | -0.18 | 0.67 | -0.70 | 0.67 | 0.86 |
| ICT capital, of which | 0.87 | 0.60 | 0.36 | 0.42 | 0.50 | 0.57 | 0.82 | 0.86 |
| ICT hardware | 0.49 | 0.37 | 0.16 | 0.28 | 0.24 | 0.36 | 0.52 | 0.44 |
| Software | 0.14 | 0.14 | 0.13 | 0.09 | 0.12 | 0.12 | 0.20 | 0.27 |
| Communications equipment | 0.14 | 0.09 | 0.07 | 0.06 | 0.15 | 0.08 | 0.09 | 0.15 |
| Non-ICT capital | 0.46 | 0.62 | 0.39 | 0.48 | 0.66 | 0.57 | 0.65 | 0.31 |
| MFP | 1.52 | 1.01 | 1.48 | 0.68 | 0.04 | 0.56 | 0.85 | 1.24 |
| GDP growth | 3.71 | 3.64 | 2.35 | 1.41 | 1.88 | 1.00 | 2.99 | 3.27 |
| **Change 1990-95 to 1995-2002*** | | | | | | | | |
| Labour input | -0.01 | 1.13 | 0.70 | 0.57 | 2.08 | -0.14 | 1.46 | -0.05 |
| ICT capital, of which | 0.33 | 0.26 | 0.18 | 0.09 | 0.29 | 0.19 | 0.33 | 0.33 |
| ICT hardware | 0.18 | 0.20 | 0.08 | 0.09 | 0.14 | 0.13 | 0.26 | 0.18 |
| Software | -0.02 | 0.03 | 0.08 | 0.01 | 0.08 | 0.03 | 0.01 | 0.08 |
| Communications equipment | 0.08 | 0.03 | 0.02 | -0.01 | 0.07 | 0.03 | 0.06 | 0.06 |
| Non-ICT capital | 0.08 | -0.01 | -0.21 | -0.19 | 0.06 | -0.37 | 0.01 | 0.10 |
| MFP | 0.11 | 0.56 | 0.62 | -0.36 | -1.83 | -0.18 | -0.46 | 0.45 |
| GDP growth | 0.51 | 1.94 | 1.30 | 0.12 | 0.61 | -0.50 | 1.33 | 0.82 |

* 2001 for Italy and the United Kingdom.

Source: OECD, Productivity Database, March 2005.

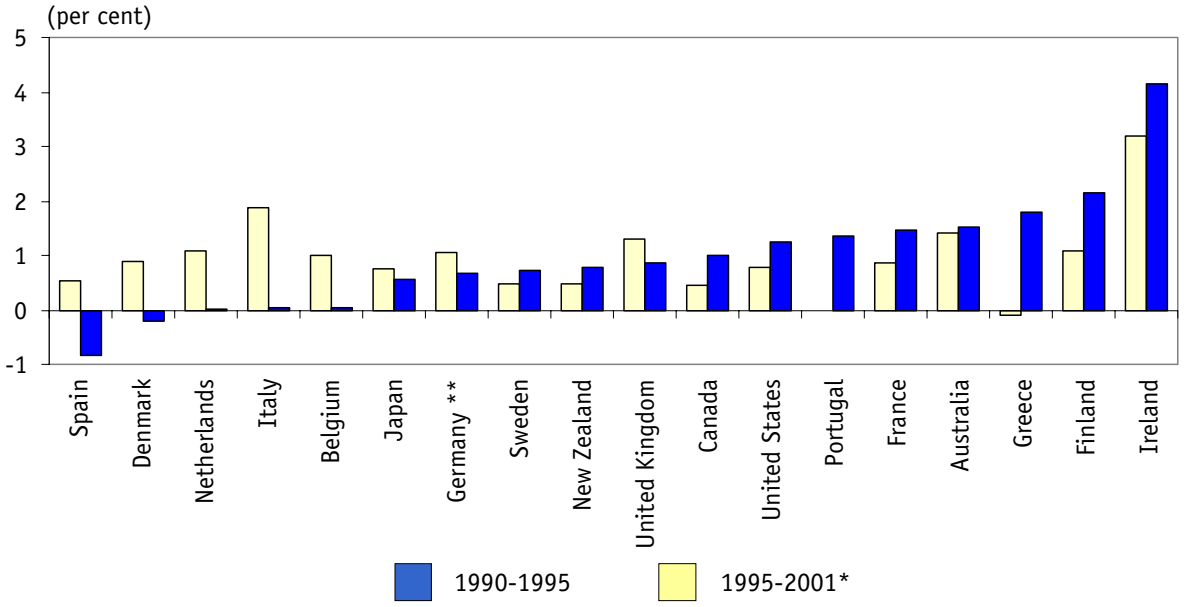
ronment. Moreover, excessive regulation in product and labour markets may make it difficult for firms to draw benefits from investment in ICT and may thus hold back such spending. These issues will be further discussed below, as they also affect the returns to ICT that have thus far become visible in ICT-using industries.

## Strengthening MFP Growth

The final component that accounts for some of the pick-up in labour productivity growth in the 1990s in certain OECD countries is the acceleration in multifactor productivity (MFP) growth (Chart 5). MFP growth rose particularly in Australia, Canada, Finland, France, Greece, Ireland, and the United States. In other countries, including Germany, Italy, Japan, the United Kingdom, Denmark, the Netherlands and Spain, MFP growth slowed down over the 1990s.[5]

The improvement in MFP in some countries reflects a break with slow MFP growth in the 1970s and 1980s and may be due to several sources. Better skills and better technology may

**Chart 5**
**MFP Growth, 1990-95 and 1995-2001***
(total economy, in percentage points per year)




* 2002 for Japan, Germany, New Zealand, Canada, the United States, France and Australia.
** 1992-1995 instead of 1990-95.
Source: OECD Productivity Database, March 2005.

have caused the blend of labour and capital to produce more efficiently, organizational and managerial changes may have helped to improve operations, and innovation may have led to more valuable output being produced with a given combination of capital and labour. MFP growth is measured as a residual, however, and it is difficult to provide evidence on such factors. Some is available, though, and is discussed below.

### Production of ICT – a boon to MFP growth in some countries

First, in some OECD countries, MFP reflects rapid technological progress in the production of ICT. Technological progress at Intel, for instance, has enabled the amount of transistors packed on a microprocessor to double every 18 months since 1965, and even more rapidly between 1995 and 1999. While the ICT manufacturing sector is relatively small in most OECD countries, it can make a large contribution to growth if it expands much more rapidly than other sectors. Some OECD countries, such as Finland, Hungary, Ireland, Japan, Korea and the United States, benefited from rapid productivity growth in the ICT-producing sector in the 1990s (Pilat and Wölfl, 2004 and Chart 6).[6] In Canada and many other OECD countries, ICT manufacturing is of little importance for aggregate productivity growth, however.

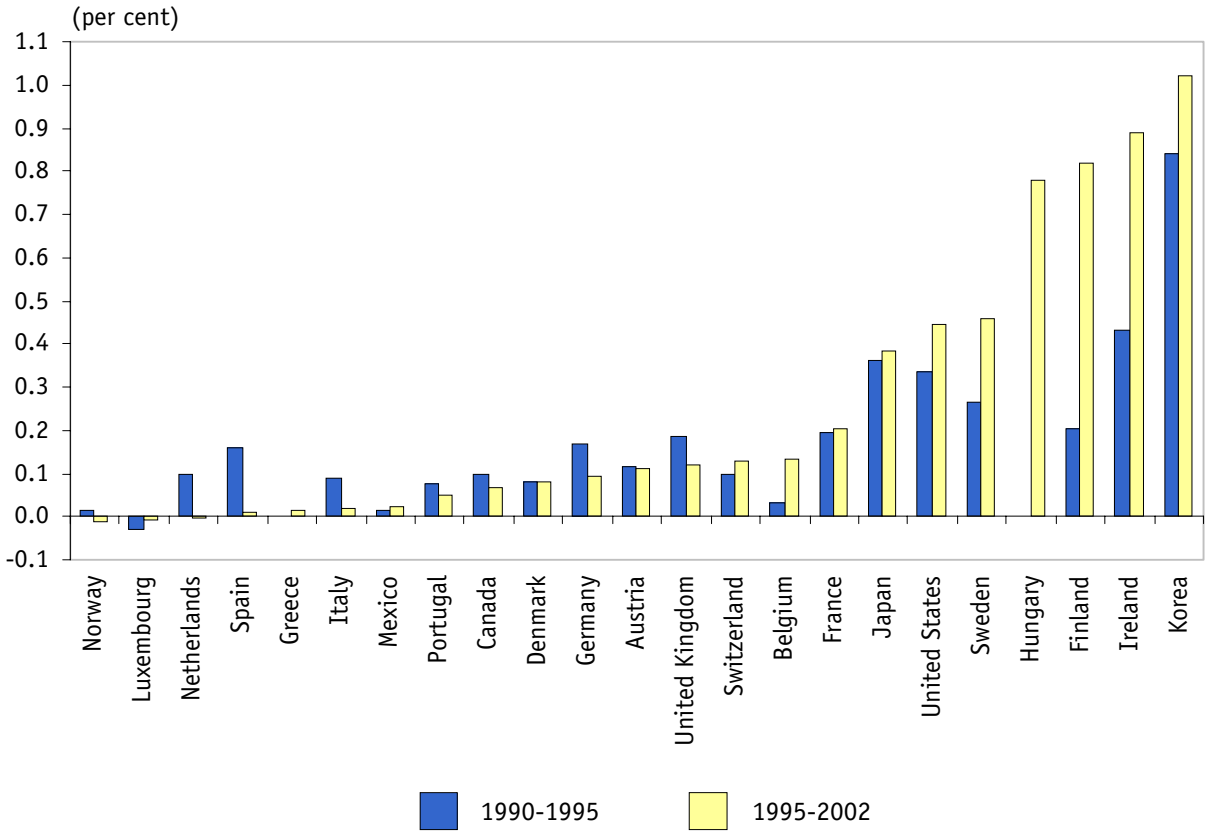
5 The MFP estimates in Chart 5 are not adjusted for labour composition. Moreover, for some countries, software investment may be underestimated (Ahmad, 2003). Adjusting for both factors would lead to a smaller contribution of MFP to total GDP growth.

6 Chart 6 shows the contribution of these sectors to labour productivity growth, since data for capital input by industry are only available for some OECD countries. However, the contribution of the ICT-producing sector to MFP growth is considerable in some countries where data are available, e.g. Finland, Japan and the United States (Pilat and Wölfl, 2004).

**Chart 6**

**Contribution of ICT Manufacturing to Aggregate Labour Productivity Growth**

(total economy, value added per person employed, contribution in percentage points per year)




Note: 1991-1995 for Germany; 1992-95 for France and Italy and 1993-1995 for Korea; 1995-99 for Korea and Portugal, 1995-2000 for Ireland, Spain and Switzerland, 1995-2001 for France, Germany, Hungary, Japan, Mexico, the Netherlands, Norway, Sweden, the United Kingdom and the United States.

Source: Estimates on the basis of the OECD STAN database, September 2004. See Pilat and Wölfl (2004) for details.

The ICT-producing services sector, notably the telecommunications sector, also made an important contribution to aggregate productivity growth in certain OECD countries over the second half of the 1990s (Pilat and Wölfl, 2004). Partly, this is linked to the liberalization of telecommunications markets and the high speed of technological change in this market. Some of the growth in ICT-producing services is also due to the emergence of the computer services industry, which has accompanied the diffusion of ICT in OECD countries.

### A high level of firm dynamics can boost productivity growth

MFP also reflects the effects of competition. Analysis of productivity growth at the firm level shows that the impacts of competition, such as the entry and exit of firms and changes in market shares, are important drivers of productivity growth (OECD, 2003a). New firms may use a more efficient mix of labour, capital and technology than existing firms, which in the long term has a positive effect on MFP growth. This is particularly true of industries that have grown rapidly in response to the new technological

opportunities, such as the ICT sector, where new firms play a key role (Brandt, 2004). In contrast, growth in mature industries is typically driven by productivity growth within existing firms or by the exit of obsolete firms.

This factor might potentially also help explain low MFP growth in certain OECD countries. Some evidence is available on this issue, both from previous OECD work (OECD, 2003a), from more recent OECD work, based on a new dataset from Eurostat (Brandt, 2004), and from a recent study by Bartelsman and De Groot (2004). The first two studies suggest that rates of firm creation and destruction in OECD countries are fairly similar, in particular after they have been adjusted for differences in the composition of the economy. Moreover, the available estimates show that the entry and exit of firms made a sizeable contribution to MFP growth in the early 1990s (OECD, 2003a). Evidence for Canadian manufacturing, using a slightly different breakdown of productivity growth, shows that plant turnover accounts for half of total productivity growth (Baldwin and Gu, 2004).

While firm creation as such does not appear to be a problem for MFP growth in many OECD countries, the growth of firms once they have been created appears problematic in many European countries. Compared with the European Union, the United States appears to be characterized by: a smaller (relative to the industry average) size of entering firms; a lower labour productivity level of entrants relative to the average incumbent; and a much stronger (employment) expansion of successful entrants in the initial years which enables them to reach a higher average size (OECD, 2003a). These differences in firm performance can only partly be explained by statistical factors or differences in the business cycle (OECD, 2003a; Brandt, 2004), and seem to indicate a greater degree of experimentation amongst entering firms in the United States. U.S. firms take higher risks in adopting new technology and opt for potentially higher results, whereas European firms take fewer risks and opt for more predictable outcomes. This is likely related to differences in the business environment between the two regions; the U.S. business environment permits greater experimentation partly because barriers to entry and exit are relatively low, in contrast to many European countries. Barriers to entrepreneurship in Canada are among the lowest in the OECD area (Conway, Janod and Nicoletti, 2005), suggesting that this may not be a problem for Canada.

A recent study by the Netherlands Ministry of Economic Affairs (2004), drawing on work by Eric Bartelsman, further adds to this evidence. It finds that the top U.S. performers are not only more productive than equivalent European firms, but also that they account for a larger share of total employment, and thus contribute to a substantial part of the overall productivity difference. This top quartile of U.S. firms also grows faster than other quartiles, and than the top European quartile. Moreover, the U.S. manufacturing sector is characterized by negative employment growth in the bottom quartile of the productivity distribution, which implies that its least productive companies are losing resources. In contrast, the EU countries are characterized by positive employment growth in the bottom quartile.

These findings demonstrate that a dynamic business environment, i.e. one that fosters firm creation and efficient resource reallocation, is important for good growth performance. A striking feature of the U.S. economy in the 1990s was the large number of new firms that was created. In conditions of rapid technological change, such firms have an advantage in that they can come on to the market with the latest technology and hope to benefit from both the cost advantage that this gives them and strongly rising demand in the early phases of the product cycle. There are risks as well as benefits, of

course, as high entry rates go hand-in-hand with high exit rates. But provided that the barriers to both entry and exit are low, that innovation is rewarded and that displaced human and capital resources can be quickly re-allocated, this continuing process of creative destruction brings strong productivity gains. In turn, this requires an environment in which entrepreneurship is respected and encouraged. The ease and speed with which new firms can be created varies strikingly between OECD countries, while bankruptcy legislation can have an important impact on the speed with which resources can be re-allocated as well as on the willingness of managers to invest in risky but possibly very rewarding projects (OECD, 2001 and Brandt, 2004).

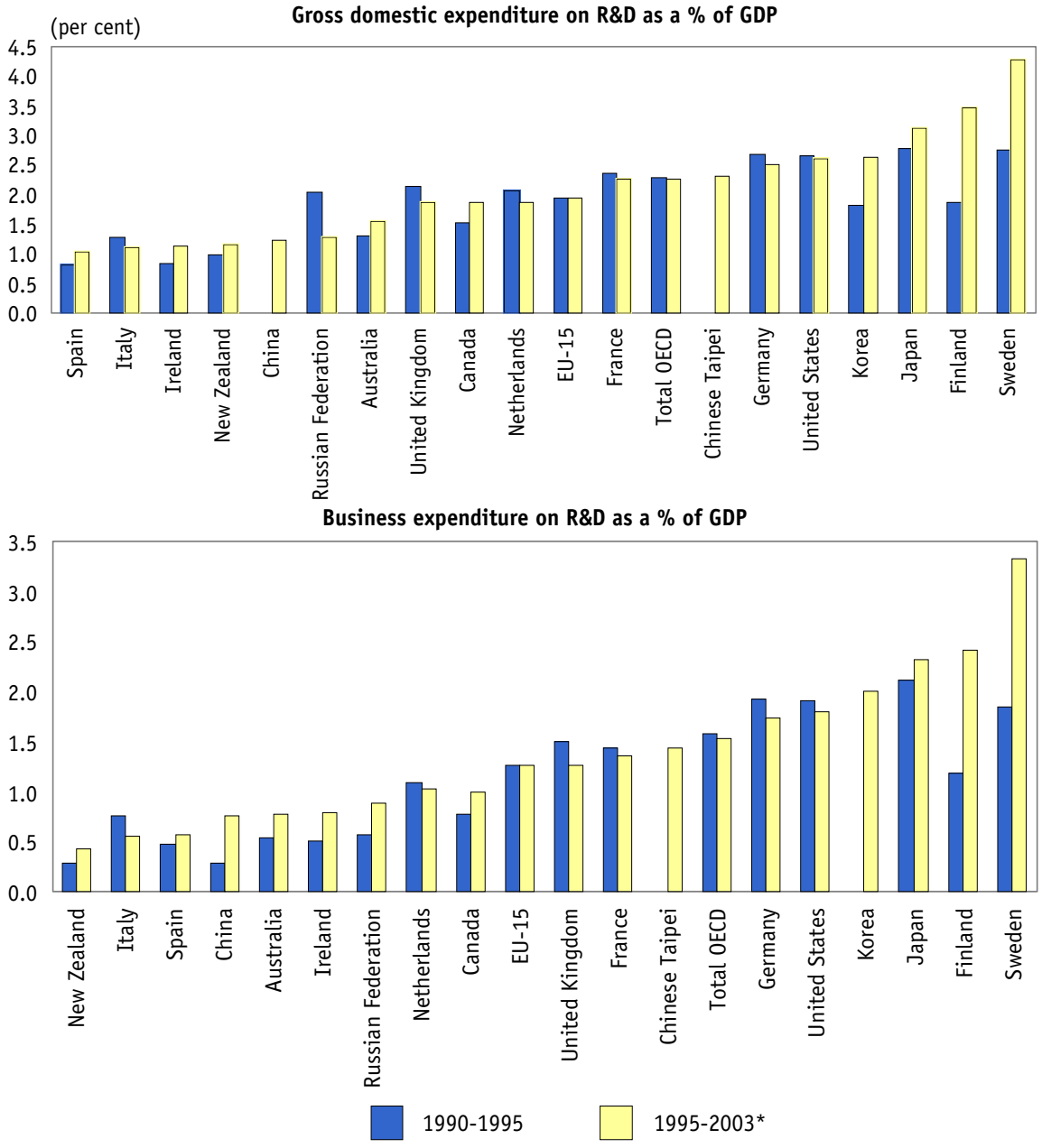
### Making innovation more effective

Innovation is the third important driver of MFP growth (Guellec and van Pottelsberghe de la Potterie, 2001 and Donselaar, Erken and Klomp, 2004). Foreign research and development (R&D) is particularly important for most OECD countries, since the bulk of innovation and technological change in small countries is based on R&D that is performed abroad. But domestic R&D, i.e. business, government and university research, is also an important driver of MFP growth. It is also the key in tapping into foreign knowledge; countries that invest in their own R&D appear to benefit most from foreign R&D as they are better able to absorb foreign knowledge. OECD countries and regions have had different experiences in the role of R&D over the past decade, however (Chart 7 and OECD, 2004b). In Canada, R&D intensity has increased considerably over the past decade, to a level close to that of the European Union. These R&D patterns mainly reflect the development of business R&D; in the United States, government R&D declined over the past decade, mainly due to lower spending on defence R&D, while it increased only slightly in Japan.

Changes in business R&D are affected by a broad range of factors (Guellec and Ioannidis, 1997), including growth in business GDP and changes in interest rates as well changes in government funding of business R&D. Structural factors also play a role for total R&D spending, notably the contribution of high-technology sectors, such as the ICT-producing sector. The average size of firms in different economies also plays a role; in many OECD countries, a limited number of large firms accounts for the bulk of business R&D. In countries such as Finland, Japan, Korea, Sweden and the United States, firms with other 500 employees account for over 80 per cent of total business R&D; the corresponding share for Canada is under 70 per cent (OECD, 2004b). The differences in business R&D of the main regions should therefore be seen in the light of such structural differences and broader economic developments (Sheehan and Wyckoff, 2003).

In their drive to boost innovation, several OECD countries, including the European Union, have introduced formal R&D targets over the past decade (Sheehan and Wyckoff, 2003). While doubts can be raised about the usefulness of such targets for economic growth, achieving R&D targets typically primarily involves increases in business R&D (Chart 7). Indeed, in most of the countries with high R&D intensity, the business sector is the main source of R&D, with much of this concentrated in a number of high-technology sectors and in a number of large, often multinational, firms. Increasing business R&D thus has close links with broader structural changes in economies, and is therefore not an objective that can be achieved in isolation. Moreover, R&D targets have important implications on human resource policies for researchers, as wages account for the bulk of R&D costs. Cultivating, attracting and retaining high-skilled workers is thus important, as are policies to make a country more attractive for investment in inno-

**Chart 7**
**R&D Intensity by Country and Main OECD Region, 1990-2003***




* Or nearest available year, see source for details.
Source: OECD, *Main Science and Technology Indicators 2004-2*, December 2004.

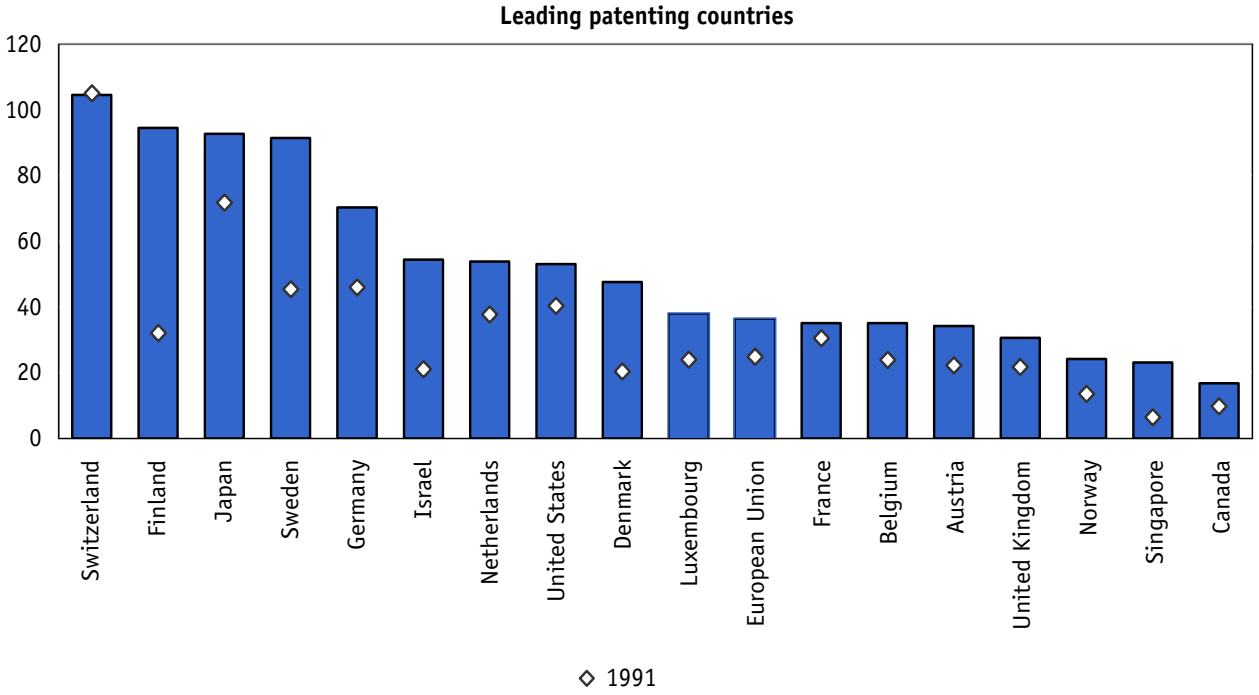
vation and R&D, including foreign direct investment (Sheehan and Wyckoff, 2003). In the Canadian context, R&D by foreign affiliates accounts for about 30 per cent of total business expenditure on R&D (OECD, 2004b).

Expenditure on R&D primarily reflects an input into innovation, however, and is not a measure of innovation output. Chart 8 shows how different OECD countries perform in terms of triadic patents, i.e. patents to protect a

**Chart 8**

**Number of Triadic Patent Families per Million Population**

(according to the residence of the inventors, for priority year 2000)




Patents all applied for at the EPO, USPTO and JPO. 2000 figures are estimates.
Source: OECD, Patent Database, September 2004.

single invention that are taken in the three main patent offices, notably the European Patent Office (EPO), the U.S. Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO). The graph shows that most OECD countries have experienced a growth in innovation according to this indicator over the 1990s. Canada ranks as the last of these 18 leading patenting countries, but has more triadic patents per million population than countries such as Australia, Ireland or Korea.

Innovation is not just about R&D and much innovation is of a non-technological nature. Such process innovation is particularly important in the services sector, where lack of innovation can contribute to low MFP growth. For example, turning investment in fixed capital, such as ICT, into more rapid productivity growth is closely associated with innovation in products and processes (OECD, 2003a). Regulatory barriers and lack of international trade in services are particularly important constraints for innovation in services, as competition can provide powerful incentives for firms to enhance performance and gain an edge on other firms. Several OECD governments are currently considering whether and how they can broaden their innovation policies to incorporate innovation in services (OECD, 2004b).

Insufficiently developed links between science and industry are another factor limiting innovation in several OECD countries. Innovation in key sectors such as biotechnology, in particular, is closely linked to advances in basic science. Interaction within the innovation system, notably between science and industry, has grown in recent years. Nevertheless, there are considerable differences among OECD countries in the extent to

which innovation draws on science. The growth in science-industry links over the 1990s, as measured by patent citations, has been much more rapid in the United States, Canada, the United Kingdom and Australia than in France, Germany or Japan (OECD, 2002). Policy plays a role in explaining these cross-country differences. In the United States, for example, the linkages have been strengthened by initiatives in the 1980s and 1990s, like the extension of patent protection to publicly funded research, and the introduction of co-operative research and development agreements to facilitate technology transfer from the public sector to private industry.

### Seizing greater benefits from the use of ICT

The fourth factor possibly affecting MFP that can be identified is the use of ICT in the production process. This effect can be interpreted in several ways. For example, ICT may help firms gain market share at the cost of less productive firms, which could raise overall productivity. In addition, the use of ICT may help firms to expand their product range, to customize the services offered, to respond better to client demand, or in short, to innovate. Moreover, ICT may help reduce inefficiency in the use of capital and labour, e.g. by reducing inventories. The diffusion of ICT may also help establish ICT networks, which can give rise to spill-over effects.

In recent years more evidence has emerged that ICT use can indeed help raise MFP growth. First, certain ICT-intensive services, such as wholesale and retail trade and finance, have experienced an above-average pick-up in labour productivity growth in recent years, e.g. in Australia and the United States, but to a lesser extent also in Canada (Pilat and Wölfl, 2004 and Chart 9). Second, there is growing evidence at the firm level from a wide range of studies in many OECD countries that ICT can help to improve the overall efficiency of capital and labour (OECD, 2004a). Third, there is evidence for a few countries, notably Australia and the United States, that certain ICT-using industries have also experienced a strong improvement in MFP growth in recent years (Gretton, Gali and Parham, 2004 and Bosworth and Triplett, 2003).

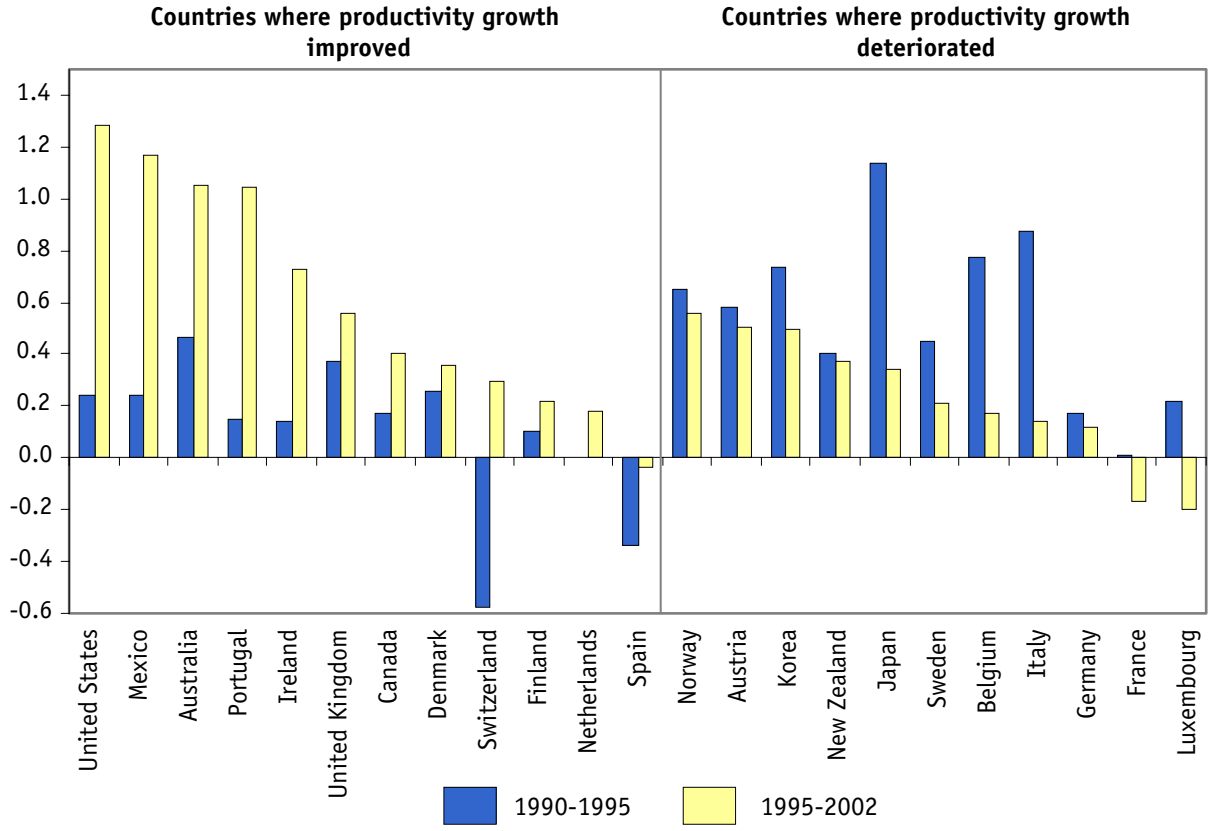
For many other OECD countries, firm-level studies have shown that ICT use can have positive effects on productivity (OECD, 2004a). However, in most of these countries, these benefits are not yet very visible at the sectoral level, which suggests that some of the conditions for this investment to become effective in improving aggregate productivity growth may not yet have been fully established. For example, ICT networks in many OECD countries may not yet have been sufficiently diffused, or for a sufficiently long period, and companies may therefore not yet have been able to achieve large productivity returns from their investments. Given the relatively high rate of diffusion of ICT networks at this time (OECD, 2003c), this explanation would imply that the returns of ICT investment on productivity might still emerge in the near future (Leung, 2004).

However, this is not the only possible explanation. There is some evidence from cross-country comparisons of the productivity impacts of ICT that the firm-level impacts of ICT may be smaller in European countries such as Germany than in the United States (Haltiwanger, Jarmin and Schank, 2003). Productivity gains in ICT-using services might be smaller since the necessary complementary investments, e.g. in organizational change, skills and innovation, have not occurred to a sufficient degree. The lack of such changes in many OECD countries could be due to difficulties in changing organizational set-ups linked to relatively strict employment protection legislation, in particular for regular employment (De Serres, 2003). Another factor limiting the gains from ICT, already discussed

**Chart 9**

**Contribution of ICT-using Services to Aggregate Labour Productivity Growth, 1990-95 and 1995-2002**

(total economy, value added per person employed, contributions in percentage points per year)




Note: ICT-using services are defined as the combination of wholesale and retail trade (ISIC 50-52), financial intermediation (ISIC 65-67) and business services (ISIC 71-74). See Chart 6 for period coverage. Data for Australia are for 1995-2001.

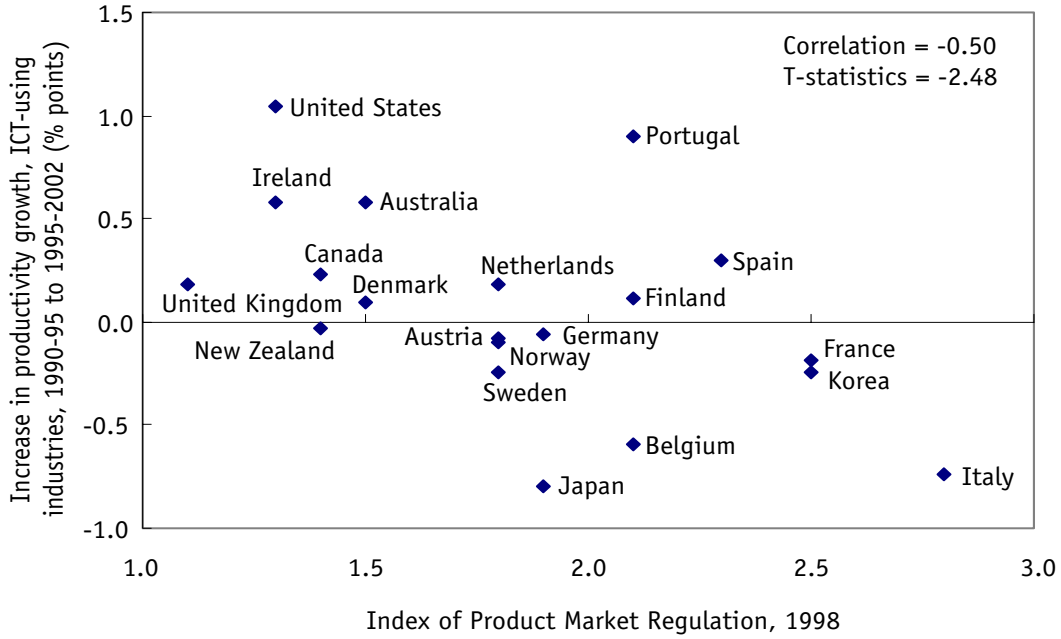
Source: Estimates on the basis of the OECD STAN database, September 2004. See Pilat and Wölfl (2004) for details.

above, may be lack of complementary process innovation in the service sector (OECD, 2003b). Innovation is important since users of ICT often help make their investments more valuable through their own experimentation and innovation, e.g. the introduction of new processes, products and applications. Without this process of "co-invention", which often has a slower pace than technological innovation, the economic impact of ICT could be more limited.

The aggregate impacts of ICT might also be smaller in Europe if firms that succeed in increasing productivity thanks to their investment in ICT do not grow sufficiently to gain market share. The U.S.-Germany comparison highlighted above suggested that U.S. firms had much greater variation in their productivity outcomes than German firms, with some U.S. firms experiencing very strong productivity gains from ICT (Haltiwanger, Jarmin and Schank, 2003). This may be because U.S. firms engage in much more experimentation than their German counterparts; they take greater risks and opt for potentially higher outcomes. Lack of competition and lack of new firm creation in ICT-using services may also play a role. Competition is important in spurring ICT investment as it forces firms to seek ways to strengthen perfor-

**Chart 10**

**Relationship Between Growth in the Contribution of ICT-using Services to Aggregate Productivity Growth and the State of Product Market Regulation**




Source: Productivity growth in ICT-using services from Chart 9, product market regulation from Conway, Janod and Nicoletti (2005).

mance relative to competitors. In addition, newly created firms are often the first to take up new technologies; a lack of new firm creation and a lack of subsequent growth of these firms may therefore also be linked to poor performance in turning ICT investment into productivity gains.

Product market regulations may also play a role as they can limit firms in the ways that they can extract benefits from their use of ICT and reduce the incentives for firms to innovate and develop new ICT applications. For example, product market regulations may limit firms' ability to extend beyond traditional industry boundaries. The impact of product market regulations on ICT investment is confirmed by several studies. For example, OECD countries that had a high level of regulation in 1998 have had lower shares of investment in ICT than countries with low degrees of product market regulation (Gust and Marquez, 2002 and OECD, 2003b). Moreover, countries with a high degree of product market regulation have not seen the same pick-up in productivity growth in ICT-using services than countries with low levels of regulation (Chart 10).

Seizing the benefits from ICT therefore crucially depends on complementary investments in organizational change, skills and innovation (OECD, 2003b). These investments and changes, in turn, require a business environment that is sufficiently flexible for firms to make the necessary changes. Many OECD countries still require further reform of product and labour markets to foster such an environment.

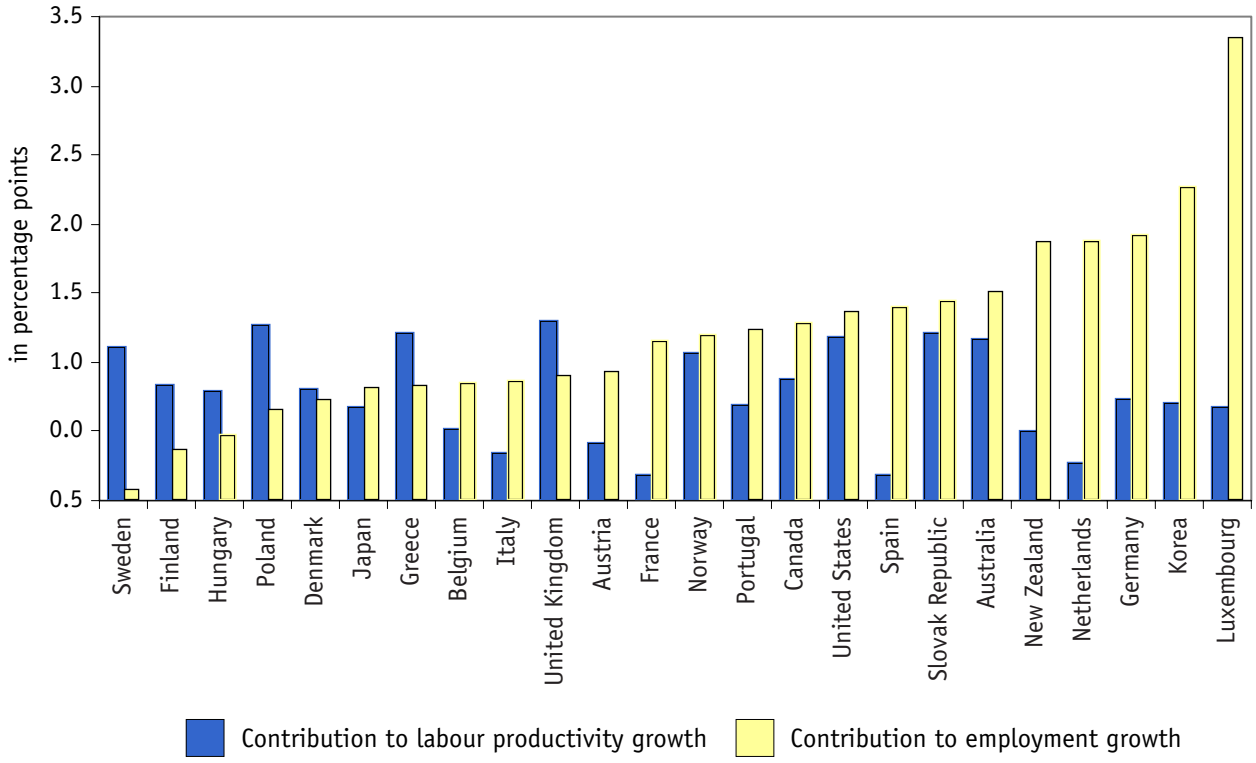
### The role of services

More attention has recently also focused on the contribution of services to productivity growth, primarily because of the growing

**Chart 11**

**Contribution to Aggregate Productivity and Employment Growth of the Services Sector, 1990-2002**

(average annual contribution in percentage points per year)




Source: OECD STAN database, 2004.

weight of this sector in OECD economies. Canada takes an intermediate position in OECD countries as regards the contribution of services to productivity and employment growth (Chart 11 and Wölfl, 2005). In certain countries, such as Korea, New Zealand and the Netherlands, services have made an important contribution to employment growth over the past decade, but a relatively small contribution to productivity growth. In a few others, such as Greece, Poland and the United Kingdom, the contribution of services to productivity growth has been larger than their contribution to employment growth. In yet another group of countries, including Australia, Canada, the Slovak Republic and the United States, services have made important contributions to both employment and productivity growth.[7]

Over time, the contribution of services will have to grow in many OECD countries, as the manufacturing sector will decline and manufacturing firms will slowly be turned into services firms. Moreover, a productive and competitive services sector is also important to underpin the performance of the manufacturing sector. The growing importance of services makes it important to implement policies that take account of the growing contribution of this sector to aggregate performance. Regulatory reform and openness to trade and foreign direct investment in

7 The contribution of services to employment growth may reflect different starting points; for example, Finland and Sweden already have a considerable part of the population employed in the services sector.

services are of great importance in this regard, as the services sector is traditionally less exposed to competitive pressure than the manufacturing sector. In the case of Canada, restrictions on FDI in the services sector remain relatively high compared to other OECD countries (OECD, 2004c and 2005).

Better product market regulation and a more competitive environment can speed up the adoption of new technologies in the services sector and, more generally, the process of innovation and growth. It is also important to consider whether existing policies may have an implicit policy bias against services. For example, government policies for R&D and technology diffusion are often primarily focused on the manufacturing sector and are not always suitable for addressing the specific needs of the services sector.

Enhancing the understanding of the services sector is important since the recent experience of countries such as the United States and Australia shows that this sector can be a dynamic source of growth, notably through the effective application of ICT, organizational change and upgrading of skills. Moreover, with the slow decline of the manufacturing sector throughout the OECD area, the services sector becomes increasingly important for aggregate employment and productivity growth. To address these issues, the OECD is currently engaged in a project on the economic performance of the services sector, and the policies that can help foster growth of employment and productivity. The results of this work will be presented to the OECD Ministerial meeting in 2005.

## Concluding Remarks

This article has revisited some of the previous OECD work on productivity and economic growth and brings together some further evidence at the aggregate, industry and firm level. It also points to some of the factors that have influenced the diversity in growth performance of OECD countries over the past years. There are obviously other factors that may have contributed to higher growth in the 1990s, and it will take further research to understand better why Australia, Canada, the United States and some other countries did so well over this period. One important driving factor may have been the increased level of competition in many OECD countries, due to regulatory reform and greater openness to international trade and investment. This has likely increased the incentives for firms to increase overall efficiency, and may also have facilitated the diffusion of new technologies, including ICT, and knowledge more broadly.

As regards the position of Canada in international productivity performance, this article demonstrates that Canada has been among the strongest performers in the OECD area over the 1995-2003 period. While it has not grown quite as fast as top performers such as Australia, Ireland and Finland, it has grown more rapidly than many other OECD countries. Canada is also among the few OECD countries that have been able to combine rapid productivity growth with strong employment creation. One of the factors underpinning this performance has been strong capital deepening, in both ICT and non-ICT capital. Another factor is Canada's excellent level of human capital, which according to some studies has gained in importance in recent years (Gu and Wang, 2004).

The most important driver of the pick-up in growth performance in Canada from 1995 to 2003 appears to be strong multifactor productivity growth, however. While it is not possible to quantify which factors have been responsible for this pick-up, some are likely to have played a role. First, as in many other OECD countries, Canada has benefited from rapid technological progress in the ICT-producing sector. However, this factor plays only a small role in Canada,

since Canada does not have a large ICT-producing sector, in contrast to the United States. There are benefits and drawbacks of a strong reliance on such a sector, however, as Canada has not been as much affected by the heavy turbulence in parts of this sector as the United States.

Second, there are some indications that Canada has benefited from strong MFP growth in ICT-using services, notably retailing. However, this pick-up has thus far been smaller than in the United States or Australia. The productivity benefits of ICT in these sectors might still come in the future, although it is also possible that there are some factors that – to some extent – prevent ICT-driven structural change in Canada, such as restrictions on FDI in services (OECD, 2005).

Third, as in several other OECD countries, investment in business R&D has increased in Canada over the past decade, which may have had positive impacts on MFP growth. Nevertheless, Canada continues to lag many OECD countries in innovative performance and may have some scope for further catch-up. On the other hand, Canadian investment in R&D is unlikely to catch up with the R&D intensity recorded for some other OECD countries, as it is limited by the structural composition of the economy – i.e. without a large high-tech industry – and by a relatively small average firm size.

Fourth, as pointed out in several studies, firm dynamics play an important role in productivity growth and are considered to have made an important contribution to Canadian productivity growth. It is not clear from the available international evidence to what extent Canadian performance in this area is exceptional, although Canada has among the lowest barriers to firm creation among OECD countries (Conway, Janod and Nicoletti, 2005).

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