Centre for the
Study of Living Standards
Centre d'étude des
niveaux de vie

111 Sparks Street, Suite 500
Ottawa, Ontario K1P 5B5
613-233-8891, Fax 613-233-8250
csls@csls.ca

Future Productivity Growth in Canada and Implications for the Canada Pension Plan

Andrew Sharpe
Executive Director

CSLS Research Report 2006-01-E

April 2006

Report prepared for the Seminar on Demographic, Economic and Investment Perspectives for Canada: Years 2006 to 2050, Conference Centre, Ottawa, Ontario, March 24, 2006, organized by the Office of the Chief Actuary.

Future Productivity Growth in Canada and Implications for the Canada Pension Plan

Abstract

This is organized into three main parts. The first section provides a perspective on future productivity growth in Canada. It discusses key productivity concepts, looks at current productivity trends, examines the forces affecting future productivity growth, and reviews productivity projections in Canada and the United States. The second section discusses the relationship between productivity growth and the real earnings of workers, and examines the implications of different productivity assumptions for CPP financial projections. The third part examines the relationship between productivity growth and other key variables affecting CPP financial projections, namely the real rate of return on investments, price increases, participation rates, retirement rates, migration rate, mortality rate, fertility rate, and disability rates.

Future Productivity Growth in Canada and Implications for the Canada Pension Plan[1]

Introduction

The Canada Pension Plan (CPP) is one of the most important components of Canada's social safety net. Its sustainability is crucial for the future economic well-being of Canadians. Productivity is well recognized as the key determinant of future income growth in Canada. It represents our economic destiny. The objective of this paper is to examine the implications of future productivity growth paths for the financial position and sustainability of the CPP.

This report is organized into three main parts. The first section provides a perspective on future productivity growth in Canada. It discusses key productivity concepts, looks at current productivity trends, examines the forces affecting future productivity growth, and reviews productivity projections in Canada and the United States. The second section discusses the relationship between productivity growth and the real earnings of workers, and examines the implications of different productivity assumptions for CPP financial projections. The third part examines the relationship between productivity growth and other key variables affecting CPP financial projections, namely the real rate of return on investments, price increases, participation rates, retirement rates, migration rate, mortality rate, fertility rate, and disability rates.

Before beginning the discussion, it is useful to provide the reader with some background information on the CPP, which will be essential for understanding the subsequent discussion. Contributions or premiums to the CPP are currently based on the earnings of workers at a rate of 4.95 per cent for both the employee and employer up to the level of maximum pensionable earnings ($42,100 in 2006). With a fixed contribution rate, overall contributions rise with increases in average nominal earnings, as well as with employment growth. Changes in average nominal earnings reflect both inflation and real earnings gains. Real earning growth in turn is driven by labour productivity growth. From this perspective, the future trend in productivity growth is a very important variable for the Office of the Chief Actuary to monitor, understand, and project as it affects CPP contributions.

It is important to note that, in contrast to earnings, total CPP benefits (in addition to reflecting the benefit structure and the number of eligible beneficiaries) are indexed to the rate of inflation, as proxied by the Consumer Price Index, and not to changes in nominal earnings.[2] Historically, nominal earnings have outpaced inflation by the rate of labour productivity growth.

---

[1] The author would like to thank Jean-Claude Ménard Michel Millette,and Michel Montambeault from the Office of the Chief Actuary for answering numerous questions related to the preparation of this paper. He would also like to thank Ernie Stokes from the Centre for Spatial Economics, Carl Sonnen from Informetrica Ltd. and Pedro Antunes from the Conference Board of Canada for provision of information on long-terms projections, and Jean-Francois Arsenault and Peter Harrison for research assistance. Finally, the author would like to thank participants in the Seminar on Demographic, Economic, and Investment Perspectives for Canada: Years 2006-2005 held March 24, 2006 in Ottawa for comments.

[2] In contrast, in the United States social security benefits are indexed to nominal wages. One proposal debated in 2005 in the context of the proposed reform of US social security was the introduction of a progressive indexing scheme whereby benefits for most social security beneficiaries would be indexed to prices, but wages. For a critique of this scheme, see Stiglitz (2005), who argues that the currently retired have a right to benefit from rising productivity and real wage gains.

With positive productivity growth, average CPP benefits paid out, as a proportion of average earnings, will fall. This provides a significant degree of freedom for CPP financial sustainability. The greater the productivity growth, the larger this degree of freedom.

I Perspectives on Future Productivity Growth in Canada

This section of the paper provides an overview to issues related to future productivity growth in Canada. It first examines which aggregate productivity measure (e.g. labour versus total factor productivity, output per worker versus output per hour, total economy versus business sector) is most appropriate from the point of view of CPP projections and review Canada's historical aggregate labour productivity performance up to 2005. It will then discuss the factors or scenarios that will affect productivity growth in Canada in the 2006-2078 period. These factors include, among others, demographic shifts, the pace of technological change, capital accumulation, relative factor prices, human capital investments, and commodity prices. A number of projections of long-term productivity growth by Canadian economic forecasters (e.g. Finance Canada, Centre for Spatial Economics, Informetrica, University of Toronto) are also presented.

Basic Productivity Concepts

Three productivity concepts and definitions are of particular relevance to discussion of the productivity assumptions used in CPP financial projections: labour versus total factor productivity; total economy versus business sector productivity; and hours-based versus persons-employed based measures of productivity. This section briefly discusses these concepts.[3]

Labour productivity, defined as output per unit of labour input, is the most widely used definition of productivity. But many economists prefer the concept of multifactor productivity (also called total factor productivity), which relates output to more than one input, generally labour and capital. Labour productivity growth, which is always measured in real terms, can be decomposed into two components, changes in capital intensity or the capital-labour ratio (also called capital deepening) and changes in multifactor productivity, which captures the effect of a number of factors including technical change, measurement error, economics of scale, and capacity utilization.

Some labour productivity projections are derived from independent projections for the capital-labour ratio (in turn based on projections for labour input and capital stock) and for multifactor productivity. Other labour productivity projections make no explicit or implicit use of the capital-labour ratio or multifactor productivity in their formulation. It appears that the labour productivity assumption or projection (i.e. the real wage differential) used in CPP financial projections is not based on independent capital-labour ratio and multifactor productivity projections.

Aggregate productivity growth, which is the concept of relevance for CPP productivity projections, can be defined in terms of the total economy or the business sector. The official productivity estimates produced by Statistics Canada (and by the Bureau of Labor Statistics in

[3] For a comprehensive discussion of productivity definitions and concepts, see Sharpe (2002) and Rao and Sharpe (2002).

the United States) are for the business sector, not the total economy. Productivity growth for the non-business sector (public administration and the non-marketed components of education and health and comprising around 80 per cent of total GDP) is by definition zero or near zero since real output is not directly measured by market prices and must be proxied by labour input. For this reason, Statistics Canada prefers to exclude the non-business sector from aggregate productivity estimates. Finance Canada, on the other hand, prefers the total economy measure of productivity as macroeconomic forecasting models use the total economy for estimating potential output and for measuring and decomposing GDP per worker and GDP per capita.[4]

Because of the near zero or low productivity growth in the non-business sector, total productivity growth is normally less than business sector productivity growth.[5] Labour productivity projections are made by different organizations for both the total economy and the business sector. It is always important to specify which, given the upward bias to business sector productivity growth relative to that for the total economy. The labour productivity assumption used in the CPP financial projections refers to the total economy. Given the economy-wide nature of the CPP, and the closer relationship between real wages and total economy productivity growth than with business sector productivity growth, this definition of aggregate productivity is the appropriate one.

Labour productivity can be defined on an hours-worked basis or on a persons-employed or worker basis. The two measures of labour productivity will differ when the two measures of labour input grow at different rates, due, for example, to a fall in total annual hours worked reflecting longer vacations or fewer hours worked per week. Indeed, over the 1973-2001 period in Canada, growth in output per hour in the business sector was 0.20 percentages point faster than growth in output per worker (1.40 per cent versus 1.20 per cent) because of the 0.20 point fall in average hours (Sharpe, 2002:32). Because hours worked reflects more accurately the actual amount of labour time expended than the number of workers, output per hour is preferred over output per worker as a measure of labour productivity.

Labour productivity projections are made on both a per-hour and per-worker basis. As there is currently little trend in average working time, there is little difference in the projections. The productivity assumption for CPP financial projections appears to be on a per worker basis. This assumption is used (with the CPI Increase) for the indexation of Yearly Maximum Pensionable Earnings (YMPE). Since YMPE is based on Average Weekly Earnings, a wage measure not based on hours worked, it appears appropriate for the Office of the Chief Actuary to define labour productivity on a worker basis.

Current Productivity Trends

In principle, a full understanding of past and current productivity trends and determinants would be useful, indeed necessary, to make well-founded and reliable projections of future

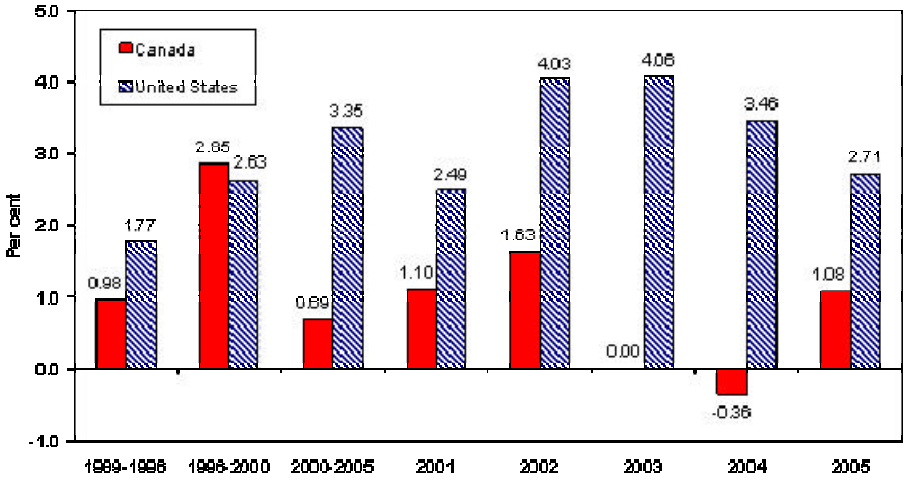
[4] For a detailed discussion of the advantages and disadvantages of the two definitions of aggregate productivity as well as a comparison of trends in the two measures, see Smith (2004).

[5] Smith (2004: 50) shows that over the 1981-2003 period, business sector output per hour grew at a 1.42 per cent average annual rate in Canada, compared to a 1.34 per cent rate for the total economy. Output per hour growth of 1.12 per cent in the non-business sector accounts for this divergence. In the United States the discrepancy was much greater: 2.18 per cent for the output per hour growth in the business sector versus 1.72 for the total economy due to non-business sector growth of only 0.15 per cent.

productivity growth. But given the complex nature of productivity growth, economists cannot claim to completely understand past or current productivity trends. For example, economists are still debating the causes of the post-1973 productivity slowdown, a phenomenon that affected nearly all developed countries. Despite economists' ignorance of the causes of long-term productivity fluctuations, it is nevertheless very important to monitor and to attempt to understand these developments, with the hope that even a partial understanding will contribute to more meaningful and reliable productivity projections.

Two key productivity developments have taken place in Canada over the past decade. The first is the acceleration in labour productivity growth that occurred in the second half of the 1990s. The second is the post-2000 fall-off in productivity growth. From 1989 to 1996, business sector output per hour growth in Canada advanced at a meager 0.98 per cent average annual rate (Chart 1). Labour productivity growth then more than doubled to a 2.85 average annual rate in the 1996-2000 period, before falling off drastically to 0.69 per cent in the 2000-2005 period.

Chart 1: Business Sector Output per Hour Growth in Canada and the United States (average annual and annual rates of change, per cent)



Sources: Statistics Canada and US Bureau of Labor Statistics.

These developments have important implications for productivity projections in Canada. Did the 1996-2000 period herald in a new era of productivity growth based on information and communication technologies (ICT) comparable to the golden age of capitalism of the 1946-73 period when productivity growth (business sector output per hour) exceeded 4 per cent per year (Sharpe, 2002:32)? Is the slow productivity growth since 2000 a temporary development related to special factors that will soon disappear as the higher trend productivity growth recorded in the second half of the 1990s reasserts itself. Or rather was the 1996-2000 period a transitory phase of

rapid productivity growth related to a one-time ICT investment boom and the post-2000 productivity deceleration the return to trend? If the former explanation is correct, then future productivity projections will be rosy. If the latter explanation is valid, then future productivity growth will be somber. Unfortunately, a definitive answer to these questions is not possible. Only time will tell.

Developments in the United States suggest that a new era of higher trend productivity has indeed emerged. Business sector output per hour in the United States accelerated to 2.63 per cent per year in the 1996-2000 period from 1.77 per cent in 1989-1996. Then, in contrast to the post-2000 productivity growth deceleration in Canada, productivity growth in the United States further picked up to a 3.35 per cent average annual rate in the 2000-2005 period. While the productivity growth acceleration in the second half of the 1990s could be largely accounted for by very strong growth in ICT capital services (Jorgenson, Ho, and Stiroh, 2005), this was not the explanation for the post-2000 productivity growth pick-up.

While this recent development is poorly understood, it could represent an upward shift in underlying or trend productivity growth as productivity-augmenting effects of ICT finally come into their own. As developments in the United States spillover to Canada, often with a lag, recent productivity trends south of the border may bode well for this country. Indeed, studies have shown that Canada lags the United States in the use of best practice technologies, but that the technological gap remains fairly constant over time. Thus a technological spurt in the United States eventually follows in Canada, keeping the gap constant. If the US productivity growth acceleration is indeed based on a faster pace of underlying technological change, this phenomenon will over time spill over into Canada through the importation of the latest US machinery and equipment and managerial practices, boosting productivity growth in this country.

Drivers of Future Productivity Growth in Canada

Productivity growth is determined by many factors, including among others capital accumulation, technological progress, human capital formation, composition shifts in output and employment, as well as the macroeconomic and microeconomic policy contexts (CSLS, 1998). This section discusses a number of scenarios for particular variables that influence productivity and the effect of these scenarios on long-term productivity growth in Canada.[6]

Scenarios favourable for productivity growth

The most important explanatory factor for future productivity growth in Canada is the rate of technological change. Rapid technological progress will boost productivity growth while slow technological progress will depress it. Unfortunately, it is extremely difficult to even measure technological progress and quantify its pace, let alone predict its time path. As noted above, it appears that the pace of technological progress has accelerated in the United States. As Canada tends to follow the United States with a lag, one might expect that productivity growth

[6] A comprehensive identification of all variables that affect productivity, and discussion of their probable future trends and implications for long-term productivity growth in Canada, while a worthwhile exercise in itself, is beyond the scope of this paper.

will pick-up in Canada because of the apparent acceleration in technological advance south of the border. But weak productivity growth in this country since 2000 has been a very disappointing development.

It is also important to note that technological progress appears to arrive in waves of innovation which over time peter out and then reappear. The Kondratieff, or long wave cycle, for example, consists of 25 years of strong economic and productivity growth fuelled by rapid technological change followed by 25 years of weak growth as the productivity-augmenting effects of the new technologies are depleted. Thus even if technological progress is rapid for the next 25 years, from a 50-year or 75-year perspective, which is the time horizon of CPP projections, if history is any guide, it will likely revert to the mean.

With the aging of the baby boom cohorts, the average age of the workforce in Canada is rising and will continue to rise until 2025 or 2030 by which time most of the baby boomers will have retired. The rate of growth of real wages is linked to general labour market demand conditions related to the overall strength of the economy rather than to labour force growth per se. Nevertheless, the slower rate of labour force growth because of the retirement of the very large baby boom cohorts in the 2010-2030 period, everything else being equal, could put upward pressure on wages and contribute to more rapid labour productivity growth, although the appearance of long-term generalized labour shortages is unlikely.

Growth in the human capital of the workforce is a key determinant of productivity growth. The share of the workforce with post-secondary education and the average number of years of educational attainment, have been rising in Canada for many years. With higher real wages rising due to slower labour force growth in the future, Canadians will have an additional incentive to invest in human capital, particularly if wages of the well educated increase as a faster pace than those of the poorly educated. The pace of labour quality improvement may accelerate, with favourable consequences for labour productivity growth.

Economists are in general agreement that economic policies that are market-oriented tend to have a greater positive impact on productivity than more interventionist policies (there are of course exceptions). Economic policy in Canada is already quite market-oriented by international standards, but there are areas where market forces could play a greater role in resource allocation. Consequently, an increase in the degree of market orientation could spur productivity growth in some sectors, although any societal costs of such policies would have to be taken into consideration in an overall assessment of the desirability of such action.

Productivity growth arises from both productivity growth within industries and the reallocation of workers between industries with different productivity levels. A faster pace of reallocation from industries or regions with below average productivity levels to industries or regions with above average productivity levels boosts aggregate productivity through composition effect. A scenario where this reallocation process is faster would see more rapid productivity growth. Better labour market information on employment opportunities and greater incentives for occupational and regional mobility could promote such a scenario.

Scenarios unfavourable for productivity growth

In recent years, Canada has experienced a natural resource boom. Perhaps surprisingly, this development has had a negative effect on labour productivity growth in the oil and gas sector (e.g. the amount of labour needed to produce a barrel of oil), even though nominal productivity (current dollar output per hour worked) has increased because of higher natural resource prices. This development reflects the fact that more marginal, less productive resources such as the oil sands have now become profitable. If the real price of natural resources continues to rise on world markets because of growing demand from developing countries such as China and India, greater amounts of labour and capital in Canada may be reallocated to natural resource industries, with a downward effect on physical productivity growth. But lower productivity growth arising from this source does not necessarily make Canada relatively poorer. The higher prices of exports improve Canada's terms of trade and national income. Productivity is not the only source of real income growth, although terms of trade improvements are likely not as sustainable a source of better living standards than productivity growth.

The relationship between productivity growth and environmental regulation is complex. Regulations often require additional resources for pollution reduction and consequently lower conventionally measured productivity growth. But if a measure of output that included adjustments for environmental improvements were used, then productivity growth might not be lower. The main environmental problem facing Canada and the world appears to be global warming arising from increased emissions of greenhouse gases. If large-scale measures were taken to reduce greenhouse gas emissions, it is possible that large parts of the Canadian economy would be significantly affected, with negative implications for productivity growth. This is more a risk to future productivity growth than a long-term factor that will inevitably exercise a downward influence on productivity.

For many years the share of employment, and to a lesser degree the share of nominal output, accounted for by service-producing industries has been rising, and that accounted for by goods-producing industries has been falling. This development largely reflects slower productivity growth in many service industries such as business services, health, and education (but not all service industries as certain ones such as trade and communications have enjoyed rapid productivity growth). It is likely that this trend toward increased service sector employment will continue. It appears to be more difficult to raise labour productivity levels, measured in physical terms, in many of the service industries with rising employment shares. This situation may exert some downward pressure on aggregate labour productivity growth.

Demographic trends are leading to the aging of the Canadian workforce. Some persons argue that this development will have a negative effect on productivity growth, because older workers are less productive than younger workers. The relative hourly productivity of workers by age is a complex issue. Arguments can be made to support both of the following views. Older workers (55-69) are considered less productive because of greater physical limitations, less energy, and less ability and willingness to learn new technologies. Alternatively, older workers are not considered less productive (and even more productive in certain situations) because of their accumulated contacts, experience, and wisdom. The bottom line is that the aging of the workforce in itself will likely have little effect on productivity as measured on an output-per-hour basis , but could reduce labour productivity measured on a per worker basis as older workers tend to work fewer hours than younger workers.

Exhibit 1 summarizes the above discussion on the different scenarios for future productivity growth in Canada. The bottom line is that unlike population projections for the current population, it is impossible to project with any degree of certainty future productivity growth. Cases can be made for both pessimistic projections and optimistic projections. The wild card is technological progress, which is the most important long-run determinant of productivity growth. The one development that will happen with certainty is the slower rate of labour force growth, although the impact on real wage growth, which in the long-run is much more driven by productivity growth than the size of the labor force, is uncertain. Nevertheless, the scenario of rising wages promoting higher labour productivity growth should likely be given a higher probability of occurrence than most of the other scenarios.

Exhibit 1: Scenarios for Future Labour Productivity Growth in Canada

Variable	Scenario	Expected Effect
Favourable		
Technological Progress	rapid pace of US technological spills over to Canada	higher productivity growth
Wages	slower labour force growth increases price of labour relative to capital	faster capital intensity and labour productivity growth
Labour Quality	higher wages encourage human capital investment	faster productivity growth
Economic Policy	increased market orientation of economic policy	somewhat faster productivity growth
Resource Allocation	faster reallocation of resources from declining to expanding regions and industries	stronger aggregate productivity growth
Unfavourable		
Natural Resource Prices	higher prices lead to exploitation of more marginal resources	lower productivity growth, offset by improved terms of trade
Increased Services Share in Employment	employment growth is concentrated in low-productivity -growth service industries	lower productivity growth
Environmental Regulation	global warming requires stringent control on greenhouse gas emissions	lower productivity growth, offset by higher quality environment
Aging Workforce	supposedly less productive workers 55 and over account for increasing share of workforce	possible small negative effect on productivity

Productivity Projections

Canada

As noted earlier, the 21st Actuarial Report on the CPP as of December 31, 2003 projects the real-wage differential (the CPP proxy for aggregate labor productivity growth measured on a worker basis) at 1.2 per cent from 2012 onwards. This was up from 1.1 per cent (from 2015 onwards) in the 18th Report Actuarial Report as of December 31, 2000. For the 2005-2012 period productivity growth is assumed to be 0.7 per cent per year. It is instructive to compare the CPP assumption with other long-term productivity projections. A major problem however is the CPP time horizon, which extends to 2078, is much beyond that used by other forecasters, whose horizons generally extends to only 2025 or 2030.

In the *Economic and Fiscal Update* that Finance Canada released in November 2005, private sector survey forecasts showed that labour productivity growth (real GDP per person employed derived from real GDP and employment forecasts) is expected to average 1.7 per cent from 2005 to 2010.

In the document *Plan for Growth and Prosperity* released with the *Update*, Finance Canada noted that labour productivity, defined as GDP per person employed, advanced at a 1.7 per cent average annual rate in 1997-2004. In a discussion of the impact of the aging population on living standards, Finance Canada projects productivity growth for the 2005-2029 period at the same 1.7 per cent. This is 0.5 percentage points faster than the productivity growth assumption used in the CPP financial projections.

The Policy and Economic Analysis Program at the Institute for Policy Analysis at the University of Toronto produces a long-term outlook for the Canadian economy through 2025 (Dungan and Murphy, 2006). This document released in February 2006 projects labour productivity growth, defined as real GDP per worker, to rise at 1.7 per cent per year for almost every year from 2006 to 2025 inclusive (the exceptions are 1.4 per cent in 2007 and 2008 and 1.8 per cent in 2010). The real average annual wages per employee (private sector) is projected to increase at 1.7 per cent, identical to the productivity forecast. Again, this projection is significantly higher than that used in the CPP projections, although the CPP projection applies to the 2006-2078 period and may not apply to the 2006-2025 period.

The Centre for Spatial Economics in 2005 did a long-term economic projection from 2005 to 2050 for the National Round Table on the Environment and the Economy. It projected growth of GDP per hour worked at 1.2 per cent per year for the overall period (and total factor productivity growth of 1.0 per cent). Productivity growth started at 1.5 per cent at the beginning of the period and then trended down to 1.0 per cent by the end of the period. This downward trend reflected an increasing share of service sector employment. The forecasting model assumed 1 per cent or less productivity growth for most service industries, compared to 2-3 per cent for goods industries. An alternative scenario with lower participation rates resulted in higher productivity growth as firms substituted more capital for labour because of very tight labour markets.

The Conference Board of Canada produces a long-term economic projections to 2025. It forecasts total economy labour productivity (real GDP per worker) to grow at a 1.6 per cent

average annual rate from 2006 to 2025, with the rate picking up to 1..8 per cent rate in the 2016-2025 period. It also produces a forecast for private non-farm productivity, which it sees advancing at a 1.7 per cent average annual rate in the 2006-2025 period (2.0 per cent in 2016-2025).

The forecasting firm Informetrica expects aggregate labour productivity growth to average 1.6 per cent per year from 2006 to 2025, with a slight acceleration in the closing decade. The firm UK Consensus, which pools Canadian panelists twice a year on their productivity forecasts, finds the consensus forecast for productivity to 2020 in the 1.5-1.6 per cent range, and has found little change in the consensus estimate over the last several years.

Exhibit 2: Future Productivity Growth Projections in Canada and the United States
(average annual rates of growth)

Forecaster	Period	Productivity Measure	Estimate
Canada			
Office of the Chief Actuary estimate (2003)	2012-2078	real wage differential (Average Weekly Earnings)	1.2 % (best-estimate) 0.5 % (high cost) 2.0 % (low cost)
Finance Canada (2006)	2006-29	real GDP per worker	1.7%
University of Toronto (2006)	2006-2025	real GDP per worker	1.7%
Centre for Spatial Economics (2005)	2005-2050	real GDP per hour	1.2%
Informetrica (2006)	2006-2025	real GDP per worker	1.6%
Conference Board of Canada (2006)	2006-2025	Real GDP per worker	1.6%
United States			
US Council of Economic Advisors (2006)	2007-2013	non-farm business sector output per hour	2.6%
US Social Security Trustees (2005)	2005-2080	real GDP per hour	1.9% low-cost scenario 1.6% intermediate 1.3% high cost
		Real wage differential	1.1 % intermediate

United States

The 2006 *Economic Report of the President*, released in February, noted that that output per hour growth in the US non-farm business sector advanced at a very strong 3.6 per cent

annual rate since the first quarter of 2001. However, rather than assume the recent remarkable pace of productivity growth will continue, the Administration believed it prudent to build a budget based on a somewhat lower productivity estimate. It consequently projected productivity growth to average 2.6 per cent per year during the six-year span of the budget projection (2007-2013), which is roughly equal to the average pace during the past decade.

The Board of Trustees of the US Social Security Trust Funds defines productivity as the ratio of real gross domestic product to hours worked by all workers (civilian and military wage and salary workers and self-employed). Productivity growth in the United States averaged 1.6 per cent over the last four complete economic cycles. Average annual increases in productivity over the cycles were 2.2, 1.2, 1.3, and 1.6 per cent for 1966-73, 1973-78, 1978-89 and 1989-2000 respectively. As in the 2004 Report, in the 2005 Report the Trustees assumed ultimate productivity growth rates of 1.9, 1.6 and 1.3 per cent in the low-cost, intermediate, and high-cost scenarios respectively.[7]

Exhibit 2 summarizes the productivity projections discussed above. The best-estimate real/wage productivity assumption of the 21st Actuarial Report on the CPP at 1.2 per cent per year for the 2012-2075 period is conservative compared to consensus productivity estimates for Canada, which are in the 1.6-1.7 per cent range, at least up to 2025.

II Relationship between future productivity growth and the real earnings of workers

This second section discusses the relationship between future productivity growth and the real earnings of workers, and the implications for CPP financial projections. It first reviews the real wage productivity assumption used in the CPP *21st Actuarial Report* released in 2003. It then discusses the relationship between productivity growth and real wages, discussing the impact of the use of different price indexes to deflate nominal GDP and nominal wages, changes in the labour share of national income. It then analyzes the impact of different productivity assumptions for CPP financial projections.

CPP Real Wage Assumption

Historically, the Canada Pension Plan has not made an assumption concerning future productivity growth in the Canadian economy. Rather it has made an assumption about the rate of growth of real earnings, or what it calls the real wage difference (Average Weekly Earnings

[7] The Board of Trustees of the US Social Security Trust Funds uses three scenarios to explore the possible impacts of basic economic assumptions on the financial status of the program. Assumptions used in Social Security financial projections are classed into three categories: demographic, economic, and program specific. Economic assumptions concern productivity, price inflation, average earnings, assumed real-wage differentials, labour force and unemployment, gross domestic product, and interest rates. The intermediate scenario embodies the Trustees' consensus on moderate economic growth over the projection period. The low-cost scenario assumes higher economic growth, and the high cost scenario assumes lower economic growth and two recessions in the short-range period.

(AWE) minus the CPI). This variable is of course closely related to productivity growth and thus can be considered the productivity assumption for the CPP.

The assumed increase in average annual earnings (AAE) is used to project the earnings of CPP contributors, while the assumed increase in Average Weekly Earnings (AWE) is used to increase the Year's Maximum Pensionable Earnings (YMPE) from one year to the next.[8] Increases in this variable lead to increased total contributions given the stable contribution rate (9.9 per cent of earnings up to the YMPE). Changes in YMPE include both an inflation or CPI component and a real wage growth component when real wages are positive.

The real-wage differential, as measured by the difference between the increase in the AWE and the CPI, has fluctuated significantly from year to year. The trend has been generally negative since 1991. The 10-year average real-wage differential was 0.4 per cent for the period ending in 1993 while it was -0.2 per cent for the period ending in 2003. The average annual real-wage differential was 1.2 per cent for the 50-year period ending in 2003.[9] The Actuarial Report states that many factors influence real wage increases, including general productivity, labour demand, the move to a service economy and decreases in the average hours worked.

The base line real wage difference assumption for CPP financial projections is 1.2 per cent per year from 2012 to 2075, up from an average of 0.8 per cent over the period 2004 to 2012. The 21st Actuarial Report states that this increase takes into account the expected upward pressure on real wages due to the expected labour shortage. The assumption is based on the expected labour shortage starting this decade, as moderated by higher participation rates at older ages and productivity gains.[10] It should be noted that this rate corresponds to the rate of Average Weekly Earnings from 1950 to 2002. There are also two alternative real wage assumptions for 2012 onward, 0.5 per cent in the high-cost scenario and 2.0 per cent in the low-cost scenario.

It is interesting to note that the base case real wage assumption used in CPP projections in Canada is almost identical to that used by the Social Security Trustees in the United States. The ultimate covered real-wage differential in the United States is assumed to be 1.1 per cent for the intermediate scenario. It is 1.6 per cent for the low-cost scenario and 0.6 per cent for the high cost scenario respectively.[11]

---

[8] According to the 21st Actuarial Report on the CPP, the difference between real increases in the AWE and the AAE has been relatively small over periods from 1966, 1975, and 1980 ending in 2002; that is, an absolute difference of less than 0.2 percentage points per year. Over the last few years, the difference has been more pronounced, but has started to decrease since 2000. Between 1995 and 2002, the increase in the AWE was about 1% lower than the AAE. However, over the long term it is assumed that the AWE will increase at the same rate as the AAE because of the long-term relationship between the two.

[9] It is interesting to note that for the 1961-2004 period real labour compensation per job grew at a 1.22 per cent average annual rate, above the 0.92 per cent rate for real average weekly earnings. Labour compensation, a broader concept than earnings, must have grown at a faster rate.

[10] The Actuarial Report notes that many factors have influenced the real rate of increase in average annual wages, including general productivity improvements, the move to a service economy, decreases in the average hours worked and fluctuation in the size of the workforce.

[11] Real wage differentials for the ten-year periods 1964-73, 1974-83, 1984-93, and 1994-03 were 1.8, -0.5, 0.9 and 1.6 percentage points respectively.

Unlike Canada, the US Social Security Administration does make productivity assumptions, and these growth rates are higher than real wage growth. For example, in the three scenarios the productivity assumption ranged from 0.3 to 0.7 percentage points higher than real wage assumption.

Relationship between Productivity Growth and Real Wage Increases.

There is not an exact one-to-one relationship between labour productivity growth and real wage increases (on both a per-worker and a per-hour worked basis). The first factor that can account for deviations in different rates of increase is the GDP deflator, used to deflate nominal GDP, and the CPI, used to deflate nominal wages. The second is changes in the share of GDP going to labour compensation. The third factor is different rates of growth for wages and the broader concept of labour compensation.

The key driver of trends in real wages is labour productivity growth. An increase in the amount of output a worker produces creates an equivalent increase in the amount of income, and this income translates into higher wages and profits. Consequently, it is useful to compare real wage and productivity growth to ascertain if real wage gains are keeping pace with productivity growth, and if not, why.

Labour productivity, defined as total economy output per hour worked, increased at an average annual rate of 1.31 per cent over the 1981-2004 period. Consequently, one might expect real wages to have increased at a comparable rate. However, this has not been the case. Real hourly compensation grew much more slowly, at an average rate of only 0.46 per cent per year, which represents a difference of 0.85 per cent per year (Table 1).[12]

The first reason behind this variation in productivity and wage growth is the use of different price indexes to deflate nominal hourly compensation (CPI) and nominal output (GDP deflator). With the CPI growing 0.46 per cent per year faster than the GDP deflator over the 1981-2004 period,[13] the differential deflator growth explains 54 per cent of the productivity/wage growth gap.

[12] Over the 1961-2004 period real GDP per person employed increased at a 1.41 per cent average annual rate over the 1961-2004 period, compared to 0.92 per cent for real average weekly earnings.

[13] The slower growth in the GDP deflator reflects low rates of increase in the price of investment goods due to the falling absolute price of information and communications technologies

Table 1: Measure of wage in Canada compared to productivity, average annual change (per cent)

	Real hourly compensation based on SNA	Productivity in the total economy, GDP per hour
1981 – 2003	0.51	1.36
1981 – 2004	0.46	1.31
1981 – 1989	0.27	1.15
1989 – 2000	0.76	1.50
2000 – 2003	0.28	1.40
2000 – 2004	0.05	1.13

Source : CSLS (2005:Table 23)

The remaining 46 per cent of the gap can be accounted for by faster growth in nominal GDP than nominal wages. Since wages are already included in income-based GDP and account for about one half of GDP, faster growth in the non-wage components of GDP must explain the remaining part of the gap. During the 1981-2004 period, average annual growth of nominal wages, salaries and supplementary income was 5.25 per cent, slightly lower than nominal GDP growth of 5.71 per cent per year, and significantly slower than the 6.21 per cent per year rate of increase of nominal GDP excluding wages. All non-wage components of income-based GDP except interest and miscellaneous investment income contributed to the faster growth of GDP relative to wages. Profits, growing at a robust 6.92 per cent per year, made the most important contribution.[14] In 1981, profits represented 11.3 per cent of GDP. By 2004, the share had risen to 14.7 per cent.

Finally, differences in the rate of growth of Average Weekly Earnings and nominal labour compensation per worker reflect differences in the rate of growth of wages and the non-wage components of labour compensation. These components include supplementary labour income (employer contribution to social programs such as CPP, EI and worker compensation), and fringe benefits (e.g. parking) included in labour compensation but not in wages.

In summary, the reasons behind slower wage growth compared to productivity growth are two-fold: the use of different deflators for wages and output and the faster growth in components of income-based GDP, such as corporate profits, which are not part of worker compensation.

Sensitivity of CPP Financial Projections to Real Wage Assumptions

[14] Nominal net income of unincorporated businesses including rent grew at a 6.99 per cent average annual growth rate between 1981 and 2004, with capital consumption allowances increasing at a 6.27 per cent average annual rate, and net taxes (taxes less subsidies) at a 6.19 per cent rate. Interest and miscellaneous investment income advanced at only a 2.36 average annual rate. In relative terms, the faster growth of corporate profits account for 60.9 per cent, or 33.3 percentage points, of the 54.7 percentage point difference between the growth of wages and the growth of GDP minus wages and inventories for the 1981-2004 period. Taxes contributed 29.4 percent, capital consumption allowance about 36.6 per cent, unincorporated businesses 27.4 per cent and interest and investment income, which grew slower, had a negative contribution of 54.3 per cent.

The 21st CPP Actuarial Report describes the relationship between wage increases and CPP financial position[15] as follows:

> "Wage increases impact the financial balance of the Canada Pension Plan in two ways. In the short term, an increase in the average wage translates into higher contribution income, with little immediate impact on benefits. Over the longer term, higher average wages produce higher benefits. The long-term projected financial status of the Plan is more dependent on the differential between the assumed annual rate of wage increases and price increases (the real-wage differential) than on the level of wage increases."

As noted above, the base line real wage difference assumption for CPP financial projections is 1.2 per cent per year from 2012 to 2075. The rate is consistent with a steady state contribution rate of 9.8 per cent, slightly below the actual rate of 9.9 per cent.[16]

In the 21st Actuarial Report sensitivity tests for the steady state contribution rate and the asset-expenditure ratio were undertaken for the nine key assumptions behind the CPP financial projections. It was found that these variables were much more sensitive to the assumptions used for the real-wage differential than for all other assumptions. In the high-cost scenario, the real wage differential was assumed to be 0.5 per cent, 0.7 percentage points less than the best-estimate of 1.2 per cent. This results in a steady state contribution rate of 10.3 per cent, 0.5 percentage points above the best-estimate of 9.8 per cent (based on a real-wage differential assumption of 1.2 per cent). In the low-cost scenario the real-wage differential was assumed to be 2.0 per cent, which resulted in a steady state contribution rate of 9.2 per cent.

The low-cost, high real-wage differential scenario also produced a much higher asset/expenditure ratio in 2075, namely 13.68, double the ratio for the best-estimate scenario, namely 6.88. In contrast, the high cost, low real-wage differential scenario results in the depletion of assets by 2067. Fortunately, based on the real wage experience of the 1924-2003 period, the Actuarial Report argues that the probability of the real wage increase over the next 20 years being below 0.5 per cent is only 4 per cent (and 12 per cent of exceeding 2 per cent).

In the short run the impact of higher real wages is immediately felt on the total CPP contributions at a stable contribution rate. Benefits for persons who have already started to receive CPP are indexed to the CPI and hence do not benefit from real wage gains. However, higher real wage levels increase the initial level of CPP benefits so high wages arising from real wage gains have a cumulative effect on the level of CPP benefits, although there is always a lag.

---

[15] Wage distribution trends can affect CPP financial status projections. The CPP financial projections are based on the average real wage differential or increase of all workers. But this average may not apply to workers earning the YMPE or less if workers above this wage level received greater wage increases because of increased inequality of the wage distribution. In this case the increase in CPP contributions in real terms per worker would advance at a slower pace than the actual wage increase of workers receiving the YMPE or less. This latter rate of growth determines the actual wage level upon which benefits will be ultimately based. Thus increased wage inequality does not improve the CPP financial position.

[16] The steady state contribution rate is defined as the lowest level contribution rate applicable after the end of the review period that results in the asset/expenditure ratio being the same in the 10th and 60th year following the end of the review period, which is 2016 to 2066.

Table 2: Sensitivity Test Assumptions

	Canada	Low-Cost		Best-Estimate		High-Cost	
I.	Fertility rate	1.9		1.6		1.3	
II.	Net migration rate	0.64%		0.54%		0.44%	
III.	Mortality rates	Life expectancy at 65 (2050)		Life expectancy at 65 (2050)		Life expectancy at 65 (2050)	
		Males	18.7	Males	20	Males	21.2
		Females	21.4	Females	22.6	Females	23.8
IV.	CPP disability rates	Males	2.25	Males	3.25	Males	4.25
	(per 1,000 eligible)	Females	2.5	Females	3.5	Females	4.5
V.	Retirement rates	All retirements at age 65 from 1009 onward		Retirements between ages 60 to 70		All retirements at age 60 from 2009 onward	
VI.	Unemployment rate	4.5%		6.5%		8.5%	
	Participation rates(ages 15-69)	81 % (2030)		73 % (2030)		71 % (2030)	
VII.	Real-wage differential	2.00%		1.20%		0.50%	
VIII.	Rate of increase in prices	3.70%		2.70%		1.70%	
IX.	Real rate of return on investments	5.10%		4.10%		3.10%	

Source : Based on Table 68 from: Office of the Superintendent of Financial Institutions Canada (2004), "21st Actuarial Report on the Canada Pension Plan as at 31 December 2003", November 2004, 128 pages available at http://www.osfi-bsif.gc.ca/app/DocRepository/1/eng/oca/reports/21/CPP2104_e.pdf

III Relationship Between Productivity and Key Variables Behind CPP Financial Projections

In addition to the effect of productivity on the real-wage differential (or real wages) discussed above, productivity also effects other key variables behind CPP financial projections. This section of the paper discusses the impact of productivity on these variables and the implications for CPP financial projections. These variables are the real rate of return on investments, price increases, participation rates, retirement rates, migration rate, mortality rate, fertility rate, and disability rates.

The Appendix to the 21st Actuarial Report of the CPP provides a sensitivity analysis of the impact of changes in the best-estimate (base case) assumed values of the key variables on CPP financial projections for the 2006-2075 period, both for the steady state contribution rate and for the asset/expenditure ratio assuming a 9.9 ultimate contribution rate. A low cost and a high-cost scenario are simulated for each variable. Table 2 shows the three sets of assumptions (best-estimate, low-cost, high-cost) for each variable. Table 3 shows the implications of the low and high cost scenarios for the steady state contribution rate and for the asset-expenditure ratio in 2050 based on a 9.9 ultimate contribution rate.

Table 3: Sensitivity of contribution rate and funding levels

	Assumption	Scenario	Steady-State Contribution rate	Asset/Expenditure ratio (2050)*
		Best-Estimate	9.8	6.28
I.	Fertility Rate	Low	9.5	7.32
		High	10.1	5.23
II.	Migration Rate	Low	9.6	7.56
		High	9.9	5.31
III.	Mortality Rates	Low	9.6	7.00
		High	9.9	5.61
IV.	Disability Rates	Low	9.5	8.04
		High	10.0	4.59
V.	Retirement Rates	Low	9.4	9.55
		High	10.2	2.48**
VI.	Unemployment and Participation Rates	Low	9.3	9.94
		High	10.0	4.46
VII.	Real-Wage Differential	Low	9.2	9.42
		High	10.3	2.98***
VIII.	Price Increases	Low	9.6	7.42
		High	10.0	4.87
IX.	Real Rate of Return on Investments	Low	9.3	10.70
		High	10.3	3.41
X.	Economic Cycle		9.9	5.14

*Based on a 9.9% ultimate contribution rate

**Assets depleted by 2074

***Assets depleted by 2067

Source : Based on Table 70 and Table 71 from: Office of the Superintendent of Financial Institutions Canada (2004), "21st Actuarial Report on the Canada Pension Plan as at 31 December 2003", November 2004, 128 pages available at http://www.osfi-bsif.gc.ca/app/DocRepository/1/eng/oca/reports/21/CPP2104_e.pdf

Real Rates of Return on Investments

Real rates of return on investments, another key assumption in CPP financial projections, can be affected by productivity growth. Higher rates of return arising from strong economic and labour productivity growth fuelled by rapid technological advance [17] increase investment earnings and hence improve the financial status of the CPP.[18] Lower rates of return have the opposite effect. The best estimate scenario in the 21st CPP Actuarial Report assumes a real rate of return of 4.1 per cent. In the low-cost scenario the rate of return is increased to 5.1 per cent. This reduces the steady state contribution rate from 9.8 per cent to 9.3 per cent in the best-estimate scenario and increases the asset-expenditure ratio in 2050 to 10.70 from best-estimate scenario of 6.28. Alternately, in the high cost scenario the rate

[17] It should be noted that labour productivity growth arising from increased capital intensity and not total factor productivity growth would have much less effect on the real rate of return.

[18] Baker, DeLong, and Krugman (2005) demonstrate the strong positive relationship between economic growth and asset returns. They expect that a reduction in asset returns to be greater for a given reduction in productivity growth than for an equal reduction in labour force growth.

of return is reduced to 3.1 per cent. This raises the steady state contribution rate from 9.8 per cent to 10.3 per cent and lowers the asset-expenditure ratio in 2050 to 3.41.

The real rate of return for the CPP investments depends on many factors in addition to underlying productivity growth in Canada. These factors include, productivity growth (and other factors) outside Canada, which affects the rate of return on CPP investments outside Canada, saving behaviour, population growth, labour market behaviour, demographic trends, monetary and fiscal policy. Consequently, it is very difficult to identify with any level of confidence any stable relationship between labour productivity growth and the real rates of return, but it is important to be aware of this relationship.

CPI Inflation or Price Increases

The CPI inflation is another assumption that affects the CPP financial status through its effect on CPP contributions, investment earnings and CPP expenditures. Nominal wages and rate of return assumptions include an inflation component and CPP benefits are indexed to the CPI. However, the effects of a CPI change are not neutral on the CPP financial status as the amount of revenue coming from CPP premiums and investment earnings is currently and projected to remain greater than the expenditures of the CPP. This means that CPI increases tend to improve the CPP financial position, everything else being equal."

In the low-cost scenario the CPI rate of increase is assumed to be 3.7 per cent, 1 percentage point above the best-estimate scenario of 2.7 per cent. This produces a steady-state contribution rate of 9.6 per cent compared to the best-estimate rate of 9.8 per cent and an asset/expenditure ratio in 2050 of 9.58 instead of 6.88. In the high-cost scenario the CPI rate of increase is assumed to be 1.7 per cent. This produces a steady-state contribution rate of 10.0 per cent and an asset/expenditure ratio in 2050 of 4.87.

CPP financial projections appear to treat the real-wage differential or productivity assumption and the CPI increase assumption as completely independent of one another. But in reality productivity growth and price increases are interrelated. Everything else being equal, higher productivity growth will reduce unit costs and hence prices, while lower productivity growth will have the opposite effects. This means that the high-cost scenario with lower CPI increases is associated with high productivity growth, while the low-cost scenario with higher CPI increases is associated with low productivity growth. This somewhat ironic relationship arises from the positive effect of inflation on the CPP financial position.

There may also be a relationship between inflation and rates of return, with lower inflation leading, everything else equal, to higher real rates of return and higher inflation producing the opposite the opposite. This means that some of the deterioration in the CPP financial position arising from higher productivity growth may be offset by higher real rates of return.

Labour Force Participation

Labour force participation is another key assumption in CPP financial projections, affecting in particular CPP contributions. The more persons in the labour force, the more persons who are working, and hence the greater the CPP contributions.[19] In the low cost scenario the labour force participation rate is assumed to be 81 per cent for the population 15-69 in 2030, up from 73 per cent in the best-estimate scenario. This decreases the steady state contribution rate to 9.3 per cent from 9.8 per cent in the best-estimate scenario and increases the asset/expenditure rate in 2050 to 9.94 from 6.28. Alternately, the assumed participation rate of 71 per cent in the high-cost scenario raises the steady state contribution rate to 10.0 per cent and lowers the asset/expenditure ratio in 2050 to 4.46.

Economic theory suggests that there are two possible links between labour force participation rate and labour productivity growth. Both links run through real wages, which are largely determined by labour productivity. The standard labour supply model has an upward sloping labour supply curve whereby higher wages elicit greater labour supply through the substitution of work for leisure. This substitution takes the form of an increase in labour force participation (or increased hours worked per employed person). Thus faster productivity growth would lead to a higher participation rate and improve the CPP financial status. But the upward sloping labour supply curve can be backward bending if the individuals have a target income. Higher wages mean that they can work less and still achieve this target level. As a result, the income effect of substituting leisure for income becomes greater than the substitution effect of substituting income for leisure.

In addition to the level of real wages, many factors, including educational levels, societal attitudes toward work, particularly for women, and the availability of employment opportunities, affect age-specific labour force participation rates.[20] Consequently, forecasting participation rates is particularly tricky. It is also difficult to know a priori whether real wages will have a positive or negative effect on labour force participation. On average over all age/sex groups, economists would expect the substitution effect to be greater than the income effect, producing a positive, although likely small, relationship between real wages and labour force participation.

Retirement Rates

Retirement rates is another key assumption in CPP financial projections, affecting both CPP contributions and expenditures or benefits. The later persons retire, the more persons who are working, and hence the greater the CPP contributions and the lower the CPP benefits paid out. In the low-cost scenario, it is assumed that all retirements from 2009 onward are at age 65,

[19] The unemployment rate, another variable included in 21st CPP Actuarial Report sensitivity test assumptions with the labour force participation rate, also affects the number of persons who are working, but the role of participation rates is much more important. The link between the unemployment rate and productivity growth is unclear. Certainly, there is no reason to expect that in the long run higher productivity growth will result in higher aggregate unemployment because higher productivity growth results in real income increases that feedback to stronger demand growth.

[20] Aggregate participation rates are greatly influenced by the trends in the overall age structure of the population as older age groups have significantly lower participation rates than prime-age groups. Indeed, the rapid growth in the population aged 55 and over will be putting significant downward pressure on the aggregate participation rate in coming years.

compared to the best-estimate assumption of retirements between ages 60 and 70. This decreases the steady state contribution rate to 9.4 per cent from 9.8 per cent in the best-estimate scenario and increases the asset/expenditure ratio in 2050 to 9.55 from 6.28. Alternately, in the high-cost scenario, all retirements are assumed to take place at age 60 from 2009 onwards. This results in an increase in the steady state contribution rate to 10.2 per cent and a decrease in the asset/expenditure ratio to 2.48 in 2050 and the complete depletion of CPP fund assets by 2074.

The impact of productivity growth on retirement rates is similar to that on participation rates. Increased real wages arising from productivity growth affect the decision of persons 60 and over whether to continue working or to retire. Again it is difficult to say a priori whether a scenario with more rapid productivity and real wage growth will decrease the retirement rate through a substitution effect or increase the retirement rate through an income effect. Most economists would believe that the substitution effect would be greater and that higher productivity and real wage growth would be associated with a lower retirement rate, although the relationship may be weak.

Net Migration Rate

The net migration rate, through its effect on the population growth rate, exercises some impact on CPP financial status. More rapid population growth increases the rate of growth in the number of earners more than the rate of growth in the number of CPP beneficiaries and hence has a positive effect on the CPP financial position. Slower population growth has the opposite effect.

In the low-cost scenario, the net migration rate is assumed to be 0.64 per cent, 0.10 percentage points above the best-estimate scenario of 0.54 per cent. This results in a steady-state contribution rate of 9.6 per cent, down slightly from the 9.8 per cent best-estimate scenario steady state rate. The asset/expenditure ratio in 2050 rises to 7.32 from 6.28 in the best-estimate scenario. In the high-cost scenario, the net migration rate is assumed to be 0.44 per cent, with a steady state contribution rate of 9.9 per cent and an asset/expenditure ratio of 5.31.

The relationship between productivity growth and net migration again passes through the impact of productivity on the real income in Canada. Higher incomes in Canada in theory should boost net migration. But it is relative productivity and income performance, not absolute performance, that matters. A greater income gap between Canada and source countries of current immigrants to Canada, largely developing countries in Asia, will provide a greater economic incentive for persons in these countries to immigrate to Canada. Higher incomes in Canada relative to countries that receive large flows of immigrants, such as the United States and Australia, will make Canada relatively more attractive and divert to Canada potential immigrants who would have previously gone to these countries. Higher income in Canada relative to the countries to which Canadians emigrate, particularly the United States, will reduce emigration.

There are many factors that influence net migration to Canada, including Canadian immigration policy and employment opportunities in both the source countries and Canada. Faster or slower productivity and income growth in Canada will likely have little effect on the massive income gap between Canada and most of the developing countries that currently supply

the lion's share of Canada's immigrants. Productivity growth in the source countries is more important. For example, the very rapid growth in real income in China certainly provides less incentive for the Chinese to emigrate to Canada, especially if there are expectations of further growth. Compared to other factors affecting immigration and emigration, the role of productivity is likely small, but nevertheless is positive.

Mortality Rates and Life Expectancy

Life expectancy at 65, a key assumption in CPP financial projections, is closely related to mortality rates. Longer life expectancy increases the costs of benefits. Indeed, an increase in life expectancy at 65 in 2050 from the best-estimate assumption of 20.0 years for males and 22.6 years for females to the high-cost assumption of 21.2 for males and 23.8 for females increases the steady state contribution rate from 9.8 to 9.9 per cent and reduced the asset/expenditure ratio in 2075 from 6.88 to 4.34.

The link between productivity and life expectancy is indirect. Stronger productivity growth makes the economy richer. At constant tax rates, this means that governments have addition resources, which can be allocated to the health sector and in theory contribute to an improvement in life expectancy. Such a development of course increases the cost of the CPP. But longer life expectancy increases the well-being of Canadians. From this perspective, the minimization of CPP expenditures and an improved CPP financial status and the well-being of Canadians are in conflict. However, this appears to be not an important issue as the life expectancy-augmenting effects of additional expenditures on health care in Canada is likely small.

Fertility Rates

The role of fertility on the CPP financial position is somewhat analogous to that of net migration as fertility affects population growth. Higher fertility increases the rate of growth in the number of earners more than the rate of growth in the number of CPP beneficiaries and hence has a positive effect on the CPP financial position. Lower fertility has the opposite effect.

But there is much less evidence of a positive relationship of productivity on fertility through higher incomes than for the other variables discussed in this section. The determinants of fertility are complex. They appear more related to social factors such as female educational levels, female labour force participation and career aspirations, urbanization, child quality considerations, and societal norms on optimal or appropriate number of children, than purely economic factors. Women do not decide to have more children just because family income rises. Indeed, fertility has been falling in Canada since the mid-1960s despite rising family incomes.

CPP Disability Rates

Higher CPP disability rates affect the CPP financial position through the effect on the number of earners and the number of beneficiaries. Higher disability rates reduce the number of earners and increase the number of beneficiaries, worsening the CPP financial position, while lower disability rates have the opposite effect.

Disability rates are affected by workplace safety regulations and their enforcement, industrial structure, and the criteria and conditions used to determine who can qualify for CPP disability payments, as well as the strictness of the enforcement of these criteria and conditions. It is unlikely that productivity growth has any effect on the disability rate.

Exhibit 3: Relationship Between Productivity and Key Variables Behind CPP Financial Position

Variables	Sign of the Relationship between Productivity and the Variable	Magnitude of the Relationship between Productivity and the Variable	Effect of Higher Productivity on CPP
Real wage	positive	important	improve through impact on real earnings
Real Rate of Return	positive	moderate	improve through impact on investment earnings
Price Increases	negative	moderate	worsen through lowering inflation
Participation Rate	likely positive, possibly negative	small	improve through increased no. of earners
Retirement Rate	likely negative, possibly positive	small	improve through fewer beneficiaries
Migration Rate	positive	small	improve through more earners
Mortality Rate	negative	small	worsen through increased life expectancy of beneficiaries
Fertility Rate	likely no relationship	-	-
Disability Rate	no relationship	-	-

Exhibit 3 synthesizes the relationship between productivity and the key variables that determine the CPP financial projections. The relationship between productivity and real wages is discussed elsewhere in the paper. Of the eight other variables in the Exhibit , it is estimated that productivity growth has no effect on fertility rates and disability rates. In terms of the six variables that are affected by productivity, the sign of relationship is estimated to be positive for three of the variables (real rate of return, participation rate, and migration rate) and negative for three (price increases, retirement rates, and mortality rates). In terms of the magnitude of the impact of productivity on the variables (both in absolute terms and relative to other factors that affect the variables), it is estimated moderate for two variables (real rate of return and price increases) and small for four variables (participation rate, retirement rate, migration rate, and mortality rates).

In summary, the key mechanism whereby higher productivity growth relative to a base case affects CPP financial projections is through higher real income. This increases the real rate of return on investments and the number of earners paying CPP contributions through the impact of higher labour force participation and lower retirement rates, and more migration. Higher income also can reduce mortality rates and increase life expectancy through greater resources available for and devoted to health arising from the larger tax base. Higher productivity growth also reduces inflation by lowering unit costs.

Based on the relationship between productivity and the variables affecting CPP projections, Exhibit 3 shows that higher productivity growth will improve the CPP financial position through its impacts on real rates of return, labour force participation, retirement rates, and the migration rate. On the other hand it will worsen the CPP financial position through its impact on CPI increases and mortality rates. The net effect of course is very difficult to know. This analysis suggests that there will be an overall improvement, because higher productivity improves the CPP financial position through four variables or channels, and worsens it through only two. In terms of the magnitude of the effects of the channels improving the financial position due to higher productivity growth, one is believed of moderate size (real rate of return) and three of small size, compared to one of moderate size (price increases) and one of small size for the channels worsening the CPP financial position.

Current sensitivity analysis for CPP financial projections are based on the varying of the best-estimate assumption for each variable one at a time independent of changes in assumptions for other variables. Thus the sensitivity analysis of the effect of higher productivity and real wages on the CPP financial position ignores the effect of higher productivity on the other variables. Of course in the real world, higher productivity affects all the variables. But to simulate all these relationships would require coefficients of the impact of changes in productivity of all variables and would be a major general equilibrium modeling exercise.

IV Conclusion

This paper has three objectives, each explored in a separate part of the paper The first is to identify various scenario for future productivity growth in Canada and compare productivity projections from various sources. The second is to analyse the relationship between real wages and productivity as well as the sensitivity of CPP financial projections to the real wage/productivity assumptions. The third is to go beyond the productivity-real wage relationship and relate productivity to all the economic assumptions that affect the CPP financial projections.

The key conclusions of the first part on the paper on future productivity growth
Are highlighted below.

- It is extremely difficult to forecast long-term productivity growth because of its many determinants.

- The pace of technological change is the key driver of long-term productivity growth. The current rapid productivity growth in the United States, likely fuelled by technological changes associated with ICT, bodes well for future Canadian productivity growth as Canada tends to follow the United States with a lag.

- The slower rate of future labour force growth in Canada related to the retirement of the baby boom cohorts will tighten labour markets. This will in principle put upward pressure on wages, promote the substitution of capital for labour, and increase labour productivity. This is the main reason to be optimistic about future productivity growth in Canada.

- The best-estimate real wage difference assumption of the 21st Actuarial Report on the CPP is 1.2 per cent per year for the 2012-2075 period. Most long-term productivity growth estimates are in the 1.6-1.7 per cent range up to 2025. The Actuarial Report real wage assumption hence appears conservative compared to consensus productivity estimates. However, real wage growth tends to be 0.4-0.5 percentage points below productivity growth because of faster growth in the CPI (used to deflate nominal wages) and the GDP deflator (used to deflate nominal output) and faster growth in supplementary labour income and fringe benefits than wages. Thus the best-estimate real wage assumption is consistent with current expectations of future productivity growth

The key conclusions of the second part of the paper follow.

- The rate of growth of real wages and productivity may differ. Faster growth in the CPI inflation relative to the GDP deflator and the fall in the share of national income going to wages resulted in slower growth of real wages compared to productivity over the 1981-2004 period in Canada.

- A higher real/wage productivity growth assumption leads to a significant improvement in the CPP financial position because of greater growth in contributions than benefits. A lower real wage/productivity assumption has the opposite effect.

The key conclusions of the third part follow.

- In addition to its effect on real wages, productivity affects the other key variables behind CPP financial projections through different mechanisms and in different directions.

- Higher productivity growth raises real incomes, which can have a positive effect on participation and migration rates and have a negative effect in retirement rates. All these effects improve the CPP financial position.

- Higher productivity growth can also improve the CPP financial balance by increasing the real rates of return on investments.

- Higher productivity growth can have a negative effect on the CPP financial position by lowering the CPI rate of increase.

- Another indirect mechanism whereby higher productivity can worsen the CPP financial position is by enlarging the tax base. Health spending can be increased, lowering mortality rates and increasing life expectancy. .

The paper offers two recommendation for the next Actuarial Report prepared by the Office of the Chief Actuary. First, the report should consider making an explicit productivity assumption and relate this assumption to its real wage difference assumption. This would increase the transparency of the formulation of the real wage assumption. Second, the Report should acknowledge the interrelationships or feedback mechanisms between productivity and the other economic and demographic variables used in the CPP financial projections and the implications of different productivity assumptions for these variables.

Bibliography

Baker, Dean (1999) "Long-term Productivity Projections," Centre for Economic and Policy Research, May 25.

Baker, Dean and Mark Weisbrot (1999) *Social Security: The Phony Crisis* (Chicago: University of Chicago Press).

Baker, Dean, J. Bradford Delong, and Paul Krugman (2005) Assets Returns and Economic Growth," *Brookings Papers on Economic Activity*, Number 1, pp. 289-330.

Centre for the Study of Living Standards (1998) "Productivity: Key to Economic Success," report prepared for the Atlantic Canada Opportunities Agency, March.

Centre for the Study of Living Standards (2005) "The Living Standards Domain of the Canadian Index of Well-being," unpublished report prepared for the Atkinson Foundation, September.

Council of Economic Advisors (2006) *Economic Report of the President*, February.

Dungan, Peter and Steve Murphy (2006) "Long Term Outlook for the Canadian Economy: National Projections Through 2025," Policy Study 2006-02, Policy and Economic Analysis Program, Institute for Policy Analysis, University of Toronto, February.

Finance Canada (2004) "The Importance of Productivity Growth for the Long-term Well-being of Canadians," Appendix 7 in *The Budget Plan*, February.

Finance Canada (2005) *A Plan for Growth and Prosperity*, November.

Gordon, Robert (2003) "Exploding Productivity Growth: Context, Causes and Implications," *Brookings Papers on Economic Activity*, No. 2, pp. 207-79.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh (2005) *Information Technology and the American Growth Resurgence* (Cambridge, Mass: MIT Press).

Macklem, Tiff (2003) "Future Productivity Growth in Canada: Comparing the United States," *International Productivity Monitor*, Number Seven, Fall, pp. 50-57.

Office of the Chief Actuary (2003) "Canada Pension Plan: Actuarial Adjustment Factors Study," Actuarial Study No. 2. March.

Office of the Chief Actuary (2004) *21th Actuarial Report of the Canada Pension Plan as of 31 December 2003* (Ottawa: office of the Superintendent of Financial Institutions Canada).

Ontario Ministry of Finance (2005) *Towards 2025: Assessing Ontario's Long-term Outlook* Queen's Printer for Ontario

Rao, Someshwar and Andrew Sharpe, eds. (2002) *Productivity Issues in Canada* Industry Canada Research Monograph, (Calgary: University if Calgary Press).

Rao, Someshwar, Andrew Sharpe and Jeremy Smith (2005) An Analysis of the Labour Productivity Growth Slowdown in Canada Since 2000," *International Productivity Monitor*, Number Ten, Spring, pp. 3-23.

Robidoux, Benoit (2003) Future Productivity Growth in Canada: The Role of the Service Sector," *International Productivity Monitor*, Number Seven, Fall, pp. 58-65.

Robson, William and Yvan Guillemette (2003) "Aging, Saving, Productivity Growth and Canadian Incomes to 2050: Some Sombre Sketches," presentation to the Chief's Actuary's Seminar, March 18.

Sharpe, Andrew, (2002) "Productivity Concepts, Trends and Prospects: An Overview," in Andrew Sharpe, France St-Hilaire, and Keith Banting (eds.) *Towards s A Social Understanding of Productivity: Review of Economic Performance and Social Progress* (Ottawa: Centre for the Study of Living Standards and Montreal: Institute for Research in Public Policy).

Smith, Jeremy (2004) "Assessing Aggregate Labour Productivity Trends in Canada and the United States: Total Economy versus Business Sector Perspectives," *International Productivity Monitor*, Number Eight, Spring, pp. 47-58.

Stiglitz, Joseph E. (2005) Progressive Dementia, *The Atlantic Monthly*, November, pp. 42-46.

Technical Panel on Assumptions and Methods (2003) *Report to the Social Security Advisory Board*, Washington, DC, October.

Wilson, Thomas (2003) A Perspective on Future Productivity Growth in Canada," *International Productivity Monitor*, Number Seven, Fall, pp. 46-49.